REVIEW

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The Effectiveness of Nonoperative Treatment Modalities in the Management of Frozen Shoulder: a Systematic Review of Randomized Controlled Trials

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SUMMARY

Background. Frozen shoulder is a widespread concern having an unknown etiology. Management mainly aims at restoring function and treating symptoms. The choice of treatment may differ based on patient variables, stage of presentation, priorities of clinicians, and funding. No robust evidence exists to endorse one treatment modality over another in a conclusive way. Therefore, we performed a systematic review of the conservative therapeutic options for the frozen shoulder.

Materials and methods. A wide range of electronic bibliographic databases such as PubMed, Embase, and ERIC was searched. Based on the eligibility criteria, all randomized controlled trials that compared the efficacy of any type of non-surgical or conservative management from 2010 to 2020 are incorporated in the review. Following screening and assessing the abstracts, we ended up reviewing 12 full-text articles and data extracted on essential parameters such as sample size, type of non-surgical treatment, time of follow-up, and primary outcomes.

Results. Overall, the systematic review results seem promising for the efficacy of different non-surgical modalities. They improve multiple outcomes such a pain, range of motion, Constant-Murley score, simple Shoulder Test, Shoulder Pain, Disability Index, and patient satisfaction. Nonsurgical management is the preferred initial care option, with most patients typically improving within 6 to 18 months. Steroids, physiotherapies, hydrodilatation with hypertonic saline, suprascapular nerve block (SNB), Extracorporeal shockwave therapy, and intra-articular steroid or sodium hyaluronate injections are conservative treatment choices.

Conclusions. Treatment of frozen shoulder remains a challenge, and high-level conclusive evidence is needed to recommend one treatment method over another. The results of this systematic review showed that nonsurgical management, regardless of the preferred treatment option, is beneficial and effective in the treatment of frozen shoulder, and that can guide clinicians in making evidence-based decisions when managing this condition conservatively. This will avoid unnecessary burdens on the healthcare system and patients, as they might be treated effectively without undergoing surgery.

KEY WORDS

Frozen shoulder; conservative treatment; shoulder stiffness; systematic review; shoulder pain.

INTRODUCTION

In general practice, frozen shoulder is a common concern, and its frequency is estimated to be 2 to 5 percent (1, 2). It usually affects the non-dominant extremity, but bilateral involvement has been reported in up to 40 % (3). The cause of frozen shoulder and its pathogenesis is unknown. Still, diabetic patients, patients with thyroid disease, cardiovascular disease, autoimmune disease, and paralysis have been shown to be susceptible to this disorder (4-8). Patients usually present with painful and limited shoulder movements, which can lead to severe disabil-

ity (9). Although the etiology of primary frozen shoulder is not yet fully understood, histological studies have shown a thick, tight capsule with chronic inflammatory cells and fibroblast located in the joint capsule (10). In addition, fibroblasts have a functional phenotype correlated with cytokine dysregulation, suggesting an autoimmune etiology (11, 12).

Frozen shoulder progresses through 3 overlapping phases (2). The first phase is the freezing phase, which lasts from 2 to 9 months, the shoulder becomes increasingly painful with a gradual reduction in the range of motion (2). Following this, the frozen phase in which pain is decreased but the stiffness remains, and it can last from 4 to 12 months (2). Finally, the thawing phase, during which a slow but gradual improvement in the shoulder's mobility is observed and can take up to 5 to 24 months (2). Although the frozen shoulder is primarily considered a self-limiting disorder, complete resolution of symptoms does not occur all the time (13). Hand *et al*. found that only 59 percent of patients returned to their normal condition after four years. Persistent symptoms, however, are usually moderate (1). Care is aimed at restoring function and treating symptoms (14). Treatment choice may differ depending on patient variables, stage of presentation, clinician priorities, and local policies or funding (14). Nonsurgical management, with most patients usually improving within 6 to 18 months, is generally the preferred initial care option (7).

Conservative treatment choices include analgesics, oral steroids, physical therapies, hydrodilatation, suprascapular nerve block (SNB), and intra-articular steroid or sodium hyaluronate injections (15 16). Surgical intervention is usually considered without significant improvement in the patient's complaint despite adherence to a conventional treatment regimen (15). There is no consensus or high-level evidence to support one treatment modality over another conclusively, which is necessary for clinicians to make informed decisions in their practical lives (17). Therefore, this study aims to assess the effectiveness of the different non-surgical treatment options available for managing frozen shoulder utilizing results from randomized controlled trials.

MATERIALS AND METHODS

We performed a systematic review to evaluate, synthesize, and combine the existing evidence on the outcome regarding non-surgical treatment options for frozen shoulder. We used the PRISMA guidelines to undertake this systematic review (18). We used the PICOT algorithm to undertake the search. These search items are grouped according to PICOS criteria (19):

1. population (patients with frozen shoulder);
2. intervention (non-surgical management);
3. comparison group (other than non-surgical management);
4. outcome (efficacy and safety of treatment);
5. setting (both high and low-middle income countries) (19).

Inclusion and exclusion criteria

To answer the study question, the study's eligibility was contingent for inclusion if a research study evaluated the effectiveness of non-surgical treatment modalities for managing frozen shoulder, published in English from 2010 to 2020 across different regions of the world. Additionally, only studies randomized controlled trials (RCTs) were included. Cross-sectional, qualitative, or any other observational studies were excluded, and studies without full text were also eliminated. All studies consisting of opinions, criticisms of older research studies, and editorials were not included, but rather studies comparing the efficac , safety, and effectiveness of non-surgical treatment options and their full texts have been reviewed.

Sources of information and search strategy for relevant articles

A systematic search of published articles was started and completed in 2021. We searched databases such as PubMed, Embase, and ERIC. We explored references of relevant reviews along with the database searches. An independent investigation was carried out by two authors who also scanned the results for potentially appropriate studies, followed by retrieving the full-text articles. The primary endpoint of the review was the efficacy and safety of available conservative treatment options available for frozen shoulder, which was resulted in improvement in pain, range of motion, scoring using different questionnaires, and patient satisfaction. We pre-piloted the search strategies without any restrictions by year of publication, geographic area, or other socio-demographic characteristics.

We identified a blend of Medical Subject Heading (MeSH) keywords and text words. We clustered these into four major groups based on population, intervention, outcome, and settings. The most general search terms found in abstracts and titles comprised "non-surgical treatment and frozen shoulder", "conservative treatment and frozen shoulder", "pharmacological treatment modalities and frozen shoulder", "treatment modalities and frozen shoulder". Further, we consulted with a librarian to generate a search in four different parts. The first part was restricted to search terms specific to the primary outcome, such as "efficacy and safety of treatment options", the second part was for the terms limited to the frozen shoulder, including "Pain or stiffness in the frozen shoulder"; the third part was related to the terminology relevant for treatment options "conservative or non-surgical", and the last term was associated with the type of treatment such as exercise *vs* some oral medication "type of non-surgical treatment".

In addition, we also considered using diverse wordings of main concepts such as frozen shoulder, adhesive capsulitis, and its management to obtain relevant research papers. This was followed by combining these major concepts using combinations (AND, OR) relevant to the research question. Moreover, we also used truncation (*) with the same root word to detect more research articles. We used truncation to make sure to retrieve all potential variants of search terms. However, we also applied search limits or filters on the language (English) and applied restrictions on publication period, age group, and type of studies to include eligible studies in the search.

Data abstraction

We imported all relevant research studies into the reference manager software (EndnoteTM) file, where each study was reviewed, and we also screened titles for duplicates in this software. We did not consider the abstracts for further review, which did not explicitly explore the study objective. Finally, we obtained and examined the full-text articles of the remaining relevant articles. This was followed by abstracting and summarizing the articles that met the eligibility criteria using a standardized proforma. Thus, after the process of removing duplicates, title, and abstract screening, we removed papers that were beyond the scope of this review as guided by inclusion criteria. Besides, the bibliography of the remaining studies was also verified and examined to evade missing any valuable studies. The reviewers carried out this process of searching the articles independently, and their judgments and extracted summaries were matched to identify the differences and resolve these accordingly.
Independent reviewers filled a standardized data extraction sheet for the eligible research articles. The reviewers compared the data extraction tables to ensure including the imperative findings of the eligible studies and pilot tested the data extraction sheet before starting the data extraction process. Furthermore, prevailing research articles on the chosen topic were reviewed to describe the data extraction proforma objects. Any discrepancies between the two reviewers were solved by agreement between the two reviewers. The abstracted data comprised of the author, reference, year of publication, type of study design, total study size or population, average age with range for age, gender, surgical group (with or without closure), rate of recurrence, significant study findings, and conclusion of the stud .

RESULTS

Findings of the search strategy

We screened the identified articles initially by titles, then by abstracts, and finall , we carried out a full-text articles assessment. Our initial search identified 1525 citations in different databases; however, 25 articles were duplicated and removed. Of the remaining 1500 unique studies, we reviewed titles and abstracts and found 1232 relevant abstracts. Upon reviewing abstracts, 249 articles did not meet the eligibility criteria while reviewing the abstracts, and seven did not meet eligibility after reviewing full texts. Hence, we retrieved full texts for 12 articles, which were incorporated in the review as shown in **figure 1**.

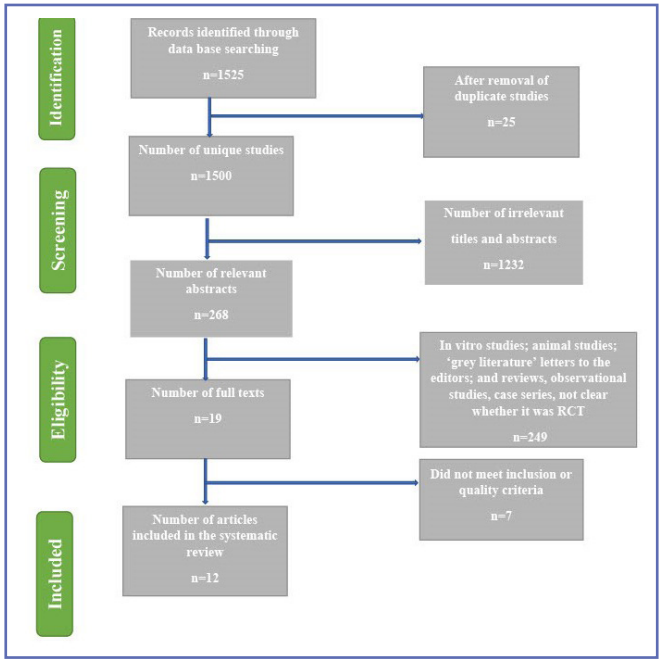

Figure 1. Flow chart summarizing the identification and selection of papers for systematic review.

Characteristics of the eligible studies

In respect to the study design, all these studies were randomized controlled trials (RCTs). The sample size of all included research studies ranged between 18 to 121, with a similar distribution among patients randomized to different non-surgical treatment modalities. One study was performed in 2010, 2012, and 2013, four in 2014, three in 2015, and 2 were conducted in 2016, as illustrated in **table I**.

Findings from randomized controlled trials (RCTs)

Almost all the RCTs included in this systematic review revealed positive effects of different conservative and non-surgical strategies to manage frozen shoulder. For example, a study conducted by Aijaz Ali *et al.* in 2015 on

Table I. Characteristics of the included studies with their settings and types of groups (n = 11).

Study name	Year	Country	Sample size	Group 1	Group 2	Group 3
Aijaz Ali *et al.* (20)	2015	Karachi, Pakistan	44	Exercise and manual therapy	Only Exercise	NA
Bae *et al.* (21)	2014	South Korea	64	patients were given injections using an anterior method with 2% lidocaine (5 mL), contrast dye (5 mL), triamcinolone (40 mg), and normal saline (9 mL) under guidance fluoroscope	patients were injected utilizing a posterolateral method with 2% lidocaine (5 mL), triamcinolone (40 mg), and normal saline (14 mL) under guidance of ultrasound	NA
Balci *et al.* (22)	2016	Turkey	53	Scapular proprioceptive neuromuscular assistance exercises and physical therapy	traditional exercise and physical therapy	Only physical therapy
Çelik *et al.* (23)	2015	Turkey	30	Combined mobilization and stretching exercises	Only stretching exercises	NA
Lee *et al.* (24)	2015	South Korea	81	hydrodilatation with hypertonic saline (3% NaCl) and 4 ml lidocaine (1%) and 1 ml triamcinolone (10 mg) under guidance of ultrasound.	hydrodilatation with hypertonic saline (0.9% NaCl) and 4 ml of lidocaine (1%) and 1 ml triamcinolone (10 mg) under guidance of ultrasound.	NA
Lorbach *et al.* (25)	2010	Germany	40	oral corticoid treatment regimen	3 intra-articular injections of corticosteroids	NA
Tsan Wu *et al.* (27)	2014	Taiwan, Republic of China.	60	12 weeks of physical therapy after pulsed radiofrequency lesioning of the suprascapular nerve	Physiotherapy only	NR
Kwak *et al* (28)	2016	South Korea	121	hydraulic distension along with manual therapy	Only hydraulic distension	NR
Vahdatpour *et al.* (29)	2014	Iran	40	Extracorporeal shockwave therapy (ESWT) one every week for one month	Sham shockwave therapy one every week for one month	NR
Schydlowsky *et al.* (30)	2012	Denmark	18	adalimumab injections subcutaneously	Intraarticular glucocorticoid injections	NR
Ohta *et al.* (31)	2014	Japan	70	Celecoxib (100 mg/dose, two times every day)	loxoprofen 60 mg/ dose, three times daily)	NR
Russel *et al.* (32)	2013	UK	75	group exercise class	individual physiotherapy	home exercises alone

44 subjects assessed the efficacy of exercise and manual therapy compared to exercise only (20). The authors found that exercise and manual therapy are more beneficial for managing frozen shoulder than exercise alone (20). Likewise, another study conducted by Bae *et al.* in South Korea on 64 patients compared injections using the anterior method using 2 percent lidocaine, contrast dye, triamcinolone, and normal saline under the guidance of fluoroscope with an injection applying a posterolateral method with 2 percent lidocaine, triamcinolone, and normal saline under the

control of ultrasound (21). The authors did not obtain any statistically substantial variation between the two treatment modalities because they improved the primary outcomes, as shown in **table II** (21).

Another RCT was conducted in 2016 by Balci *et al.* on 53 patients who were randomized to combined scapular proprioceptive neuromuscular assistance exercises and physical therapy or only traditional exercises and physical therapy (22). The authors found an identical benefit of these two non-surgical modalities concerning pain on the visual analog scale (VAS) and passive range of motions (PROM), as illustrated in **table II** (22).

Ceilk *et al.* randomized 30 patients either for combined mobilization and stretching exercises or only for stretching exercises and found that combined mobilization and stretching exercises outperformed stretching exercises alone with improvement in pain on VAS, PROM, and other outcomes during follow-up (23). Additionally, another RCT was conducted by Lee *et al.* in South Korea on 81 patients to assess the efficacy of hydrodilatation with hypertonic saline

Table II. Summary of main findings regarding efficacy of non-surgical treatment to manage frozen shoulder (n = 11).

Study name	Year	Timing of assessments	Primary outcome	Main findings	Summary of findings
Aijaz Ali *et al.* (20)	2015	Baseline and five week	Pain visual analogue scale (VAS), range of motion, Shoulder Pain and Disability Index	Within-group considerable improvements in all outcomes (P = 0.05). Intra-group analysis revealed no meaningful difference between 2 arms (P > 0.05).	Exercises with manual therapy and only exercises are equally efficacious to manage frozen shoulder
Bae *et al.* (21)	2014	Baseline, one, five, and nine weeks	Shoulder Pain and Disability Index (SPADI), range of motion and power and grip of hand	No differences were found between two groups in the measured outcomes	Ultrasound guided capsular distension using posterolateral technique has identical outcomes to fluoroscopy guided capsular distension using an anterior technique.
Balci *et al.* (22)	2016	At baseline and after session	VAS, Lateral Scapular Slide Test, passive range of motion (PROM), and simple shoulder test	There were no statistically significant differences were found between three groups	No added advantage of exercises than physical therapy. Scapular exercises are recommended as an effective treatment regime for shoulder rehabilitation in frozen shoulder
Çelik *et al.* (23)	2015	At baseline, six weeks after intervention, and at 1 year	Arm, shoulder, and hand disabilities score and constant score. Secondary outcomes: pain on VAS, and PROM.	Substantial upsurges in abduction, external rotation and Constant score was noted at end of one year in the group assigned to combined mobilization and stretching exercise group	Combined mobilization and stretching exercises are better than only stretching exercises to manage frozen shoulder.
Lee *et al.* (24)	2015		SPADI and PROM	The group assigned to hypertonic saline revealed meaningful progress in shoulder PROM and SPADI score as opposed to the group assigned to normal saline with less side effects	Hypertonic saline solution is useful than normal saline solution to manage frozen shoulder

Study name	Year	Timing of assessments	Primary outcome	Main findings	Summary of findings
Lorbach *et al.* (25)	2010	Baseline, four, eight, and twelve weeks, and six and twelve months	Constant-Murley score, Simple Shoulder Test and VAS, function, and patient's satisfaction	Among those who were treated with oral glucocorticoids, substantial improvements were seen in Constant-Murley score ($P < .0001$), Simple Shoulder Test ($P = .035$), visual pain analog scales ($P < .0001$), and ROM ($P < .05$) at the end of one month. The patients who were given intra-articular glucocorticoid injections also showed significant improvement in the Constant-Murley score ($P < .0001$), simple shoulder test ($P < .0001$), the visual analog scale ($P < .0001$), and range of motion ($P < .05$) at the end of one month	The application of cortisone is helpful in managing the pain and improves range of motion. Intra-articular glucocorticoids injections were found to be superior as opposed to the oral corticosteroids to manage frozen shoulder.
Tsan Wu *et al.* (27)	2014	Baseline, one, two and three months after treatment	VAS, pain in shoulder and SPADI, and PROM	Patients who were randomized to physical therapy after pulsed radiofrequency lesioning of the suprascapular nerve had remarkably shorter time to beginning of substantial pain relief ($P < 0.001$) and perceptible decrease of VAS score after one week ($P < 0.001$). The VAS, SPADI and PROM also improved after physical therapy after pulsed radiofrequency lesioning of the suprascapular nerve	The use of physical therapy after pulsed radiofrequency lesioning of the suprascapular nerve can relieve the pain quickly and decrease SPADI, and improve PROM as opposed to physiotherapy
Kwak *et al.* (28)	2016	Baseline, two, six, twelve, twenty-four weeks and one year after the last injection	VAS for pain and satisfaction and active AROM	Quick pain relief and improved satisfaction among those who were randomized in group 1 as opposed to group 2. There was no substantial variation in VAS between two groups at one year and AROM was improved in both groups at the end of year.	Hydraulic distension along with manual therapy demonstrated the quicker relief in pain, improved range of motions and improved satisfaction among patents as opposed to only hydraulic distension

Study name	Year	Timing of assessments	Primary outcome	Main findings	Summary of findings
Vahdatpour *et al.* (29)	2014	Baseline, two, five months post intervention.	SPADI, Pain in shoulder, and ROM	There was statistically significant difference between SPADI and pain in shoulder as well as ROM between two groups (< 0.05). However, there was no difference in average internal rotation between two groups (> 0.05).	ESWT has beneficial effects than Sham shockwave therapy in terms of returning to routine activities quickly with better quality of life.
Schydlowsky *et al.* (30)	2012	Baseline, 4, 12, and 24 weeks	SPADI, Pain in shoulder, and constant score, AROM, and PROM	There was no impact of subcutaneous injections of adalimumab	No difference between adalimumab injections and Intraarticular glucocorticoid injections
Ohta *et al.* (31)	2014		Pain on VAS	vanishing of nighttime pain was considerably higher in the celecoxib unit than in the loxoprofen unit. However, there was no difference otherwise between the two groups.	Celecoxib is like loxoprofen in reducing the pain for frozen shoulder. However, celecoxib was more efficient for nighttime ache as opposed to loxoprofen
Russel *et al.* (32)	2013	Baseline, 6 weeks, 6 months, and 1 year	Range of motion, Constant score, Oxford Shoulder Score, Short Form 36, and Hospital Anxiety and Disability Scale (HADS) outcome measures	Improvement was greater in the shoulder symptoms and range of motion with significant findings fo physiotherapy groups when compared to home therapy (P < 0.001).	An exercise program planned in the hospital can help in rapid recovery from a frozen shoulder and is more effective than individual physiotherapy or home-exercise program.

instead of hydrodilatation with normal saline. The authors concluded that hypertonic saline is much better than normal saline at improving the Shoulder Pain and Disability Index (SPADI), PROM, and shoulder pain. Therefore, it is recommended to use hydrodilatation with hypertonic saline to manage frozen shoulders (24).

Lorbach *et al.* randomized 40 patients to receive either oral corticosteroid or injectable corticosteroid and measured a simple shoulder test that consists of 12 items to assess the range of shoulder moments (25). This SST is a series of "Yes" and "No" questions, which authors used to determine the function of the shoulder pre- and post-intervention or treatment (26). The authors found that corticosteroids overall improved primary outcomes (**table II**); however, injectable corticosteroids were found to be superior to oral corticosteroids (25). Similarly, Tsan Wu *et al.* carried out an RCT on 60 patients and evaluated physiotherapy following pulsed radiofrequency lesioning of the supra-scapular nerve *versus* physiotherapy alone (27). They concluded that the use of physical therapy after pulsed radiofrequency lesioning of the suprascapular nerve could quickly relieve pain and decrease SPADI, and improve PROM as opposed to physiotherapy alone (27).

Another RCT was undertaken by Kwak *et al.* in 2016 on 121 patients to assess the efficacy of hydraulic distension along with manual therapy *versus* hydraulic distension alone (28). The authors found that hydraulic distension and manual therapy demonstrated faster pain relief, improved range of motion, and enhanced patient satisfaction than hydraulic distension alone (28). Vahdatpour *et al.* performed a study on 40 patients to assess the effect of extracorporeal shockwave therapy (ESWT) once a week for a month instead of Sham shockwave therapy once a week for a month (29). He found that ESWT has beneficial effects in a quick return to routine activities and a better quality of life (29). On the other hand, Schydlowsky *et al.* conducted an RCT in

Denmark in 2012 to assess the efficacy of subcutaneous adalimumab injections compared to intraarticular glucocorticoid injections. They found no difference between the two treatments (30). Ohta *et al*. found that celecoxib is like loxoprofen in reducing pain in frozen shoulder. However, celecoxib was more effective for nighttime ache (31). Finally, Russel *et al*. conducted an RCT on 75 patients in the UK to assess the effect of group-based physiotherapy *versus* individual-based physiotherapy and home exercise (32). The findings reveal that improvements were more significant in the shoulder symptoms and range of motion, with actual results for physiotherapy groups when compared to home therapy ($p < 0.001$) (32). The authors concluded that an exercise program planned in the hospital could help rapidly recover from a frozen shoulder and is more effective than individual physiotherapy or home-exercise program (32).

DISCUSSION

We undertook this review to assess the efficacy of different non-surgical treatment methods in managing frozen shoulder with regards to improving shoulder pain, arm movement, and other relevant clinical outcomes. Our search included all RCTs with variable treating strategies such as different pharmacological treatments administered orally or injected intraarticularly, physiotherapy, and hydrodilation. Overall, we have found positive results supporting the use of these methods in combination or independently.

When it comes to physiotherapy, our findings are analogous to the existing literature. Physiotherapy is commonly used alone or other treatments such as steroid injections, transcutaneous electrical nerve stimulation, analgesics, and hot or cold pads (33, 34). There are still variations in the physiotherapy regimen; however, the guidelines revolve around controlled stretching and strength exercises (35). Gentle stretching exercises, including pendulum exercises and passive supine forward elevation, are recommended (35). Strengthening maneuvers such as isometric external shoulder rotation and posterior capsular stretching can be added (35). Strengthening and stretching exercises can be combined and increased in frequency during the thawing phase to increase shoulder ROM. There is insufficient evidence to support physical therapy over observation or medical treatment alone, considering the clinically prevalent use of physical therapy in the treatment of frozen shoulder (36, 37). However, more research may be required to establish the role of physical therapy and adjunct therapies in managing this problem.

Regarding oral pharmacological therapy, there is a lack of robust evidence to endorse the benefit of one treatment over another (33). Some studies support the use of corticosteroids and NSAIDs, which are often the first-line pain remedies. NSAIDs showed substantial improvement in symptoms compared to placebo (38), but when comparing various NSAIDs, including naproxen and indomethacin, no significant difference in their effects was found (39, 40). Oral steroids are beneficial in the treatment of frozen shoulder (41). They provide short-term pain relief and ROM improvement; however, clinicians should be cautious with long-term steroid use due to the higher chances of side effects and flawed premises to endorse their long-term use in the frozen shoulder (41, 42).

Intra-articular steroids injection is frequently utilized to manage frozen shoulder and has been demonstrated to offer more significant pain reduction and increased shoulder mobility than oral steroids (25, 43). Furthermore, a recent meta-analysis of 225 patients found that intra-articular steroid injections offered short-term analgesia (reduction in pain score for up to 8 weeks) and enhanced both short and long-term passive ROM compared to placebo (44). In addition, a systematic review reported three high-quality RCTs demonstrating substantial analgesic gain from intra-articular injections given between 6 weeks and four months compared to placebo or physiotherapy alone (45). Recent data indicate that there is no clinical difference between subacromial and glenohumeral injection (46). The downside of injection is the high incidence of not accessing the glenohumeral joint, which is why radiological and ultrasound-guided techniques are preferred and recommended (47).

Intraarticular shoulder joint distension is an alternative treatment approach but has only been found effective over a short period and has not been shown to have any significant advantage over other treatment modalities in the long term. The procedure requires the injection of either saline or steroids and local anesthesia to expand the capsule and break down any adhesions (48). In addition, sodium hyaluronate injections are one of the treatments used for frozen shoulder (41). These can be used as an alternative approach to steroid injections or sometimes can be jointly used with steroids (49). Findings from a systematic review demonstrated that sodium hyaluronate injections could be as effective or even better than corticosteroid injections with an additional advantage of fewer side effects than corticosteroids (50).

The supraclavicular nerve supplies the rotator cuff muscles, namely the supraspinatus and the infraspinatus. SNB requires local anesthetic infiltration at the insertion of trapezius muscle through a needle inserted behind the lateral clavicular end (51). The efficacy of SNB can be increased using electromyographic or ultrasound guidance (52, 53). The literature indicates that SNB may be an effective short-

term treatment strategy, although it would be beneficial to define its position better in more extensive multicenter trials (54).

Finally, ESWT, another treatment modality for frozen shoulder, has been considered adequate to resolve the symptoms (55). The existing evidence and findings of this systematic review reveal that ESWT effectively accelerates the healing activity of the frozen shoulder (56). Further, ESWT is beneficial as it is cost-effective, non-invasive, safe, has fewer side effects, and it requires fewer visits without any need for hospitalization (57). The findings of a meta-analysis demonstrate that ESWT expands the range of flexion, internal and external rotation of the shoulder and enhances therapeutic efficiency and cure rate in treating and managing the frozen shoulder (58).

Strengths and limitations

This review has endorsed the findings regarding the non-surgical treatment options to manage frozen shoulders. The systematic review is strengthened due to robust evidence from randomized controlled trials, which is considered the higher and gold standard in the hierarchy of study designs. We also found various studies from across the globe that convinced us that the non-surgical options available to treat frozen shoulder could be generalized outside a given setting. We found a considerable consistency in the primary outcomes for included studies, as most RCTs assessed identical results. However, the length of follow-up varied from study to study, which could miss the recurrence in the longer run.

CONCLUSIONS

Frozen shoulder is a widely prevalent condition that causes patients to have a severe and extended disability and carries broader economic consequences. The management of frozen shoulder remains a challenge, and high-level conclusive evidence is needed to recommend one treatment method over another. Thus, in clinical practice, the management of this disorder remains distinct. Evidence in the literature supports varying conservative treatment modalities, including analgesics, oral steroids, intra-articular steroids, or injections of sodium hyaluronate, SNB, and physiotherapy. The proof remains inconclusive in the literature on the effectiveness of hydrodilation therapy. The findings are that this systematic review can guide clinicians in making evidence-based decisions when managing frozen shoulder with conservative treatment avoiding unnecessary burdens on the healthcare system and patients.

Clinical implications of the research

Based on the current review findings, clinicians may lean towards non-surgical management of frozen shoulders using different modalities. However, there is a need to carry out multi-country and multi-center large randomized controlled trials to study the effectiveness of non-surgical management, mainly in poor resource settings. Surgical treatment may be risky and expensive; therefore, not every patient can afford it. Furthermore, it involves manipulation under anesthesia, which risks bone fracture and tears to ligaments and tendons (59). Although non-surgical treatment may not rapidly improve the range of motion, it does not pose the threats associated with surgical treatment. However, physiotherapists and physicians may decide to make the appropriate choices for the patients and provide a customized treatment tailored to the needs of patients.

FUNDINGS

None.

DATA AVAILABILITY

As a systematic review the data provided are research papers and are listed and available in table I and the references.

CONTRIBUTIONS

All authors contributed on generating the research question, study design, data analysis, manuscript writing, referencing, and manuscript final review.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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