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Research Article

Beneficial Effects of Shock Wave Therapy in Patients with Adhesive capsulitis: A Clinical Review

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HIGHLIGHTS

1. Shock wave therapy improves adhesive capsulitis.
2. Reduces pain and improvesfunction.
3. Non-invasive treatment optionforpatients.
4. Stimulates healing and tissueregeneration.
5. Helps restore range of motion.

GRAPHICAL ABSTRACT

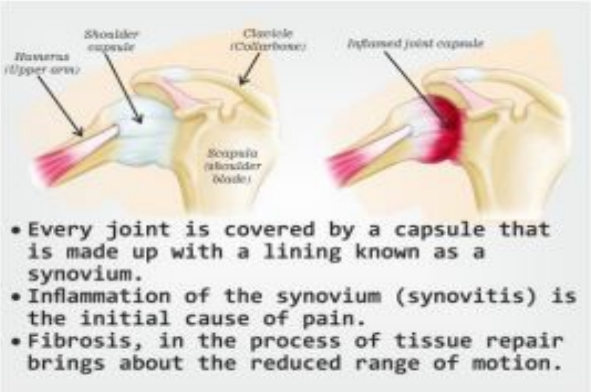

Figure: Adhesive capsulitis

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ABSTRACT

Background and purpose: This clinical review synthesizes and analyzes several studies investigating the effects of Extracorporeal Shock Wave Therapy (ESWT) on frozen shoulder patients. Studies explore the efficacy of ESWT compared to conservative physical therapy, oral steroids, and ultrasound therapy. The findings suggest that ESWT is a promising intervention for improving pain and function in individuals with frozen shoulder, offering potential advantages over traditional therapies. ***Methodology:*** Different electronic data base was explored to find the studies on the beneficial effect of ESWT on the patient with adessive capsulitis. most relevant studies were included. ***Conclusion:*** The articles thoroughly underscore Extracorporeal Shock Wave Therapy (ESWT) as highly effective for easing pain, decreasing inflammation, and restoring joint function in adhesive capsulitis. Moreover, ESWT substantially supports patients in comfortably resuming daily activities without experiencing discomfort.

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INTRODUCTION

Adhesive capsulitis (AC) commonly known as frozen shoulder is a progressive idiopathic disease that classically presents the symptoms of pain and decreased range of motion in the shoulder joint due to shoulder joint capsule fibrosis [1]. In the general population, adhesive capsulitis has an incidence of approximately 3% to 5% while in diabetic patients it can be as high as 20%. The peak incidence is typically observed between the ages of 40 and 60 with infrequent cases occurring in age groups outside the range exhibit a slightly higher prevalence in women. In 14 out of 100, patients with frozen shoulders experience the condition in bilateral shoulders at the same time. Meanwhile nearly 20 out of 100 patients have similar symptoms in either shoulder at the same point. Diabetes is the most common condition associated with adessive capsulitis if a patient has diabetes, they have a 10 to 20% chance of developing a frozen shoulder during their lifetime [2]. It is important to note that a frozen shoulder is more common in patients with various medical conditions including diabetes, rotator cuff lesions, COPD, MI, inflammatory arthritis, trauma, and prolonged immobilization [3].

Adhesive capsulitis can lead to complications such as sleep disturbance, impaired Activities of daily living (ADL). AC has three phases- pain phase ranges from10 to 36 months, frozen phase from 4 to 12 months and resolving phase varying from 12 to 24 months. Various approaches are traditionally used to manage this condition which includes:

1-Intra-articular Corticosteroid Injections: These injections can help reduce inflammation and provide pain relief.

2- Physical Therapy- Passive Joint Glides and Nonpainful Passive ROM Exercises, Scapular Stability Exercises, Closed Chain Rotator Cuff Exercises, Active-Assisted and Active ROM Activities, Open Chain and Proprioceptive Exercises.

3- Supraclavicular Nerve Block Acupuncture

4- Daily Activities Modification

Treating a frozen shoulder can be challenging and lengthy, often causing difficulties for patients by using the above protocols.

Extracorporeal Shock-Wave Therapy (ESWT) has emerged as a promising therapeutic modality, demonstrating efficacy and safety in treating various pain conditions, as reported in numerous studies. ESWT is helpful in treating conditions like myofascial pain syndrome, knee pain, chronic pelvic pain syndrome, chronic rotator cuff tendonitis, sacroiliac joint pain, and notably, frozen shoulder. The Frozen shoulder is characterized by pain and restricted mobility in the shoulder complex, presents a challenging clinical scenario. While ESWT has shown success in addressing a spectrum of pain disorders, its effectiveness and safety specifically in the context of frozen shoulder remain inconclusive. Despite the growing body of evidence supporting the benefits of ESWT in diverse pain management applications, a notable gap in the literature pertains to a comprehensive review dedicated to evaluating the Efficacy and safety of ESWT for frozen shoulder [6, 7].

This clinical review aims to fill this void by meticulously exam-ining existing research, synthesizing evidence, and providing a comprehensive analysis of the outcomes associated with ESWT in the context of frozen shoulder treatment. Through a rigorous protocol, this review will critically assess the existing literature to inform clinicians, researchers, and healthcare practitioners about the current state of knowledge regarding the utility of ESWT in managing frozen shoulder [8].

Extracorporeal shock wave therapy (ESWT) came from a method called extracorporeal shock wave lithotripsy (ESWL). Studies exploring lithotripsy's impact on body tissues touched upon bones and other parts of the body's support system. These studies revealed that sh-ock waves could have a good effect on many different body tissues[9].

ESWT devices have evolved in connection with ESWL. Initially, electro-hydraulic devices were introduced, followed by piezo-electric and various electro-magnetic devices, using flat coil or cylindrical coildesigns. All these devices produce pressure pulses that are focused. There are notable variations in the sound fields they create, particularly in the focal zones. However, all these devices can generate shock waves at the highest energy settings. Radial devices, on the other hand, use either compressed air or electro-magnetic forces to propel a 'projectile' within the device. This projectile then transfers its energy upon impact with an applicator, transmitting it to the targeted tissue.

METHODOLOGY

The exploration for pertinent journals involved scouring several databases, including PubMed, PubMed Central, Cochrane databases, and PEDro. The primary focus was on gathering information from randomized controlled trials (RCTs), clinical trials, and systematic reviews. The aim was to comprehensively investigate and analyse the effectiveness and impact of Shock Wave Therapy as a treatment method for individuals diagnosed with adhesive capsulitis.

Mechanism of Frozen shoulder:

Frozen shoulder involves intricate stages, from capsular inflammation to synovial hyperplasia and fibrosis with the underlying pathophysiology are poorly understood. Arthroscopic and imaging studies have pinpointed the glenohumeral joint's capsular tissue, including the rotator interval, as a major pathologic site undergoing inflammation and fibrosis . Recent efforts have focused on unravelling the immune system response role particularly the involvement of inflammatory mediators like cytokines and growth factors, matrix components such as collagen types I and III, and matrix metalloproteinases (MMPs) [4]. Abnormal expressions of these factors may contribute to the fibrotic response observed in FS. Additionally, immune factors, neuronal and vascular elements, and mechanical stress through MAP kinase signalling have been implicated in the disease's pathophysiology. While inconclusive, these studies provide valuable insights into Frozen shoulder's multifaceted biological processes, emphasizing the need for standardized protocols and further research to identify potential therapeutic targets for this debilitating condition[,].

Study selection

Studies included in our review, they were concluded on age group more than or equals to 45 years, the detailed inclusion and exclusion category

describe in **table 1.**

	Inclusion	**Exclusion**
Study year	2011 to 2023	2010and before
Study design	RCT, systematic review, original article, cross sectional study	Surveys, coherent study, manuscript, ROL, dissertation
Settings	Hospital, OPD, rehabilitation centre	Community, camp, NGO's
Context	ESWT, ultrasound, laser	Surgical approach
Outcome measures	DASH score, OSS score, SPADI, VAS, constant shoulder scale.	U-Penn, Patient Specific Functional Scale.

Data extraction and analysis

4 reviewers independently completed data extract and review the information extracted were on following study characteristics

1. Research aims
1. No. of subjects included
2. Research aim
3. Results

The characteristics mentioned above are summarised in **table 2**

S.no.	**Characteristics**	**Author**	**NO. of subjects, involved**	**Type of research**	**conclusion**
1.	The effects of extracorporeal shock wave therapy on pain and range of motion in patients with adhesive capsulitis	Sangho Lee, Sangyong Lee, Mugeun Jeong	30 patients involved divided equally in 2 groups	RCT	Both the groups have shown decrease in pain and improved rom but the controlled group has slightly better results
2.	The effects of extracorporeal shock wave therapy on frozen shoulder patients' pain and functions	Chan Park, Sangyong Lee, Chae-Woo Yi	30 patients involved divided equally in 2 groups	RCT	both the CPTG and the ESWTG showed significant decreases in both VAS and PSFS In intergroup comparisons of VAS and PSFS, ESWTG showed significantly lower values than CPTG
3.	Analgesic effect of extracorporeal shock-wave therapy for frozen shoulder	Han-Yong Qiao, Li Xin, and Shao-Lan Wu	60 patient involved divided equally in 2 groups	RCT	ESWT has shown better results then oral analgesic in increasing the rom of the shoulder complex
4.	The effectiveness of extracorporeal shockwave therapy for frozen shoulder in patients with diabetes: randomized control trial	Ramprasad Muthukrishnan , Ayesha Abdul Rashid , Fatma Al-Alkharji	20 patients involved divided equally in 2 groups	RCT	Extracorporeal shock wave therapy significantly reduced pain in people with diabetic Frozen shoulder with reduced treatment costs compared to the control group.
5.	Extracorporeal Shock Wave Therapy with Meridian and Acupoint Theory for Adhesive Capsulitis	Donghun Han, In-hwa Park, In Heo	5 RCT were reviewed	A Systematic Review and Meta-analysis of Randomized Controlled Trials	use of ESWT with meridian and acupoint theory for adhesive capsulitis has limited evidence. More well-designed RCTs are needed to substantiate this claim more clearly.

6.	Effects of Extracorporeal Shockwave Therapy in Long Term Functional Outcomes of Shoulder Adhesive Capsulitis	Muhammad Adnan Farh, Maryam Butt , Anam Saeed	50 patients involved divided equally in 2 groups	RCT	Extracorporeal shockwave therapy and conservative therapy both were effective in reducing pain and improving function in adhesive capsulitis patients.
7.	The Effect of Extracorporeal Shock Wave Therapy for Patients with Diabetic Frozen Shoulder	Mohamed K. Seyam, Ezzat E. Moubarak, Abdul Rahim Shaik.	30 patients involved divided equally in 2 groups	RCT	Both group A and B showed significant improvement in reducing the shoulder pain, increasing the functional activities and range of movements of shoulder joint. However group A showed good Improvement Ratio in reducing the shoulder pain, increasing the functional activities and range of movements of shoulder joint compare to the group B.
8.	Comparison of Application of the Radial Vs. Focused Probes of Extracorporeal Shockwave Therapy on Pain, Range of Motion and Function in Patients with Adhesive Capsulitis	Isam Ali Hameedi, Azadeh Shadmehr, Kazem Malmir	40 patients involved divided equally in 2 groups	RCT	It was recommended to use the rESWT in the first weeks of treatment for acceleration processing methods.
9.	Efficacy of Extracorporeal Shockwave Therapy in Frozen Shoulder	Babak Vahdatpour, Parisa Taheri, Abolghasem Zare Zade	36 patients involved divided equally in 2 groups	RCT	The intervention group showed more satisfactory improvements compared to the control group in
10.	Supervised Exercises Compared with Radial Extracorporeal Shock-Wave Therapy for Subacromial Shoulder Pain: 1-Year Results of a Single-Blind Randomized Controlled Trial	Kaia Engebretsen, Margreth Grotle, Erik Bautz-Holter	104 patients involved divided equally in 2 groups	RCT	Upon the 1-year follow-up, the study did not discover any significant differences between the SE and rESWT groups in terms of the primary outcome measure. However, the secondary analysis indicated that a larger number of participants in the SE group had returned to work compared to those in the rESWT group.

DISCUSSION

Comparing ESWT with Conservative Treatments: Insights from nine Randomized Controlled Trials and a systematic review: nine randomized controlled trials and a systematic review have provided valuable insights into the comparative effectiveness of Extracorporeal Shock Wave Therapy (ESWT) against various conservative treatments, including physical therapy, oral prednisolone, and ultrasound therapy. The trials collectively shed light on the distinctive advantages of ESWT in diverse clinical scenarios[12].

In 2017, Sangho Lee et al. conducted a randomized controlled trial titled "The effects of extracorporeal shock wave therapy on pain and range of motion in patients with adhesive capsulitis," published in the Journal of Physical Therapy Science. The trial involved thirty participants diagnosed with adhesive capsulitis, split into an experimental group (n=15) receiving extracorporeal shock wave therapy and a control group (n=15) undergoing conservative physical therapy only. Both groups underwent treatment three times per week for four weeks. The findings indicated that both groups experienced a significant reduction in pain and an improvement in range of motion after treatment when comparing pre- and post-treatment measures within each group. Moreover, when comparing the experimental and control groups after treatment, the experimental group exhibited significantly lower pain levels and greater range of motion compared to the control group[13].

In 2015, Chan Park et al. conducted a randomized controlled trial titled "The effects of extracorporeal shock wave therapy on frozen shoulder patients' pain and functions," which was published in the Journal of Physical Therapy Science. The trial involved 30 patients diagnosed with frozen shoulder, divided equally into two groups: an extracorporeal shock wave therapy group comprising 15 patients and a conservative physical therapy group also consisting of 15 patients. Over a period of six weeks, the extracorporeal shock wave therapy group underwent two sessions per week of this therapy, while the conservative physical therapy group received general physical therapy. Pain levels were assessed using visual analog scales, and patient-specific functional impairment was evaluated using functional scales.

The study's findings indicated that both groups experienced significant reductions in pain and improvements in functional scales when comparing pre- and post-treatment measures within each group. However, upon comparing the two groups, the extracorporeal shock wave therapy group exhibited significantly lower scores on both the visual analog scales measuring pain and the patient-specific functional scales, indicating greater improvements compared to the conservative physical therapy group[14].

In 2020, Han-Yong Qiao et al. conducted a randomized controlled trial titled "Analgesic effect of extracorporeal shock-wave therapy for frozen shoulder," published in the Journal of Medicine. The study enrolled 30 patients diagnosed with adhesive capsulitis. The patients were divided into two groups: Group 1 received oral prednisolone treatment, starting with a d-osage of 30mg daily for 2 weeks followed by a reduced dosage of 15mg daily for an additional 2 weeks. Group 2 underwent three sessions of extracorporeal shock-wave therapy (ESWT) administered on the first, 14th, and 28th days of the study period[15].

The primary outcome measure assessed was the shoulder pain score, while secondary outcomes included the Disabilities of the Arm, Shoulder, and Hand (DASH) score, range of motion, satisfaction rate, and any reported complications. The study aimed to compare the efficacy of oral prednisolone treatment versus ESWT in managing frozen shoulder symptoms, particularly pain intensity.

In 2019, Ramprasad Muthukrishnan et al. conducted a randomized controlled trial titled "The effectiveness of extracorporeal shockwave therapy for frozen shoulder in patients with diabetes," published in the Journal of Physical Therapy Science. The study involved twenty participants diagnosed with diabetic frozen shoulder, divided into an experimental group and a control group. The experimental group received a combination of extracorporeal shock wave therapy, mobilization, and specific exercises, while the control group received ultrasound treatment, mobilization, and similar exercises[16].

In 2022, Donghun Han et al. conducted a systematic review titled "Extracorporeal Shock Wave Therapy with Meridian and Acupoint Theory for Adhesive Capsulitis," which was published in the Journal of Korean Medicine and Rehabilitation. Their review involved searching electronic databases using keywords 'extracorporeal shock wave' in combination with '(acupuncture OR acupoint OR meridian)' to maximize the search sensitivity. After screening the identified studies based on titles and abstracts, those relevant to adhesive capsulitis were selected and included after a thorough examination of the full-text articles[17].

In a 2021 study published by Muhammad Adnan Farhat et al. in the Annals of Medical and Health Sciences Research, titled "Effects of Extracorporeal Shockwave Therapy in Long Term Functional Outcomes of Shoulder Adhesive Capsulitis," the research was conducted From July 2020 to December 2020, Horizon Hospital, Lahore, Pakistan. Sixty-five patients diagnosed with adhesive capsulitis were randomly allocated into two equal groups for the study.

Group A underwent a treatment regimen comprising extracorporeal shockwave therapy in conjunction with conventional therapy, while Group B received only conventional therapy. The assessment of both groups involved using the Constant Shoulder Scale (CSS) and the Oxford Shoulder Score (OSS) at various intervals: baseline, 4th, 8th, 12th, and 24th week of treatment. The study's findings concluded that both extracorporeal shockwave therapy and conservative therapy alone were effective in reducing pain and enhancing function among patients diagnosed with adhesive capsulitis[18].

In a study conducted by Mohamed K. Seyam et al., published in the Majmaah Journal of Health Sciences in 2023, titled "The Effect of Extracorporeal Shock Wave Therapy for Patients with Diabetic Frozen Shoulder," thirty patients diagnosed with diabetic frozen shoulder were divided into two groups. Group A, comprising 15 patients (9 male and 6 female), underwent a treatment regimen involving extracorporeal shock wave therapy combined with therapeutic exercises for a five-week duration. On the other hand, Group B, consisting of 15 patients (10 male and 5 female), received traditional physical therapy for the same duration, which included 3MH ultrasonic therapy, infrared therap-

-y, and therapeutic exercises. The study used the Shoulder Pain and Disability Index (SPADI) and a Digital Goniometer to assess outcomes, evaluating shoulder pain levels, functional activities, and the range of shoulder joint movements. Both Group A and Group B displayed significant improvements in reducing shoulder pain, increasing functional activities, and enhancing the range of shoulder joint movements following the respective treatment regimens. However, Group A, which received extracorporeal shock wave therapy alongside therapeutic exercises, demonstrated a notably better Improvement Ratio compared to Group B in reducing shoulder pain, enhancing functional activities, and improving the range of shoulder joint movements[19].

In a study conducted by Isam Ali Hameedi et al., published in the journal Neuro Quantology in June 2022, titled "Comparison of Application of the Radial Vs. Focused Probes of Extracorporeal Shockwave Therapy on Pain, Range of Motion and Function in Patients with Adhesive Capsulitis," 40 patients diagnosed with adhesive capsulitis were randomly divided into two groups. Group A (n = 20) underwent radial Extracorporeal Shockwave Therapy (rESWT) along with conventional therapy, while Group B (n = 20) received focused Extracorporeal Shockwave Therapy (fESWT) alongside conventional therapy. The conventional therapy included infrared therapy, ultrasound, supervised exercise, and home exercises. Both groups received two treatments per week for four weeks, comprising one session of ESWT per week alongside one session of conventional therapy per week. The study evaluated various parameters including Visual Analogue Scale (VAS) scores at rest and during exercise, Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, scapular dyskinesia, and shoulder motion ranges (flexion, extension, abduction, internal rotation, and external rotation) before the intervention, after two weeks, and after four weeks. The findings indicated significant improvements within both Group A and Group B for all assessed outcomes. However, the study did not observe any significant differences between the two groups in terms of outcomes at baseline, two weeks, and four weeks after the treatment interventions. This suggests that while both radial and focused probes of Extracorporeal Shockwave Therapy showed effectiveness in improving outcomes within their respective groups, there was no significant superiority observed between the two probe types [20].

In a study conducted by Babak Vahdatpour et al., published in the International Journal of Preventive Medicine in 2014, titled "Efficacy of Extracorporeal Shockwave Therapy in Frozen Shoulder," 36 patients were enrolled and divided into two groups. This study was conducted between 2011 and 2012 at Isfahan University of Medical Sciences Hospital. The intervention group consisted of patients who received actual Extracorporeal Shockwave Therapy (ESWT) once a week for a total of four weeks. The control group, on the other hand, received sham shockwave therapy once a week for the same duration. During the follow-up period, changes in individual p-

-erformance, pain levels, and disability were assessed using the Shoulder Pain and Disability Index (SPADI) questionnaire. Additionally, changes in the range of motion were measured using a goniometer. The analys is revealed differences in the mean pain and disability scores recorded in the SPADI questionnaire, as well as improvements in flexion, extension, abduction, and external rotation of the involved shoulder between the two groups before and after the shockwave therapy sessions. The intervention group showed more satisfactory improvements compared to the control group in these areas. However, the mean internal rotation did not significantly differ between the two groups following the treatment[21].

In a single-blind randomized controlled trial led by Kaia Engebretsen et al., published in the journal Physical Therapy in 2011, the study was conducted at the Physical Medicine and Rehabilitation Department of Oslo University Hospital, Ullevaal, Norway. A total of 104 patients experiencing subacromial shoulder pain lasting at least three months were enrolled.

These patients were randomly divided into two groups: an rESWT group consisting of 52 patients and an SE (standard exercise) group also comprising 52 patients. The primary outcome measure for assessment was the Shoulder Pain and Disability Index. Secondary measures included inquiries about pain, function, and work status of the participants. Upon the 1-year follow-up, the study did not discover any significant differences between the SE and rESWT groups in terms of the primary outcome measure (Shoulder Pain and Disability Index). However, the secondary analysis indicated that a larger number of participants in the SE group had returned to work compared to those in the rESWT group[22].

Among the studies reviewed, randomized controlled trials met the inclusion criteria. The meta-analysis, encompassing three of these studies, revealed positive outcomes associated with the use of Extracorporeal Shock Wave Therapy (ESWT) aligned with meridian and acupoint theory for adhesive capsulitis. Specifically, compared to the control groups, the analysis indicated significant improvements in both the efficacy rate and the range of shoulder flexion for those undergoing ESWT with consideration to meridian and acupoint theory. Throughout the four-week study period, clinical outcomes such as pain levels, active range of motion in the shoulder, disability scores measured by the Disabilities of the Arm, Shoulder, and Hand scale, and global rating of change were assessed weekly[23].

The findings of the study revealed significant improvements in pain reduction, increased active range of motion, and decreased disability scores in both groups by the end of the fourth week. However, the experimental group showed additional benefits in terms of greater pain reduction, requiring fewer therapy sessions, and consequently reducing the overall costs of treatment compared to the control group. The evidence from these nine randomized controlled trials and a systematic review consistently highlights the favorable outcomes associated with ESWT compared to conservative treatments such as physical therapy, oral prednisolone, and ultrasound therapy. In frozen shoulder patients, ESWT demonstrates superiority in terms of pain reduction, improved function, and enhanced range of motion. Moreover, its effectiveness extends to diabetic frozen shoulder, showcasing significant advantages over ultrasound therapy. Clinicians may consider ESWT as a promising and versatile intervention across v-

-arious shoulder conditions[24].

CONCLUSION

After reviewing numerous studies from various databases across different years, it can be inferred that there are exist several treatment approaches for adhesive capsulitis. These methods encompass medical interventions such as intracapsular injections and oral steroids, as well as physical therapies like mobilization, strength training and ultrasound therapy modality. However, these treatment modalities tend to be either less effective or time-consuming. Contrarily, the articles reviewed distinctly highlights extracorporeal shock wave therapy (ESWT) as the most effective means of alleviating pain, reducing inflammation, and restoring functional activity to the affected joint. Additionally, ESWT appears to significantly aid patients in engaging comfortably in their daily activities without experiencing pain.

REFERENCES

1. Leafblad, N., et al., *Adhesive Capsulitis.* Phys Med Rehabil Clin N Am, 2023. **34**(2): p. 453-468.
2. Sarasua, S.M., et al., *The epidemiology and etiology of adhesive capsulitis in the U.S. Medicare population.* BMC Musculoskelet Disord, 2021. **22**(1): p. 828.
3. Le, H.V., et al., *Adhesive capsulitis of the shoulder: review of pathophysiology and current clinical treatments.* Shoulder Elbow, 2017. **9**(2): p. 75-84.
4. Ramirez, J., *Adhesive Capsulitis: Diagnosis and Management.* Am Fam Physician, 2019. **99**(5): p. 297-300.
5. Wang, W., et al., *Effectiveness of corticosteroid injections in adhesive capsulitis of shoulder: A meta-analysis.* Medicine (Baltimore), 2017. **96**(28): p. e7529.
6. De la Corte-Rodríguez, H. and J.M. Román-Belmonte, *Extracorporeal Shock Wave Therapy for the Treatment of Musculoskeletal Pain: A Narrative Review.* 2023. **11**(21).
7. Lee, J.H. and E.J. Kim, *A Comprehensive Review of the Effects of Extracorporeal Shock Wave Therapy on Stroke Patients: Balance, Pain, Spasticity.* Medicina (Kaunas), 2023. **59**(5).
8. Cao, D.Z., et al., *Effectiveness of extracorporeal shock-wave therapy for frozen shoulder: A protocol for a systematic review of randomized controlled trial.* Medicine (Baltimore), 2019. **98**(7): p. e14506.
9. Auersperg, V. and K. Trieb, *Extracorporeal shock wave therapy: an update.* EFORT Open Rev, 2020. **5**(10): p. 584-592.
10. Cho, C.H., et al., *Biological Aspect of Pathophysiology for Frozen Shoulder.* Biomed Res Int, 2018. **2018**: p. 7274517.
11. Kraal, T., et al., *The puzzling pathophysiology of frozen sho--ulders - a scoping review.* J Exp Orthop, 2020. **7**(1): p. 91.
12. Ko, N.Y., et al., *Comparative Effectiveness of Focused Extracorporeal versus Radial Extracorporeal Shockwave Therapy for Knee Osteoarthritis-Randomized Controlled Study.* Int J Environ Res Public Health, 2022. **19**(15).
13. Lee, S., et al., *The effects of extracorporeal shock wave therapy on pain and range of motion in patients with adhesive capsulitis.* Journal of physical therapy science, 2017. **29**(11): p. 1907-1909.
14. Park, C., et al., *The effects of extracorporeal shock wave therapy on frozen shoulder patients' pain and functions.* Journal of physical therapy science, 2015. **27**(12): p. 3659-3661.
15. Qiao, H.-Y., L. Xin, and S.-L. Wu, *Analgesic effect of extracorporeal shock-wave therapy for frozen shoulder: A randomized controlled trial protocol.* Medicine, 2020. **99**(31): p. e21399.
16. Muthukrishnan, R., A.A. Rashid, and F. Al-Alkharji, *The effectiveness of extracorporeal shockwave therapy for frozen shoulder in patients with diabetes: randomized control trial.* Journal of physical therapy science, 2019. **31**(7): p. 493-497.
17. Han, D., I.-h. Park, and I. Heo, *Extracorporeal shock wave therapy with meridian and acupoint theory for adhesive capsulitis: a systematic review and meta-analysis of randomized controlled trials.* Journal of Korean Medicine Rehabilitation, 2022. **32**(2): p. 55-63.
18. Chen, C.-Y., et al., *Extracorporeal shockwave therapy improves short-term functional outcomes of shoulder adhesive capsulitis.* Journal of shoulder and elbow surgery, 2014. **23**(12): p. 1843-1851.
19. Seyam, M.K., E.E. Moubarak, and A.R. Shaik, *The Effect of extracorporeal shock wave therapy for patients with diabetic frozen shoulder.* Majmaah Journal of Health Sciences, 2020. **6**(2): p. 40-40.
20. Malmir, A.S.K., S. Fereydounnia, and Z. Shirav, *Comparison of Application of the Radial Vs. Focused Probes of Extracorporeal Shockwave Therapy on Pain, Range of Motion and Function in Patients with Adhesive Capsulitis.* NeuroQuantology, 2022. **20**(6): p. 2726.
21. Vahdatpour, B., et al., *Efficacy of extracorporeal shockwave therapy in frozen shoulder.* International Journal of Preventive Medicine, 2014. **5**(7): p. 875.
22. Engebretsen, K., et al., *Supervised exercises compared with radial extracorporeal shock-wave therapy for subacromial shoulder pain: 1-year results of a single-blind randomized controlled trial.* Physical therapy, 2011. **91**(1): p. 37-47.
23. Zhang, R., et al., *Extracorporeal Shockwave Therapy as an Adjunctive Therapy for Frozen Shoulder: A Systematic Review and Meta-analysis.* Orthop J Sports Med, 2022. **10**(2): p. 23259671211062222.
24. Alshehre, Y.M. and S.H. Pakkir Mohamed, *Effectiveness of Physical Exercise on Pain, Disability, Job Stress, and Quality of Life in Office Workers with Chronic Non-Specific Neck Pain: A Randomized Controlled Trial.* 2023. **11**(16).