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Effect of Extracorporeal Shockwave Therapy in Shoulder Adhesive Capsulitis Patients: A Systematic Review and Meta-Analysis

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Abstract

Background: Adhesive Capsulitisis a condition associated with shoulder pain and stiffness. Extracorporeal Shockwave Therapy (ESWT) is commonly used to treat many orthopedic disorders.

Aim of Study: This systematic review and meta-analysis aimed to evaluate the effect of ESWT applicationon pain intensity level, range of motion, functional and disability level in patients with Adhesive Capsulitis.

Material and Methods: Intensive search was done in electronic databases: PubMed, Cochrane Library, and PEDro, Scopus, Google Scholar, Web of Science, and Reference lists. This search was done to include randomized controlled trials (RCTs) that compare Extracorporeal Shockwave Therapy application with control, placebo, or standard care therapy for patients with shoulder Adhesive Capsulitis. Then, them ethodological quality of each included trial was assessed, and the data was extracted. Finally, the results were analyzed by pooling the data of change scores between pre- and post-intervention through calculation of the overall standardized mean differences with 95% confidence interval.

Results: Twelve studies were included in the review, the median of the PEDro scale total scores was seven points. The use of ESWT, applied to patients with Adhesive Capsulitis was associated with favorable short-term changes in self-reported pain intensity level, ROM and overall functions in individuals with Adhesive Capsulitis, when compared control or sham intervention.

Conclusion: The data from this systematic review and meta-analysis suggest that ESWT is superior to conventional therapy and steroids in reducing pain intensity level, improving shoulder ROM, overall functions at short-term; However, due to limited number of the included studies, these findings must be validated by more RCTs. The limitations in the studies performed to date suggest that future research should determine the optimal intensity and dosage of ESWT and perform longer follow-up to monitor long-term effects.

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Key Words: *Extracorporeal Shockwave Therapy – Adhesive Capsulitis – Pain – ROM – Function and disability level – Systematic Review – Meta-analysis.*

Introduction

ADHESIVE Capsulitis, also known as frozen shoulder, is a condition associated with shoulder pain and stiffness. There is a loss of the ability to move the shoulder, both voluntarily and passively, in multiple directions **[1]**. Patients with this condition often complain of progressive loss of shoulder motion with painful restriction of both active and passive ranges of motion. The incidence of adhesive capsulitis in the general population is approximately 2% to 5% but as high as 36% in patients with diabetes **[2]**.

Shoulder pain is a common presentation to primary care doctors, with approximately one out of forty patients seeking medical advice for a painful shoulder. Adhesive Capsulitis is one of the causes, as it is disabling and often presents with such severe pain that patients find it difficult to cope with **[3]**. The goal of treatment of adhesive capsulitis is to restore the shoulder to a painless and functional joint. Because some patients with adhesive capsulitis improve spontaneously, treatment varies greatly from benign neglect to invasive open capsulotomy **[4]**.

Extracorporeal Shockwave Therapy (ESWT) is a treatment method that applies shock waves to lesions to aid revascularization and stimulate or reactivate the healing of bones and connective tissues such as tendons, thereby relieving pain and improving functions. Shockwave treatment is a relatively new non-invasive therapeutic intervention, without the dangers of a surgical procedure and postoperative pain **[5]**.

Most of previous systematic reviews addressed the effectiveness of available treatment options for Adhesive Capsulitis to guide musculoskeletal practitioners and inform guidelines. However, few studies have been conducted a systematic review or meta-analysis on the effect of ESWT alone on Adhesive

Capsulitis. Moreover, up to the authors' knowledge, there is no study has yet mentioned the degree of influence on shoulder function. So, the aim of the study was to evaluate the effect of ESWT on pain intensity level, Range of motion (ROM), and overall function in patients with Adhesive Capsulitis.

Material and Methods

Search strategy:

This Study was based on the recommendations of the Preferred Reporting for Systematic Reviews and Meta-Analyses (PRISMA) statement [6]. The study protocol was approved by the Research Ethics Committee of the Faculty of physical therapy, Cairo University, Egypt and registered prospectively in the PROSPERO database (CRD 42023426072). Databases were searched from March 2021 to July 2021.

Eligibility criteria:

This review included published randomized controlled trials (RCTs), which compared Extracorporeal Shockwave Therapy (ESWT) with any other therapy modality or sham therapy or standard care. Type of participants were adult diagnosed with primary or secondary Adhesive Capsulitis. The outcomes were Pain intensity level, range of motion (ROM), Shoulder Pain and Disability Index (SPADI) and Constant Shoulder Score (CSS).

Exclusion criteria:

Thestudies wereexcluded if it was not randomized controlled trials e.g. (review articles, survey, case report and case series), all the published abstracts with no full text articles available, and studies with low methodological quality (all studies with total PEDro scores less than Average grade).

Data sources and searches:

We searched the Cochrane Central Register of Controlled Trials, PubMed, SCOPUS, Google Scholar, Web of Science and Physiotherapy Evidence Database (PEDro) databases. The articles were limited to English language and to those published online from Jan 2000 up to July 2021. Databases were searched from March 2021 to July 2021. We also searched the reference lists of relevant systematic reviews and included studies.

Study selection criteria:

Two reviewers (B.M. and N.M.) independently screened titles and abstracts for potentially eligible studies, then examined the full texts of potentially relevant papers for inclusion. Disagreements were resolved through discussion or by a third reviewer if required (W.H.). The search strategy is outlined in APPENDIX A.

Data extraction:

Data regarding trial characteristics and estimates of effect were extracted by 2 reviewers (B.M. and N.M) using a pilot-tested data-extraction form, and any disagreements were resolved by discussion or arbitration by a third reviewer (W.H.) if required.

Methodological quality assessment of the studies:

The methodological quality of the included studies was assessed using the 11-point PEDro scale, in which higher scores represent lower risk of bias. The PEDro scale has acceptable reliability [7] and validity, [8,9] and there is evidence that the scale is reliable across disciplines and correlates with other risk of bias tools [10]. If the included study was indexed in PEDro (www.pedro.org.au), the PEDro score was downloaded directly from the database. If the included study was not indexed in PEDro, 2 independent and trained reviewers performed the assessment, with disagreements resolved by discussion or arbitration by a third reviewer.

Results

One thous and and forty-six studies were identified from the search of PubMed, Cochrane, PEDro, Google Scholar, Scopus data bases and additional 2 studies from the other sources (screening the reference lists of all relevant articles). After excluding all duplicate studies, a total of 878 studies have been screened then, 819 studies have been excluded and the full-text articles of 59 studies which appear to meet the eligibility criteria have been assessed. Results of the search are displayed in (Fig. 1) according to PRISMA flow chart.

Characteristics of the included studies:

All included studies are twelve RCTs; Summary of the included studies is presented in Table (1). The clinical heterogeneity between the included trials were high and allowed the quantitative analysis of data provided by these studies.

Sample size:

The 12 studies [11-22] included a total of 573 participants. Individual sample sizes of identified trials ranged from 20 [11] to 106 [12]. A detailed description of individual sample sizes can be found in the Characteristics of included studies section (Table 1).

The mean age of the participants in the included studies is 53.4 years, and it ranged from 43.70 [11] to 67.33 [19]. There were more female (52.6%) than male (47.4%) participants.

Interventions:

Characteristics of all interventions are summarized in (Table 2). All included studies provided Extracorporeal Shockwave Therapy for patients with Adhesive Capsulitis.

Risk of bias in the included studies:

All details about the methodological quality of the included studies using the PEDro Scale are provided in (Table 3).

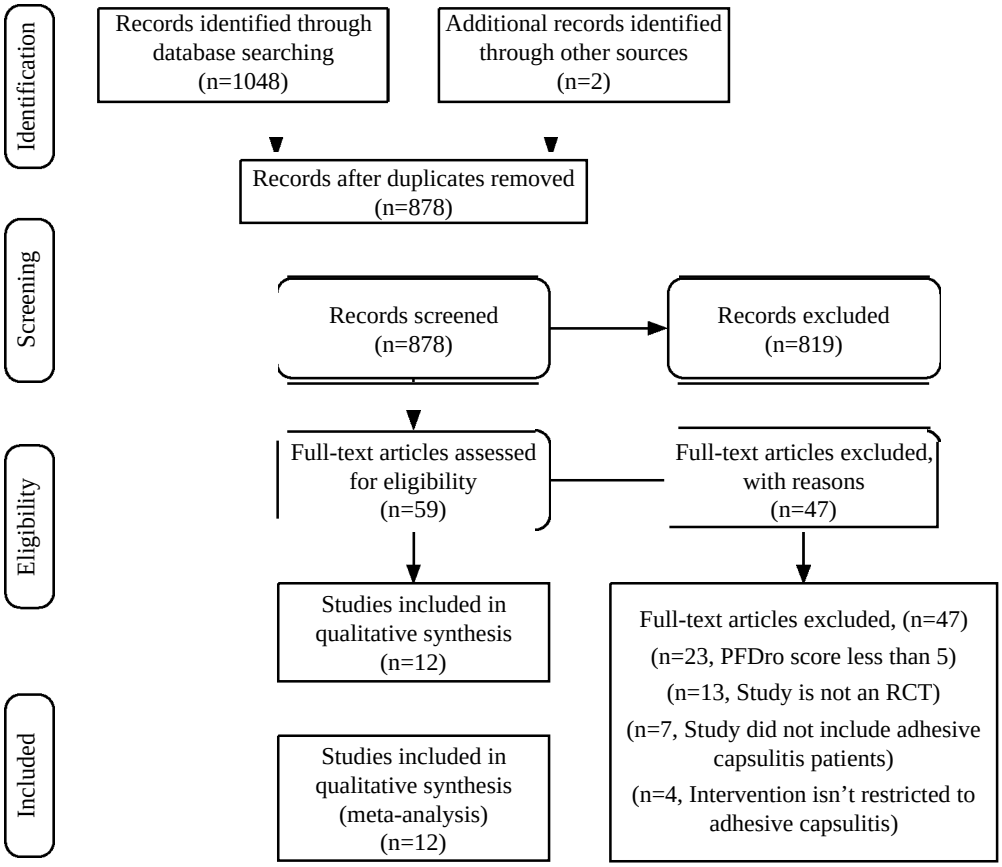

Fig. (1): PRISMA flowchart.

Table (1): Participants of the included studies.

Study	Experimental group					Control group				
	n	Male (n)	Female (n)	Age (Years) (mean±SD)	Onset of AC (months)	n	Male (n)	Female (n)	Age (Years) (mean±SD)	Onset of AC (months)
Alarab et al., (2018)	10	3	7	45.33±8.64	2-9	10	3	7	46.26±8.05	2-9
Ebadh et al., (2017)	30	30	0	67.33±1.78	>9	30	30	0	67.40±1.56	>9
El naggar et al., (2020)	52	15	37	55.9±6.7	7	51	9	42	57.9±9	7
Elerian et al., (2021)	24	9	15	52.13±3.06	-	24	10	14	51.33±4.01	-
Farahat et al., (2021)	25	8	17	46.68±7.85	10.2	25	9	16	47.80±8.48	11.4
Hussein et al., (2015)	53	32	21	55.83±1.34	11.60	53	34	19	55.81±1.29	11.55
Kim et al., (2015)	17	7	10	65.88±8.27	26.11	17	10	7	66.11±15.79	19.47
Muthukrishnan et al., (2019)	10	4	6	43.70±10.4	7.38	10	3	7	45.5±14.3	7.97
Seyam et al., (2018)	15	9	6	45.34±8.7	=<6	15	10	5	46.26±8.1	=<6
Shaimaa N et al., (2013)	20	8	12	45.33±8.64	2-9	20	11	9	46.26±8.05	2-9
Suwalak et al., (2021)	14	4	10	59.9±8.9	6.4	12	3	9	55.9±7.3	6.2
Vahdatpour et al., (2014)	19	6	13	56.1±10.6	2-9	17	5	12	60.3±4.8	2-9

Table (2): Characteristics of interventions of the included studies.

Study	Experimental Intervention	Frequency	Control Intervention	Frequency
Alarab et al., (2018)	ESWT (2000 Impulses per session) + Exercises	3 S/W for 4 weeks	US + Exercises	3 S/W for 4 weeks
Ebadh et al., (2017)	ESWT (2000 Impulses per session) + Exercises	2 S/W for 4 weeks	Pulsed Electromagnetic Therapy + Exercises.	2 S/W for 4 weeks
El naggar et al., (2020)	ESWT (2000 Impulses per session) + Home Exercises	1 S/W for 4 weeks	US-guided low dose intra-articular corticosteroid Injection on the short-term outcome (12 weeks) + Home Exercises	Once
Elerian et al., (2021)	ESWT (2000 Impulses per session) + Traditional physical therapy	1 S/W for 4 weeks	Corticosteroid injection + Traditional physical therapy	3 S/W for 4 weeks
Farahat et al., (2021)	ESWT (2000 Impulses) + Conventional Therapy	3 S/W for 4 weeks	Conventional Therapy	3 S/W for 4 weeks
Hussein et al., (2015)	ESWT (2000 Impulses per session) + Home Exercises	1 S/W for 4 weeks	Placebo treatment + Home Exercise	3 S/W for 4 weeks
Kim et al., (2015)	ESWT (3000 Impulses per session)	4 S/W for 2 weeks	Placebo treatment	4 S/W for 2 weeks
Muthu krishnan et al., (2019)	ESWT (2000 Impulses per session) +mobilization + therapeutic exercises	1 S/W for 4 weeks	US + Mobilization + Therapeutic Exercises	3 S/W for 4 weeks
Seyam et al., (2018)	ESWT (1200 Impulses per session) + Therapeutic Exercises	2 S/W for 5 weeks	3MH US + IR + Therapeutic Exercise	2 S/W for 5 weeks
Shaimaa N et al., (2013)	ESWT (2000 Impulses per session) + Exercises	1 S/W for 4 weeks	Phonophresis + Exercises	3 S/W for 4 weeks
Suwalak et al., (2021)	ESWT (1500 Impulses per session)	1 S/W for 6 weeks	Sham ESWT 1200 Impulses per session +Standard exercises	1 S/W for 4 weeks
Vahdatpour et al., (2014)	ESWT (1200 Impulses per session) +Standard exercises	1 S/W for 4 weeks	Sham ESWT 1200 Impulses per session +Standard Exercises	1 S/W for 4 weeks

ESWT: Extracorporeal Shockwave Therapy. S: Session. W: Week. US: Ultrasound. IF: Interferential. SSNB: Suprascapular Nerve Block.

Table (3): PED roscores for Included Studies.

Article	1	2	3	4	5	6	7	8	9	10	11	Total	Classification
Al Arab et al., (2018)	Yes	1	0	1	0	0	0	1	0	1	1	5	Average
Ebadh et al., (2017)	Yes	1	0	1	0	0	0	1	0	1	1	5	Average
El naggar et al., (2020)	Yes	1	1	1	0	0	1	1	0	1	1	7	Good
Elerian et al., (2021)	Yes	1	1	1	0	1	1	1	0	1	1	8	Good
Farahat et al., (2021)	Yes	1	1	0	0	0	1	1	1	1	1	7	Good
Hussein et al., (2015)	Yes	1	1	1	1	0	1	1	1	1	1	9	Excellent
Kim et al., (2015)	Yes	1	1	1	1	0	1	1	0	1	1	8	Good
Muthukrishnanet al., (2019)	Yes	1	0	0	0	0	0	1	1	1	1	5	Average
Seyamet al., (2018)	Yes	1	1	1	0	0	0	1	0	1	1	6	Good
Shaimaa N et al., (2013)	Yes	1	1	1	0	0	0	1	0	1	1	6	Good
Suwalka et al., (2021)	Yes	1	1	0	0	0	1	1	1	1	1	7	Good
Vahdatpouret al., (2014)	Yes	1	0	1	0	0	0	1	0	1	1	5	Average

9-10 points excellent 6-8 points good. 4-5 points average. 0-3 points poor.

Data analysis:

Meta-analysis was carried out on the results from 12 studies using the post intervention scores for experimental and control groups. For studies comparing ESWT with at least one control group, control groups were combined into a single group. Analyzed studies displayed high levels of heterogeneity; hence, the results are presented based on the random effects model.

Meta-analyses were performed for the sub-category of Adhesive Capsulitis (12 studies available) to assess the short-term and long-term effects of ESWT on pain level, flexion, abduction, internal and external ROM, as well as function and disability for all variables, meta-analyses were performedto evaluate the effect of ESWT, either in addition to exercise therapy and/or electrotherapy or ESWT alone (experimental group) when compared to either exercise therapy and electrotherapy alone or other type of standard care (control group). The random effects model was chosen as a conservative measure toaccount for heterogeneity among included studies.

Measures of treatment effect:

The outcome variables of interest were continuous outcomes. Data of change scores between pre- and post-intervention measures were evaluated and entered as means and standard deviations (SDs) and the standardized mean difference (SMD) with 95% confidence intervals (CIs) for each trial was calculated. Data were pooled through calculation of the overall SMD and 95% CI.

Findings:

VAS Outcome at short-term effect:

Data for meta-analysis could be extracted from the included studies for change in VAS variable at short-term effect. As reflected from Fig. (2). There were total number of subjects included into analysis was 186 in experimental groups and 183 in control groups.The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=-1.37, 95% CI of the mean difference =–2.26, –0.47). There was a significant effect of ESWT on VAS in Adhesive Capsulitis patients at short-term effect.

VAS Outcome at long-term effect:

Data for meta-analysis could be extracted from the included studies for change in VAS variable at long-term effect. As reflected from Fig. (3). There were total number of subjects included into analysis was 119 in experimental groups and 116 in control groups. The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=-1.78, 95% CI of the mean difference =–4.69, 1.13). There was a non-significant effect of ESWT on VAS in Adhesive Capsulitis patients at long-term effect.

Shoulder Flexion ROM outcome at short-term effect:

Data for meta-analysis could be extracted from the included studies for change in ROM of flexion variable at short-term effect. As reflected from Fig. (4). There were total number of subjects included into analysis was 191 in experimental groups and 186 in control groups. The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=15.59, 95% CI of the mean difference=5.70, 25.48). There was a significant effect of ESWT on ROM of flexion in Adhesive Capsulitis patients at short-term effect.

Shoulder flexion ROM outcomeat long-term effect:

Data for meta-analysis could be extracted from the included studies for change in ROM of flexion variable at long-term effect. As reflected from Fig. (5). There were total number of subjects included into analysis was 85 in experimental groups and 80 in control groups.The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=11.20, 95% CI of the mean difference =–7.44, 29.85). There was a non-significant effect of ESWT on ROM of flexion in Adhesive Capsulitis patients at long-term effect.

Shoulder abduction ROM outcomeat short-term effect:

Data for meta-analysis could be extracted from the included studies for change in ROM of abduction variable at short-term effect. As reflected from Fig. (6). There were total number of subjects included into analysis was 274 in experimental groups and 269 in control groups.The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=15.83, 95% CI of the mean difference=5.18, 26.48). There was a significant effect of ESWT on ROM of abduction in Adhesive Capsulitis patients at short-term effect.

Shoulder abduction ROM outcomeat long-term effect:

Data for meta-analysis could be extracted from the included studies for change in ROM of abduction variable at long-term effect. As reflected from Fig. (7). There were total number of subjects included into analysis was 138 in experimental groups and 133 in control groups.The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=29.80, 95% CI of the mean difference=–19.23, 78.83). There was a non-significant effect of ESWT on ROM of abduction in Adhesive Capsulitis patients at long-term effect.

Shoulder internal rotation ROM outcomeat short-term effect

Data for meta-analysis could be extracted from the included studies for change in ROM of internal rotation variable at short-term effect. As reflected from Fig. (8). There were total number of subjects

included into analysis was 120 in experimental groups and 116 in control groups. The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=1.63, 95% CI of the mean difference=0.96, 2.29). There was a significant effect of ESWT on ROM of internal rotation in Adhesive Capsulitis patients at short-term effect.

Shoulder internal rotation ROM outcome at long-term effect:

Data for meta-analysis could be extracted from the included studies for change in ROM of internal rotation variable at long-term effect. As reflected from Fig. (9). There were total number of subjects included into analysis was 33 in experimental groups and 29 in control groups.The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=3.90, 95% CI of the mean difference=–13.54, 21.34). There was a non-significant effect of ESWT on ROM of internal rotation in Adhesive Capsulitis patients at long-term effect.

Shoulder external rotation ROM outcomeat short-term effect:

Data for meta-analysis could be extracted from the included studies for change in ROM of external rotation variable at short-term effect. As reflected from Fig. (10). There were total number of subjects included into analysis was 157 in experimental groups and 152 in control groups. Theforest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=2.06, 95% CI of the mean difference=–0.93, 5.06). There was a non-significant effect of ESWT on ROM of external rotation in Adhesive Capsulitis patients at short-term effect.

Shoulder external rotation ROM outcomeat long-term effect:

Data for meta-analysis could be extracted from the included studies for change in ROM of external rotation variable at long-term effect. As reflected from Fig. (11). There were total number of subjects included into analysis was 85 in experimental groups and 80 in control groups. Theforest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=–3.43, 95% CI of the mean difference=–6.48, –0.38). There was a non-significant effect of ESWT on ROM of external rotation in Adhesive Capsulitis patients at long-term effect.

SPADI Pain outcome at short-term effect:

Data for meta-analysis could be extracted from the included studies for change in SPADI pain variable at short-term effect. As reflected from Fig. (12) There were total number of subjects included into analysis was 63 in experimental groups and 59 in control groups. The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=–8.82, 95% CI of the mean difference =–17.08, -0.55). There was a significant effect of ESWT on SPADI pain in Adhesive Capsulitis patients at short-term effect.

SPADI Pain outcome at long-term effect:

Data for meta-analysis could be extracted from the included studies for change in SPADI pain variable at long-term effect. As reflected from Fig. (13) There were total number of subjects included into analysis was 33 in experimental groups and 29 in control groupsThe forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=–11.25, 95% CI of the mean difference =–34.72, 12.22). There was a non-significant effect of ESWT on SPADI pain in Adhesive Capsulitis patients at long-term effect.

SPADI Disability outcome at short-term effect:

Data for meta-analysis could be extracted from the included studies for change in SPADI disability variable at short-term effect. As reflected from Fig. (14). There were total number of subjects included into analysis was 63 in experimental groups and 59 in control groups. The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=–4.58, 95% CI of the mean difference =–12.03, 2.87). There was a non-significant effect of ESWT on SPADI disability in Adhesive Capsulitis patients at short-term effect.

SPADI Disability outcome at long-term effect:

Data for meta-analysis could be extracted from the included studies for change in SPADI disability variable at long-term effect. As reflected from Fig. (15). There were total number of subjects included into analysis was 33 in experimental groups and 29 in control groups. The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=–9.65, 95% CI of the mean difference =–32.57, 13.28). There was a non-significant effect of ESWT on SPADI disability in Adhesive Capsulitis patients at long-term effect.

SPADI Total outcome at short-term effect:

Data for meta-analysis could be extracted from the included studies for change in SPADI total variable at short-term effect. As reflected from Fig. (16). There were total number of subjects included into analysis was 122 in experimental groups and 118 in control groups. The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=–4.27, 95% CI of the mean difference=–6.06, –2.48). There was a significant effect of ESWT on SPADI total in Adhesive Capsulitis patients at short-term effect.

SPADI Total outcome at long-term effect:

Data for meta-analysis could be extracted from the included studies for change in SPADI total variable at long-term effect. As reflected from Fig. (17).

There were total number of subjects included into analysis was 14 in experimental groups and 12 in control groups. The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=2.25, 95% CI of the mean difference =–0.75, 5.25). There was a non-significant effect of ESWT on SPADI total in Adhesive Capsulitis patients at long-term effect.

CSS Outcome at short-term effect:

Data for meta-analysis could be extracted from the included studies for change in CSS variable at short-term effect. As reflected from Fig. (18). There were total number of subjects included into analysis was 42 in experimental groups and 42 in control groups. The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=0.52, 95% CI of the mean difference =–3.14, 4.18). There was a non-significant effect of ESWT on CSS in Adhesive Capsulitis patients at short-term effect.

CSS Outcome at long-term effect:

Data for meta-analysis could be extracted from the included studies for change in CSS variable at long-term effect. As reflected from Fig. (19). There were total number of subjects included into analysis was 25 in experimental groups and 25 in control groups. The forest plot of the mean difference across all studies at 95% CI of the mean difference (SMD=13.53, 95% CI of the mean difference=11.43, 15.63). There was a significant effect of ESWT on CSS in Adhesive Capsulitis patients at long-term effect.

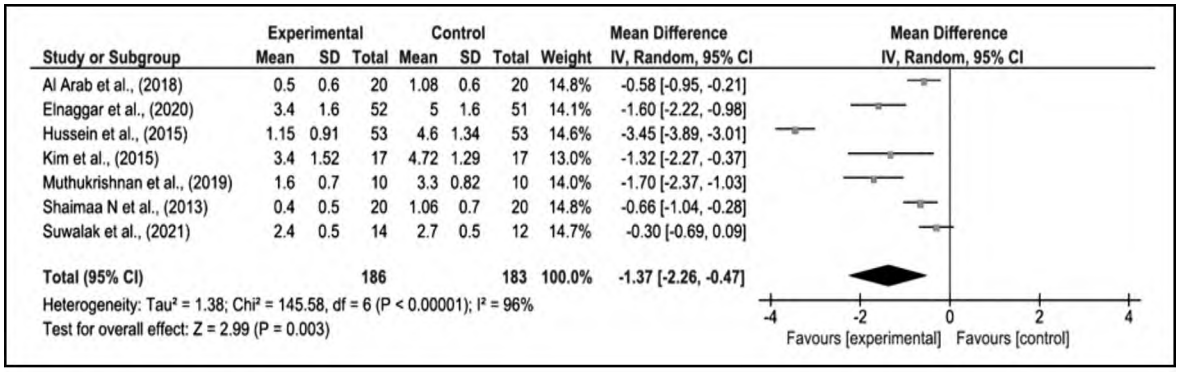

Fig. (2): Forest plot: Comparison between experimental group and control group regarding VAS at short-term effect.

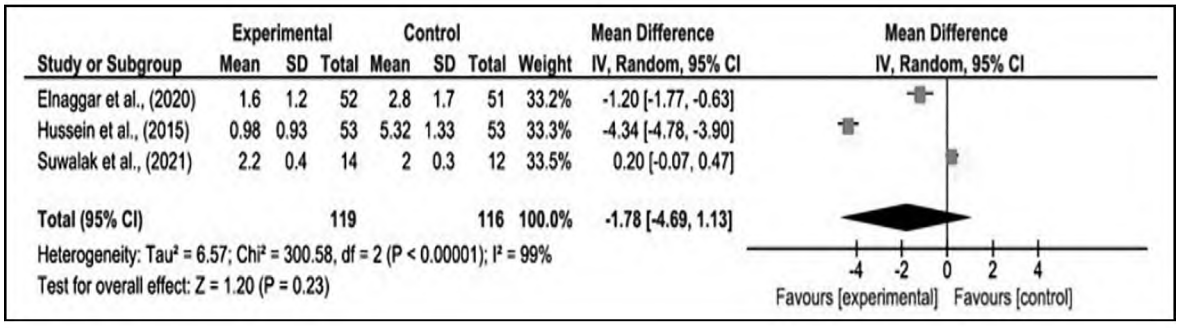

Fig. (3): Forest plot: Comparison between experimental group and control group regarding VAS at long-term effect.

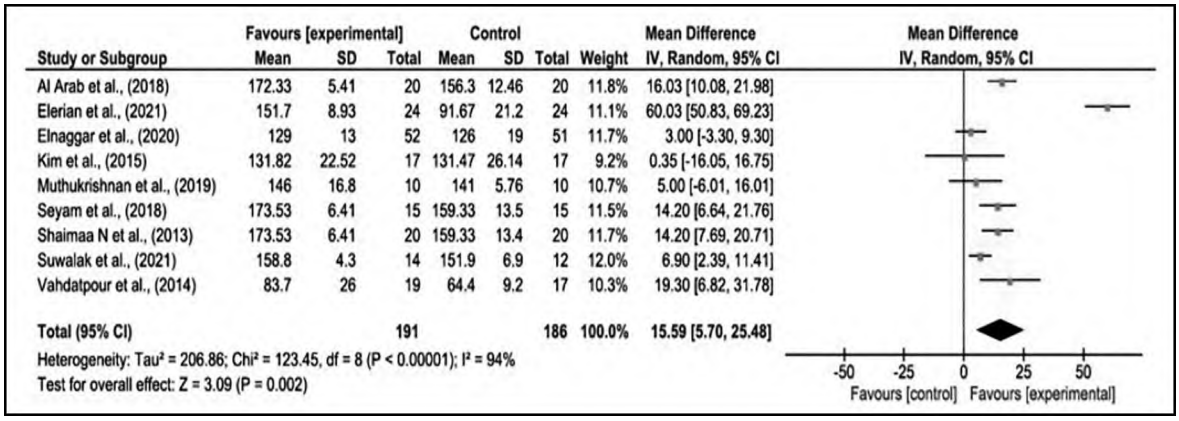

Fig. (4): Forest plot: Comparison between experimental group and control group regarding ROM of flexion at short-term effect.

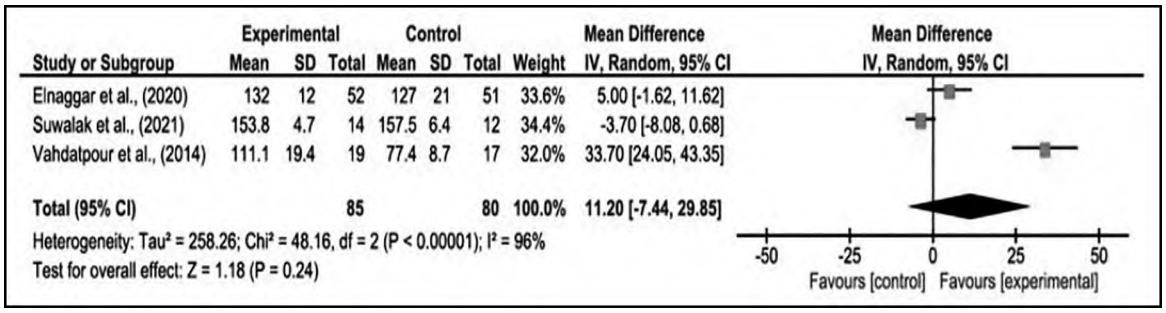

Fig. (5): Forest plot: Comparison between experimental group and control group regarding ROM of flexion at long-term effect.

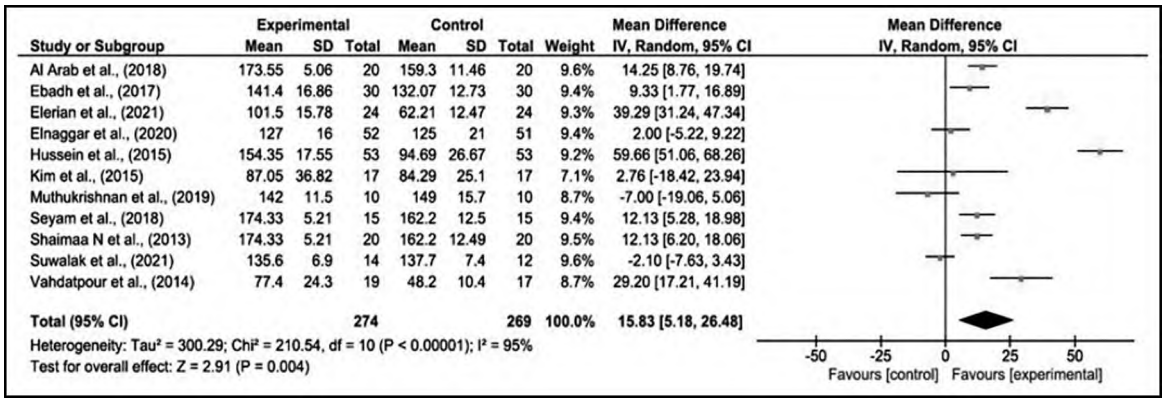

Fig. (6): Forest plot: Comparison between experimental group and control group regarding ROM of abduction at short-term effect.

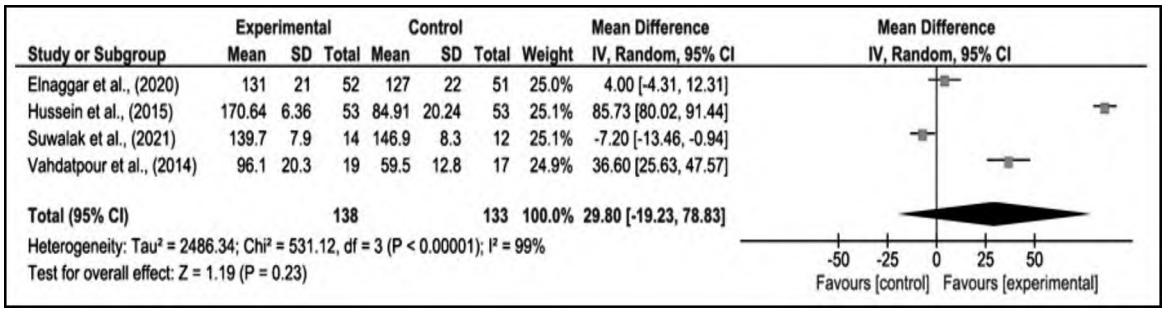

Fig. (7): Forest plot: Comparison between experimental group and control group regarding ROM of abduction at long-term effect.

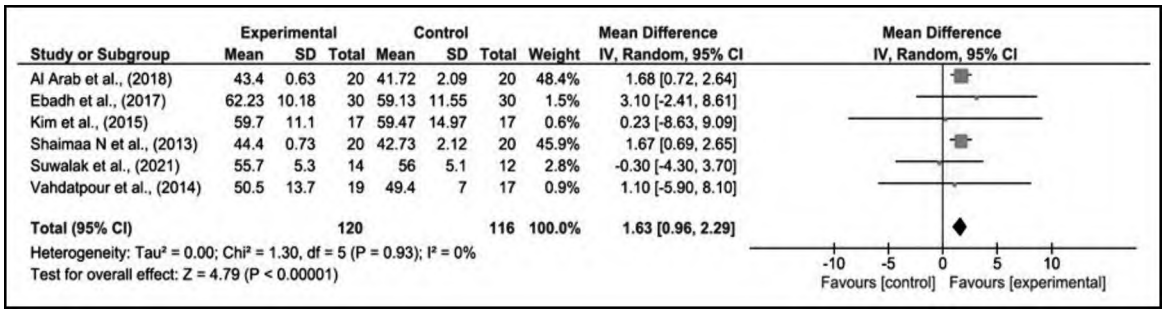

Fig. (8): Forest plot: Comparison between experimental group and control group regarding ROM of internal rotation at short-term effect.

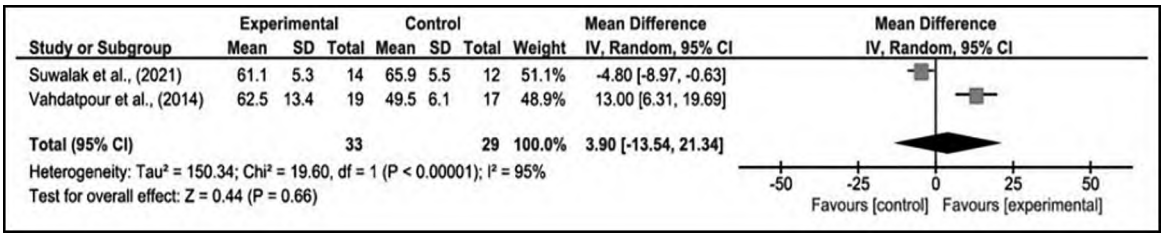

Fig. (9): Forest plot: Comparison between experimental group and control group regarding ROM of internal rotation at long-term effect.

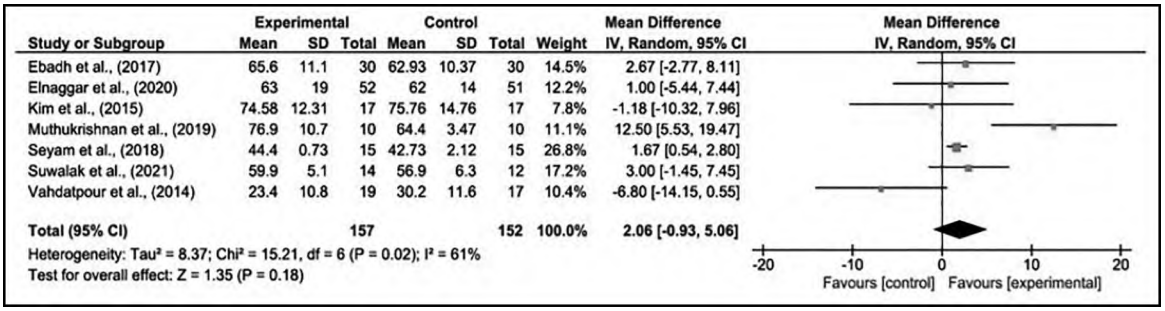

Fig. (10): Forest plot: Comparison between experimental group and control group regarding ROM of external rotation at short-term effect.

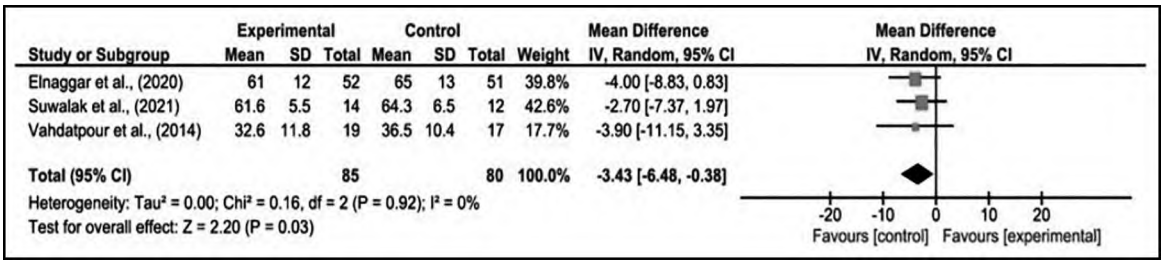

Fig. (11): Forest plot: Comparison between experimental group and control group regarding ROM of external rotation at long-term effect.

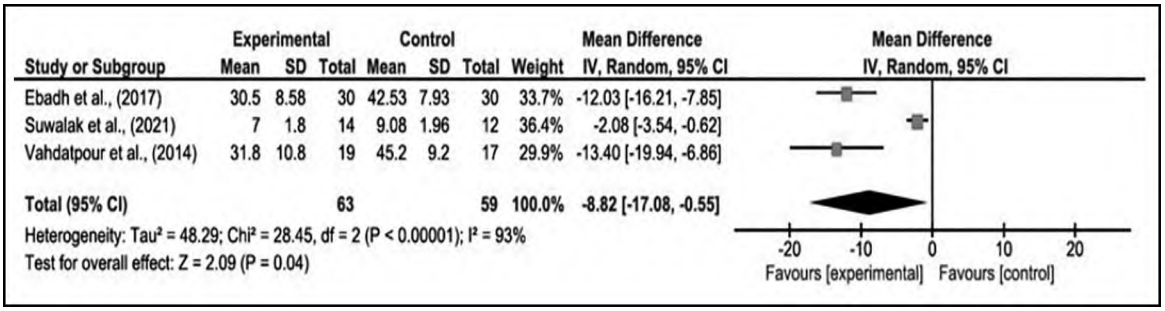

Fig. (12): Forest plot: Comparison between experimental group and control group regarding SPADI Pain at short-term effect.

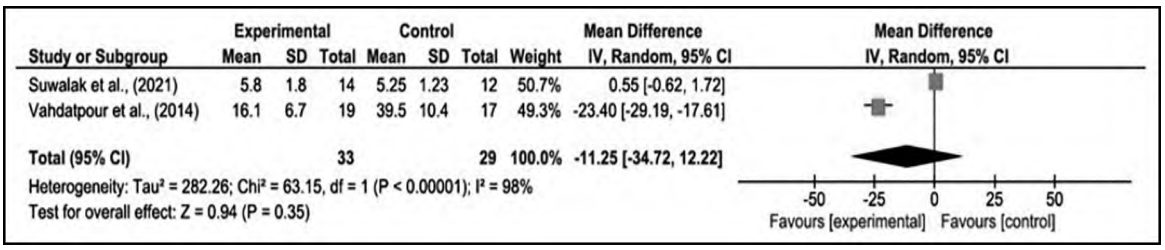

Fig. (13): Forest plot: Comparison between experimental group and control group regarding SPADI Pain at long-term effect.

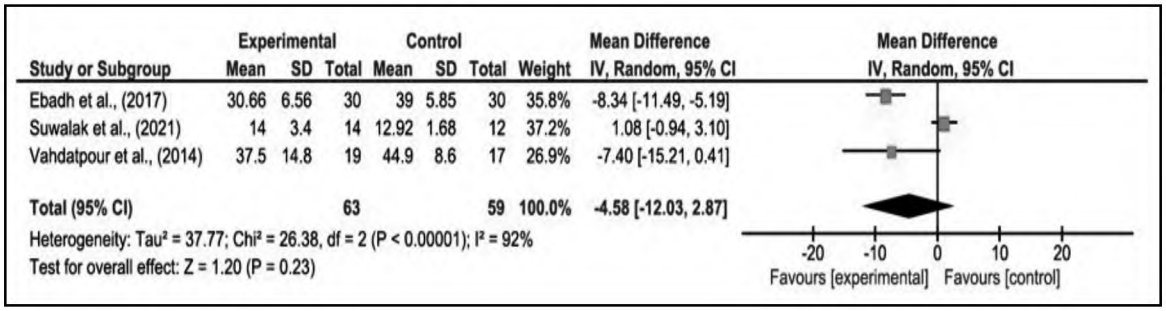

Fig. (14): Forest plot: Comparison between experimental group and control group regarding SPADI Disability at short-term effect.

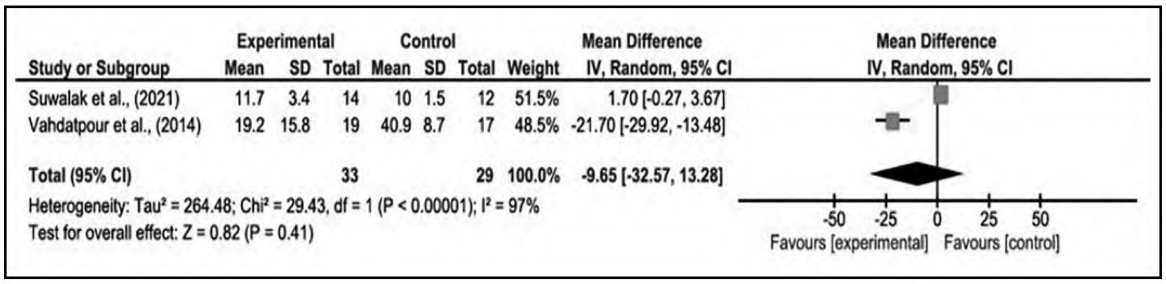

Fig. (15): Forest plot: Comparison between experimental group and control group regarding SPADI Disability at long-term effect.

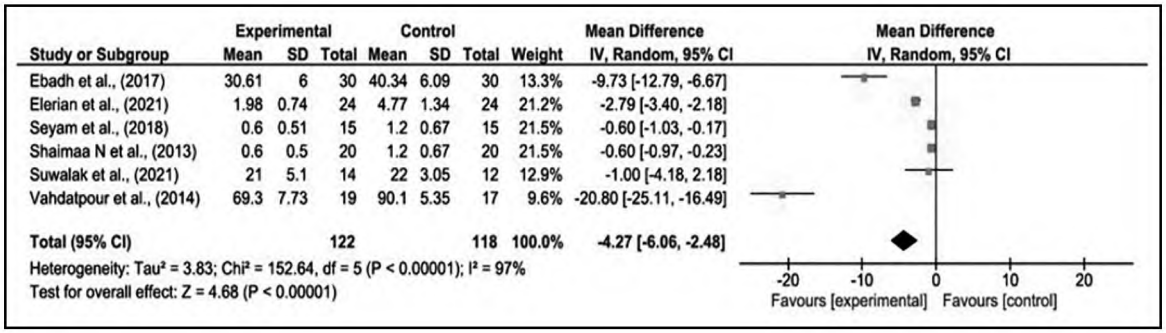

Fig. (16): Forest plot: Comparison between experimental group and control group regarding SPADI Total at short-term effect.

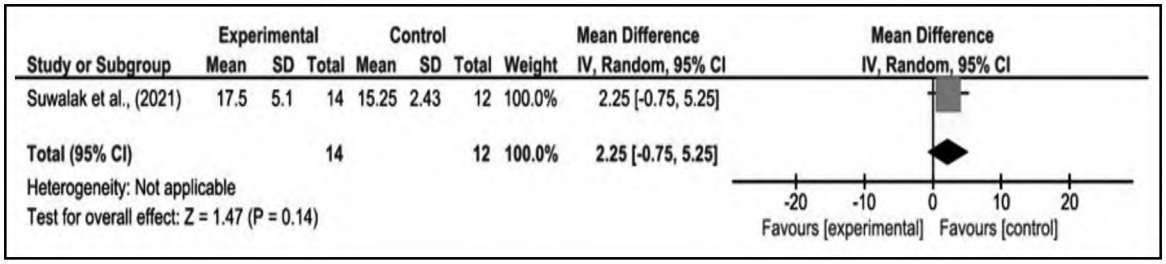

Fig. (17): Forest plot: Comparison between experimental group and control group regarding SPADI Total at long-term effect.

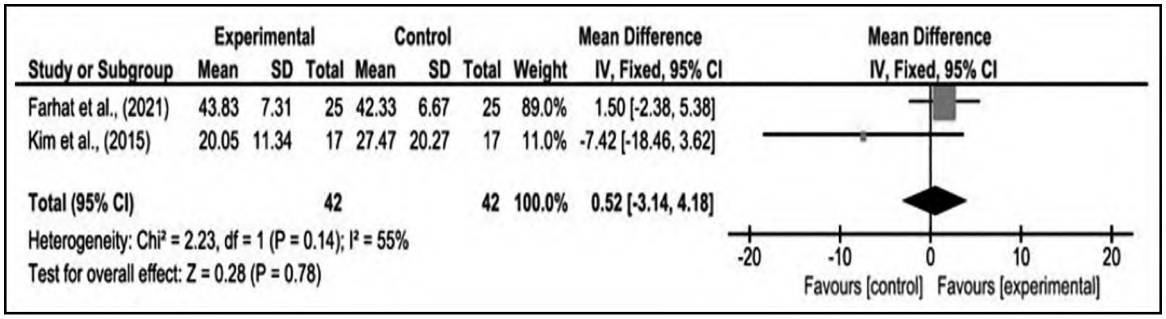

Fig. (18): Forest plot: Comparison between experimental group and control group regarding CSS at short-term effect.

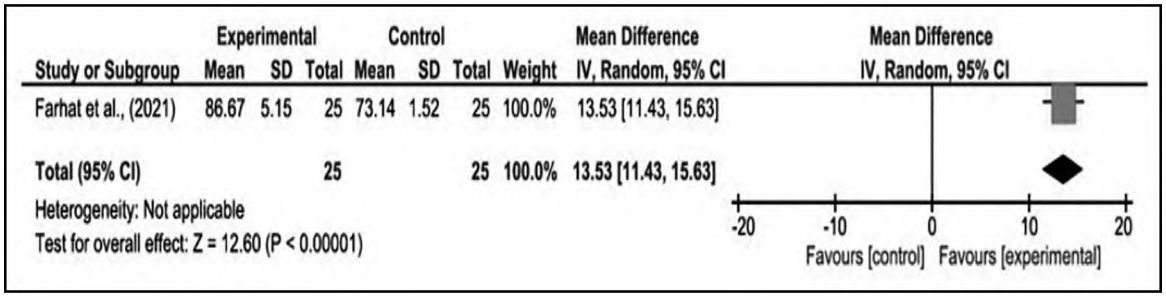

Fig. (19): Forest plot: Comparison between experimental group and control group regarding CSS at long-term effect.

Discussion

The mainpurpose of this review was to evaluate the effect of using the Extracorporeal Shockwave Therapy on pain intensity level, ROM, and overall function in patients with Adhesive Capsulitis. Twelve RCTs were included, with a total of 573 participants. All studies used ESWT as experimental and prime treatment for Adhesive Capsulitis. The results of meta-analysis showed that ESWT has a significant effect at short-term effect on Pain intensity level, ROM of flexion, abduction, and internal rotation, SPADI pain, SPADI Total. At long-term effect, ESWT has a significant effect only on CSS variable.

For pain intensity level outcomes, six out of seven studies showed that there was a statistically significant decrease in their VAS scores. Lowe et al reported that a three-month follow-up of 20 Adhesive Capsulitis patients treated with ESWT showed that 70% of the patients experienced notably reduced pain. Results illustrate moderate quality evidence at short term follow-up after using ESWT for a month, one session per week *[23]*.

The mechanism of improvement in pain intensity level may be caused by the fine and repetitive stimulations of ESWT, a type of sound wave that can be transmitted through soft tissues without the loss of energy, generated the effect of suppressing the nociceptors so, nerve endings are overwhelmed with so many stimuli that their activity diminishes resulting in short-term reduction in pain *[24]*.

This study agrees with Sung et al., as they stated that VAS scores improved post-intervention and at the second and fourth weeks of follow-up in the intervention group *[17]*. Dedes et al., concluded that ESWT significantly reduces pain in 384 patients, suffering from different tendinopathies like elbow tendinopathy, Achilles tendinopathy, plantar fasciitis, and rotator cuff tendinopathy *[25]*.

The ESWT groups in shoulder ROM exhibited statically significant improvement, The mechanism of improvement in Shoulder ROM after ESWTcould have happened because the treatment decreased pain by altering cell metabolism and the permeability of endothelial tissues *[26]*.

For overall functions, Shoulder Pain and Disability Index (SPADI) was used, Despite the small number of clinical trials that used this measure, it is noticeable that the patient's shoulder condition improved after treatment with ESWT. The results of the study showed the significant effect of ESWT only on patient's Shoulder SPADI Pain and a non-significant effect of ESWT on SPADI Disability scores.

Only three studies were included to measure both variables (SPADI Pain & Disability). The results were regarded with caution, small meta-analysis may only be useful for summarizing the available evidence and literature to encourage future research. Babak et al., who supported found that after four weeks of twice-weekly ESWT, there was

a significant increase in SPADI and shoulder motion. ESWT helps to speed up the healing process of Adhesive Capsulitis **[27].** Also, these results were clarified by the work of Vahdatpour et al., who concluded that the use of ESWT seems to have positive effects on treatment, quicker return to daily activities, and quality of life improvement on frozen shoulder **[13].**

Through an extensive search process, it is unlikely that any relevant trials have been missed. However, there is a possibility of additional (published or unpublished) studies that haven't been identified. The selection process was limited to English language, independent data extraction, and assessment of the risk of biasperformed by the review authors did minimize errors and bias in data extraction. There was heterogeneity between some studies in trial design (duration of follow-up and selection criteria for patients), characteristics of patients (i.e., severity and onset of Adhesive Capsulitis) and characteristics of interventions (i.e., number of sessions and pulses).

The results of this review indicate that there is moderate evidence for the effectiveness of ESWT on Adhesive Capsulitis patients. The current study shows that ESWT is superior conventional therapy and steroids in reducing pain intensity level, improving shoulder ROM, and overall functions; However, due to limited number of the included studies, these findings must be validated by more RCTs.

Recommendations:

The existing studies suggest an effect of ESWT, but they suffer from methodological problems such as small sample sizes, lack ofproper reporting and lack of follow-up data provided. There is thus an urgent need forwell-designed and properly reported multicenter RCTs with large sample sizes toprovide a high level of evidence.

Further research should also address specific questions about the optimal dose, frequency, and duration of the interventions. Studies should answer questions about the effect of intervention according to patient's function and quality of life.

Finally, there were few trials that investigate ESWT in patients with Adhesive Capsulitis and almost all of them with poor methodological quality. So better designed and adequately powered randomized controlled trials are still needed.

Conclusion:

The data from this systematic review and meta-analysis suggest that ESWT is superior to conventional therapy and steroids in reducing pain intensity level, improving shoulder ROM, overall functions at short-term effect. However, due to limited number of the included studies, these findings must be validated by more RCTs. The limitations in the studies performed to date suggest that future research should determine the optimal intensity and dosage of ESWT and perform longer follow-up to monitor long-term effects.

Conflict of interest:

This article has no potential for a conflict of interest.

Disclosure statement:

No author has a financial stake in or has benefited financially from this study.

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Appendixa: Search Strategy

#1- Bursitides.
#2- Frozen Shoulder.
#3- Frozen Shoulders.
#4- Shoulder, Frozen.
#5- Adhesive Capsulitis of the Shoulder.
#6- Shoulder Adhesive Capsulitis.
#7- Adhesive Capsulitis, Shoulder.
#8- Capsulitis, Shoulder Adhesive.
#9- Capsulitis.
#10- Adhesive Capsulitis.
#11- Capsulitis Adhesive.
#12- Shoulder Stiffness.
#13- Stiffness of the Shoulder.
#14- #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13.
#15- Shockwave.
#16- Shock Wave.
#17- Shock-wave.
#18- Extracorporeal Shockwave.
#19- ESWT.
#20- Extra Corporeal Shockwave.
#21- Shock.
#22- #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21.
#23- #14 AND #22.

تأثير العلاج بالموجات التصادمية من خارج الجسم فى مرضى التهاب محفظة الكتف: مراجعة منهجية وتحليلية

خلفية البحث: إلتهاب محفظة الكتف هى إصابة يصاحبها آلام وتيبس فى الحركة. العلاج بالموجات التصادمية من خارج الجسم أصبح معتاد إستخدامه لعلاج العديد من الإصابات العظمية.

الهدف: هذة الدراسة التحليلية استهدفت تقييم تأثير العلاج بالموجات التصادمية من خارج الجسم على شدة آلام الكتف، ونطاق الحركة، والمستوى الوظيفى ومستوى الإعاقة فى التهاب محفظة الكتف.

طرق البحث: تم البحث فى قواعد البيانات الأتية PubMed, Cochrane Library, and PEDro, Scopus, Google Scholar, Web of Science إالى جانب فحص جميع الدراسات وتضمن الفحص الدراسات التى قامت بتقييم تأثيرالعلاج بالموجات التصادمية مع أى نوع من أنواع العلاجات الطبيعية أو العلاجات الوظيفية التقليدية فى المرضى المصابين بألتهاب محفظة الكتف. ثم تم اختيارالدراسات التى تتوافق مع معاييرالاشتمال وتم تقييم جودة طرق البحث لكل دراسة. بعد ذلك تم استخلاص البيانات الخاصة بالدراسات المختارة. أخيرًا، تم تحليل النتائج عن طريق تجميع بيانات درجات التغيير بين ما قبل وبعد العلاج من خلال حساب الفروق المتوسطة الموحدة الإجمالية بنسبة ٩٥ فى المائة فى فترة الثقة.

النتائج: تم اختيار اثنا عشر دراسة فى هذا الفحص شارك بهم ٥٧٣ مريض بألتهاب محفظة الكتف. كان متوسط إجمالى درجات مقياس PEDro سبع نقاط. ارتبط استخدام الموجات التصادمية من خارج الجسم على مرضى ألتهاب محفظة الكتف بتغيرات مواتية قصيرة المدى فى مستوى شدة الألم المبلغ عنها ذاتيًا ، المجال الحركى والوظائف العامة لدى الأفراد المصابين بألتهاب محفظة الكتف ، عند مقارنتها بالعلاج السليم أو التدخل الوهمى.

الإستنتاج: تشير البيانات من هذه المراجعة إلى تفوق العلاج بالموجات التصادمية من خارج الجسم على كلا من العلاج التقليدى والكورتيزون فى تحسين مستوى شدة الألم، النطاق الحركى، والوظائف العامة. يجب التحقق من صحة هذه النتائج من خلال المزيد من التجارب العلمية: تشير القيود فى الدراسات التى أجريت حتى الآن إلى أن الأبحاث المستقبلية يجب أن تحدد الكثافة والجرعة المثلى للعلاج وإجراء متابعة أطول لمراقبة الآثار طويلة المدى.