

Effect of Shock Wave Therapy on Knee Osteoarthritis: A Systematic Review and Meta-analysis

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Abstract:Objective: To examine the efficiency of shock wave therapy on pain and function in patients with primary knee osteoarthritis. **Study design:** Systematic review with Meta-analysis. **Data sources:** An electronic search was done on PubMed and PEDro databases, and Cochrane Central Register of Controlled Trials (CENTRAL) on Cochrane from their inception till June 11,2020. **Methods:**A systematic review and meta-analysis was undertaken following the criteria proposed by Cochrane Handbook for Systematic Reviews of Interventions. Trials that meet the inclusion criteria: (1) randomized controlled studies; (2) a people with the diagnosis of Primary knee osteoarthritis; and (3) interventions that involved extracorporeal shockwave therapy were considered for review. When trials reported homogeneity on results measures, the mean differences or standardized mean differences with 95% confidence period were calculated and pooled in a meta-analysis for pooled synthesis.**Results:** Seven essays with a total of 520 contributors were involved in the review and only five trials were involved in the meta-analysis. Pain reduction was significant on visual analogue scale in all phases (immediate, short, medium and long terms) in Shock wave therapy groups versus the placebo/sham groups. However, Shockwave therapy impact on function in the pooled synthesis varied in different phases and on different scales, for WOMAC it showed significant improvement in the treated group at all phases except the medium term, for Lequesne index ESWT had no statistically significant effect at all phases except long term, for KOOS it showed significant improvement in immediate phase, and finally for 20 m walk test only one study used it and showed significant improvement

in all phases.**Conclusion:** The meta-analysis suggests that ESWT has a statistically significant effect on pain reduction in all four phases(immediate, short, medium and long term) using VAS scale as well as significant improvement in function in all phases on WOMAC except medium term, and on KOOS in the immediate phase, and on 20 m walk test in all phases, however there was no statistically significant effect in the pooled synthesis regarding Lequesne index in immediate, short and medium phases

Keywords: Osteoarthritis, Extracorporeal shock wave therapy, Knee pain, Knee function, Physical Therapy

INTRODUCTION

Osteoarthritis (OA) is a primary factor for pain, disability, as well as socioeconomic cost globally. It has a complicated and multifactorial epidemiological nature which involves genetics, biology and biomechanical aspects. **(Glyn-Jones et al., 2015)**

Articular cartilage loss followed by formation of new bone which most of the time accompanied by synovial proliferation are main characteristics of OA. **(Abramson & Attur, 2009)**. Men and women above 60 years of age are both affected by OA primarily in knees and hips as high as 9.6% in men and 18% in women which leads to pain and functional disabilities. **(Anthony D. Woolf and Bruce Pflieger, 2003)**

Extracorporeal shock wave therapy (ESWT) is a field which is noticeably developing with increased attention especially in the treatment of musculoskeletal diseases. ESWT is frequently used in the treatment of many orthopedic disorders such as plantar fasciitis, lateral epicondylitis of the elbow, calcific tendinopathies of the shoulder and non-union of long bone fractures **(Romeo et al., 2014)** In addition, ESWT was an effective, reliable, and noninvasive treatment in patients who have painful bone marrow edema (BME) in osteoarthritis of the knee, which was evident by improvement in the MRI findings so it is fast and effective modality with a lower complication rate and a shorter course for the disease **(Kang S. et al., 2018)**

Extracorporeal shock wave therapy even have impact on histological level as OA individuals suffer from subchondral bone loss in the beginning of OA and bone sclerosis later **(Hayami et al., 2006)** when ESWT was used the numbers of osteocytes considerably enhanced in ESWT-treated group in comparison with control ones **(Wang et al., 2011)**

Evidence indicates that ESWT may be an efficient and effective intervention for human patients of OA in clinical trials clearing considerable improvement of functional capacity recorded by Lequesne index and WOMAC **(Zhao et al., 2013, Chen et al., 2014)**; ESWT can be effective in the management of OA at Kellgren and Lawrence stages II and III. **(Zhao et al., 2013)**

Moreover, alleviation of pain and enhancements in knee functions have been reported in which investigated the effect of ESWT on knee OA **(Zhao et al., 2013; Kim et al., 2015; Cho et al.,**

2016) thus ESWT shall be considered as a good treatment option. However, one study by **Imamura et al.2017** indicated that there is no significant effect of ESWT on pain reduction, thus a meta-analysis was required for further accuracy of its efficacy

The treatment of ESWT in the remediation of OA is still growing in the clinical study and needs more solid evidence on it's underlying mechanism effects in different time phases and the most effective device parameters and treatment sessions ,thus this systematic review gathered all the latest RCTs published in English language which investigated the effects of ESWT in an attempt to have a conclusive report regarding its influence on OA.

The purpose of this systematic review and meta-analysis was to systematically review the efficacy of ESWT versus placebo/sham on knee OA in terms of pain reduction, function improvement.

METHODS

Literature search

The methodology in which this systematic review was adopted from the system proposed by Cochrane review for interventions.(**Shuster, 2011**). We performed a comprehensive search in Cochrane Central Register of Controlled Trials (CENTRAL) on the cochrane library ,Pubmed database , PEDro database from their inception to June 11, 2020 ,then a further hand searching of the reference list of the included articles was done.

The search of all three databases were conducted as shown in Appendices (1,2 and 3).

Study Selection

Two review authors assessed for inclusion all the potential studies we identified as a result of the search strategy.

The abstracts collected by the above mentioned search strategy, was first screened for identification of the relevant trials, then full text a was assessed.

Results for searching each data base was summed up, only RCTs fulfilling the inclusion criteria had their full texts evaluated and qualified. These procedures is according to recognize recording Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart. (**Moher et al , 2009**)

Eligibility

Inclusion criteria: Essays were involved if they met the following inclusion criteria: Randomized controlled trials study design; investigation contributors were patients with primary knee OA assessed via Kellgren Lawrence(KL) aged 45 years or elder and ESWT was compared to placebo/sham group.

Exclusion criteria: The study excluded articles from which were other languages than English, Patients with neurological disorders and any other assessment tool for knee OA other than KL

Data extraction

Data and results from the involved essays were taken employing a table including author name, year of publication, country ,total patient number, age, type of ESWT, interventions used, involved knee joints , severity of knee OA via KL scale, follow up time, outcomes, outcome measures scales.

Risk of Bias Appraisal Tool

The internal validity of every essay was reviewed and recorded for methodological quality employing the Cochrane Risk of Bias Tool.¹⁴ It consists of seven assessment fields that were estimated by two distinct reviewers for each involved essay. Discordance in evaluation was determined by discussion with a third reviewer. The Cochrane Collaboration Tool for Assessing Risk of Bias ¹⁴ does not formulate a inclusive quality score, only a ruling of “low,” “unclear,” or “high” risk.

Data Analysis

The primary analysis compared the overall effectiveness of the ESWT intervention to a placebo/sham for pain, function. Mean differences or standardized mean differences with 95% confidence interval (CI) were calculated where the percentages quantified the magnitude of heterogeneity: 25% = low, 50% = medium, and 75% = high heterogeneity.

Assessment of Reporting Biases

We did not perform the funnel plot as our study results were less than 10 studies. If there are ten or more investigations in an analysis, a funnel plot was planned to be employed to discuss the possibility of small study influences (a tendency for evaluates of the intervention influence to be more useful in smaller studies

Data Synthesis

Clinical or methodological heterogeneity was appropriate to indicate that therapy effects may vary between studies so we applied random-effects meta-analysis. We carried statistical analysis using inverse variance method, DerSimonian-Laird estimator for τ^2 and Jackson method for confidence interval of τ^2 and τ .

RESULTS

We conducted the search for this review on June 11, 2020. We identified 1177 records through electronic database searches in which 1082 was from Pub med data base, 74 from Cochrane data base and 21 from PEDro data base as well as identified 2 additional records through other sources and 1 via hand searching . After removal of duplicates 971 records has been left to be screened. A total of 934 articles have been excluded after screening their title leaving us with 37 studies to be screened for full text which yielded to only 7 articles meeting the inclusion criteria,

the other 30 excluded whereas the following 16 were ongoing trials, 11 didn't fulfill the inclusion criteria, 2 non-human, 1 had incomplete information and 1 included patients with neurological condition, these excluded articles are summarized in **(Table 1)** We assessed the full text article of 7 studies in the qualitative analysis and only 5 in their quantitative analysis as the other 2 articles didn't have the required statistics published. **(Figure 1: PRISMA flow)**

B. Data Extraction

Included Studies

Seven studies that enrolled a total of 520 adult patients with knee OA met the inclusion criteria. The studies compared intervention group of ESWT with Placebo/Sham group. The 7 included studies reported our review's primary outcomes which are pain and function however only 5 studies underwent meta-analysis as both **Imamura et al 2017** and **Zhao et al 2013** had missing statistical data in their paper

A detailed table for the author names, year of publication, countries, total number of patients, gender ratio, sample sizes and the mean of their ages, group interventions, ESWT type, Affected knee joints, K.L grading, desired outcomes and the outcome scales used to measure them are all extracted and summarized in **(Table 2)**.

Table (1) Summary of Excluded articles

Study	Reason
Hsu et al,2017	Non-human
Hsu et al,2020	Non- human
Wang et al,2020	ESWT vs US (Not in inclusion criteria)
Su et al,2019	ESWT vs PRP (Not in inclusion criteria)
Xu et al, 2019	ESWT vs NSAIDs (Not in inclusion criteria)
Pawel et al,2018	ESWT vs US (Not in inclusion criteria)
Pawel et al 2017	ESWT vs KT (Not in inclusion criteria)
Lee et al,2017	ESWT vs HA (Not in inclusion criteria)
Lee et al,2017	ESWT vs No treatment (Not in inclusion criteria)
Cho et al,2016	Patients with neurological conditions (Not in inclusion criteria)
Zhang et al, 2016	Acupuncture ESWT (Not in inclusion criteria)
Kim et al,2015	Comparing different doses ESWT (Not in inclusion criteria)
Chen et al,2014	ESWT vs Pulsed US vs isokinetic muscular strengthening exercises vs No treatment
Ilieva et al,2014	Abstract only (incomplete info)
Others	Ongoing trials (16)

ESWT: extracorporeal shock wave therapy, PRP: platelet rich plasma, NSAIDs: Non-steroidal anti-inflammatory drugs, HA: hyaluronic acid, US: ultrasound, KT: kinesiotherapy

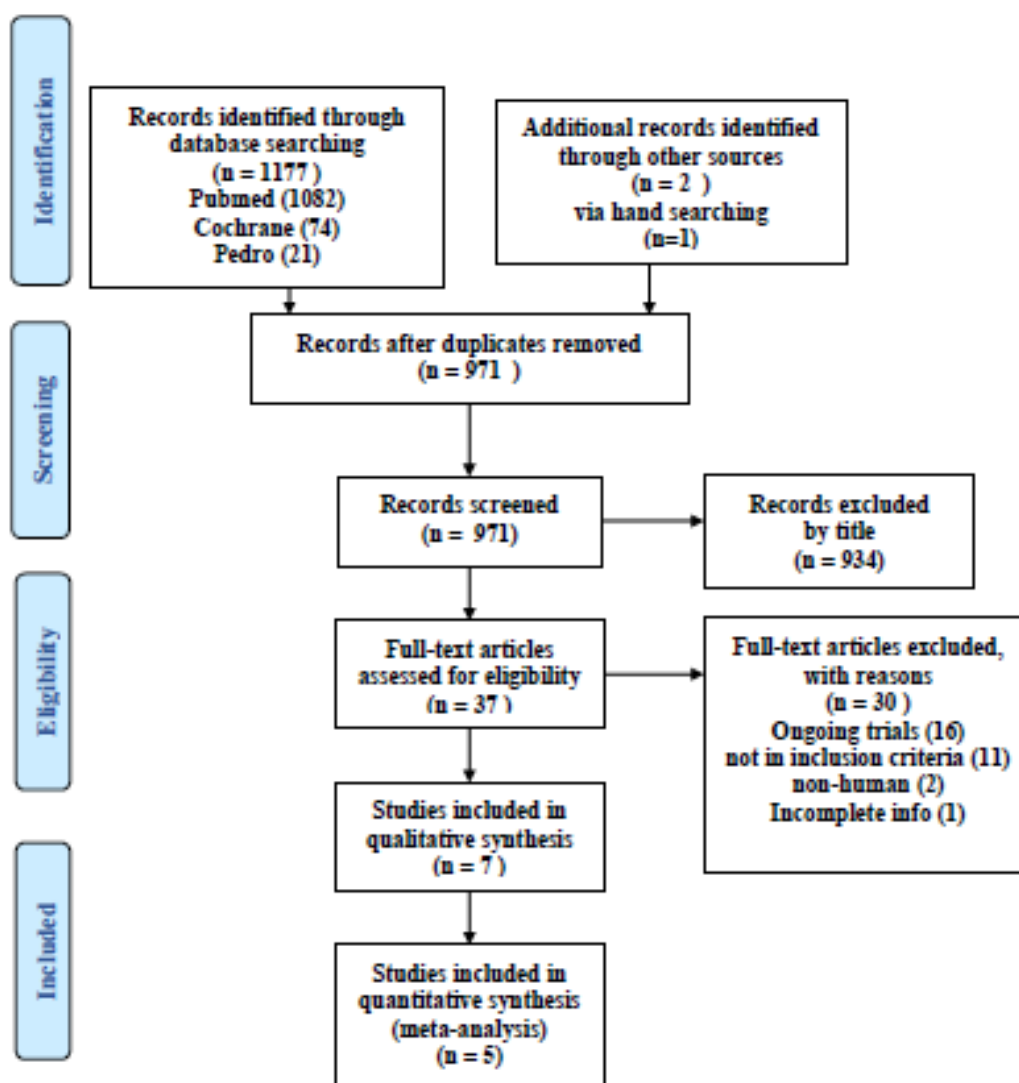


Figure (1) PRISMA Flow Diagram

C. Assessment of risk of bias in included studies

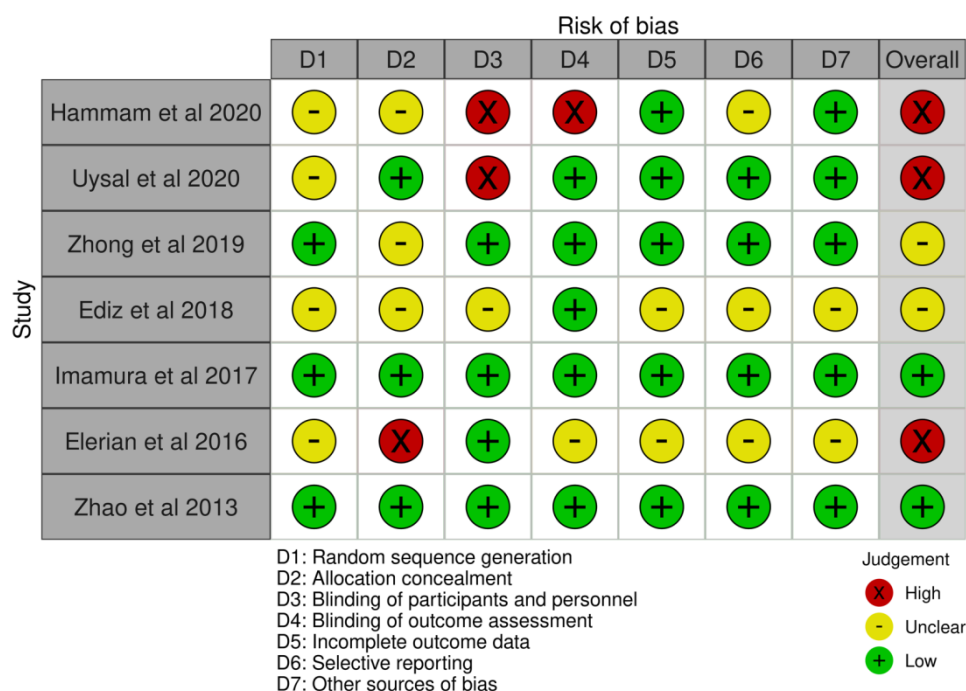
Two review authors independently estimated the risk of bias for every trial employing the criteria summarized in the Cochrane Handbook for Systematic Reviews of Interventions (Shuster 2011). Any controversy was solved by discussion or by including a third assessor.

This tool assesses the biases on different scales, giving an indication whether this domain has a high, low, or unclear risk of bias. It includes 7 domains which are identifying biases in sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources. The results showed that 3 of the studies had a high risk of bias, 2 are unclear, and 2 had low risk of bias, where each domain bias level is demonstrated in figure (2).

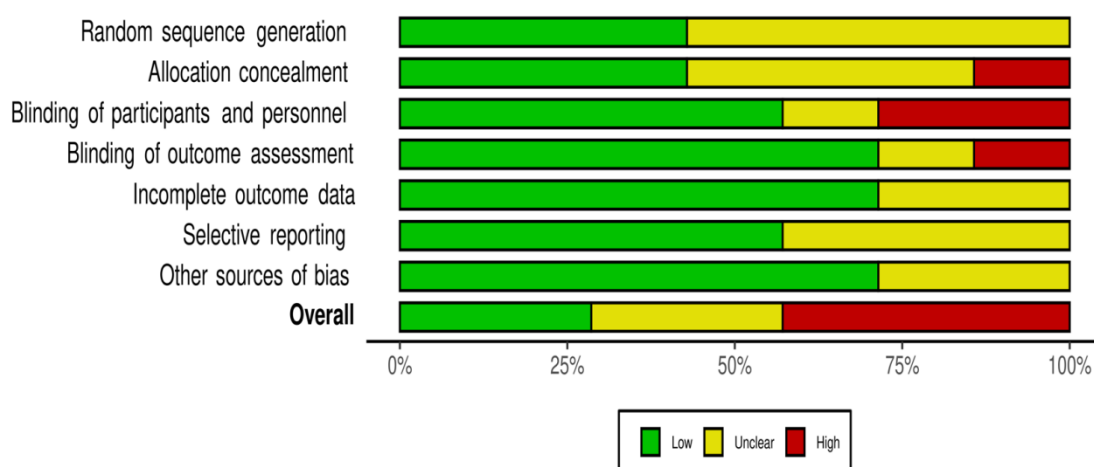
Table (2):Data Extraction for all included studies.

Author	Year	Country	Total PT no	Age	ESWT	Intervention	Knee	Grade	Follow up	Outcomes	Outcome Scale
Hamam	2020	Egypt	45	Grp A: 50.4± 3.4 Grp B: 49.7 ±3.1 Grp C: 49.9 ±2.6	Radial	Grp1: Low Level Energy SWT+ Quadriceps Strength Ex (15 patients “7M,8F”) Grp2: Medium Level Energy SWT + Quadriceps Strength Ex (15 patients “6M,9F”) Grp3: Sham SWT + Quadriceps Strength Ex (15 patients “6M,7F”)	Uni	K-L Gr.II	4 Wk	• Pain • Knee Function • Active Repositioning	• VAS • KOOS • Active Repositioning
Uysal	2020	Turkey	104	Grp A: 60.2± 6.3 Grp B: 61.8 ± 6.0	Radial	Grp1: ESWT+ Hot Pack 40min +TENS 30min +Home-based Prog. 30min (52 patients “10M,42F”) Grp2: Sham ESWT + Hot Pack 40min +TENS 30min +Home-based Prog. 30min (52 patients “12M,19F”)	Uni	K-L Gr.II,III	4Wk 12 Wk	• Pain • Walking Speed • Physical function • isokinetic muscle performance • ROM	• VAS • WOMAC • Goniometer • 20-m walk test • isokinetic Muscle performance • Goniometer
Zhong	2019	China	63	Grp A: 62.5±8.2 GrpB: 63.2±7.7	Focused	Grp1: ESWT+simple home exercise program (32 patients “11M,21F”) Grp2: Sham ESWT+simple home exercise program (31 patients “12M,19F”)	Uni	K-L Gr.II,III	12 Wk	• Pain • Physical function • Cartilage alteration	• VAS • WOMAC • Lequesne index • T2 mapping.
Ediz	2018	Turkey	73	GrpA: 70.48±4.18 GrpB: 69.65±4.49	Focused	Grp1: ESWT +TENS (38 patients”14M,24F”) Grp2:Sham ESWT+TENS *35 patients 13M,22F”)	Uni	K-L Gr.II,III	24 Wk 48 Wk	• JSW • Pain • Function	• JSN • VAS • Lequesne index • WOMAC
Imamua	2017	Brazil	105	Grp A: 70.0±6.5 Grp B: 72.4±6.5	Radial	Grp1:ESWT+Post -application surface heat 20 min + Paracetamol 500 mg if needed for 3 days (52 patients all Females) Grp2: Sham ESWT+ Post -application surface heat 20 min + Paracetamol 500 mg if needed for 3 days (52 Patients all Females)	Uni	K-L Gr.II-IV	1Wk 12Wk	• Pain on movement • Physical Function • Tolerance level to Pressure on certain muscle	• VAS • WOMAC • Fischer Algometer
Elerian	2016	Egypt	60	All Groups 51 ± 3.5	Radial	Grp.1: SWT (20 Patients) Grp.2: Sham SWT (20 Patients)	Bi	K-L Gr.II,III	8 Wk 24 Wk	• Function • ROM • Pain	• WOMAC • ROM • VAS
Zhao	2013	China	70	GrpA: 26.1 ± 2.6 Grp B: 25.6 ±2.5	Focused	Grp.1: ESWT + low level of physical activity recommended for 48 h (34 patients “14M,20F”) Grp.2: Sham ESWT + low level of physical activity recommended for 48 h (36 patients “11M,25F”)	Uni	K-L Gr.II,III	12 WK=	• Pain on movement • Physical function • Patient Perception on disease severity	• VAS • Lequesne index • WOMAC • Patient Perception on disease severity

PT: Patient Grp: Group, K-L: Kellgren-Lawrence score, Uni: Unilateral, Bi: Bilateral, VAS: Visual Analogue scale, WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index, JSW: joint space width, JSN: joint space narrowing, KOOS: The knee injury and osteoarthritis outcome score, WK: Week



Figure(2):Risk of Bias assessment tool “Traffic Light Plot”



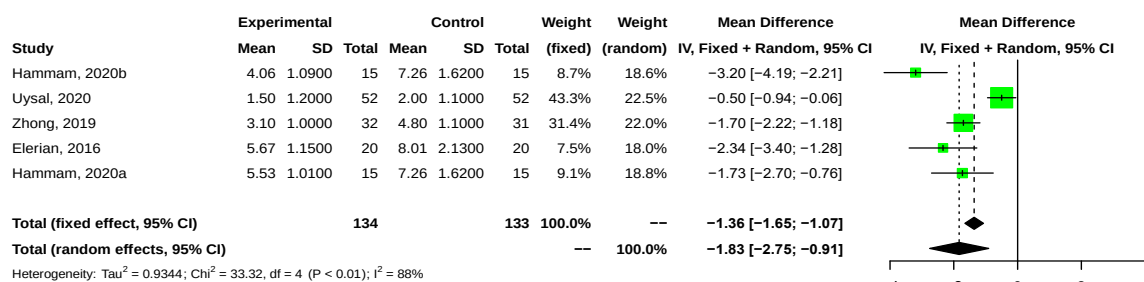
Figure(3):Risk of Bias assessment tool “Weighted summary plot”

D. Measurement of treatment effect:

We calculated the mean change in outcomes from reported mean and standard deviation at baseline and at specified time frames where the same outcome was assessed using different scales.

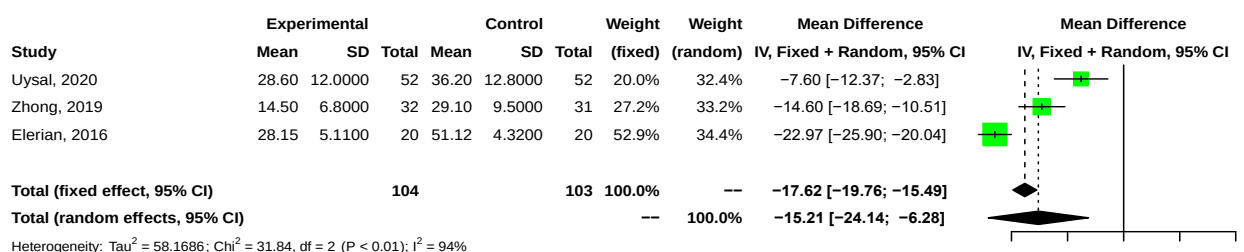
Immediate Post-treatment phase (up to 1 Week)**Pain:**

Four studies reported pain severity in the post treatment phase, all of them used visual analogue scale, all of the individual studies reported significant reduction in pain between the treatment group vs the placebo/sham group and the pooled synthesis yielded the same conclusion

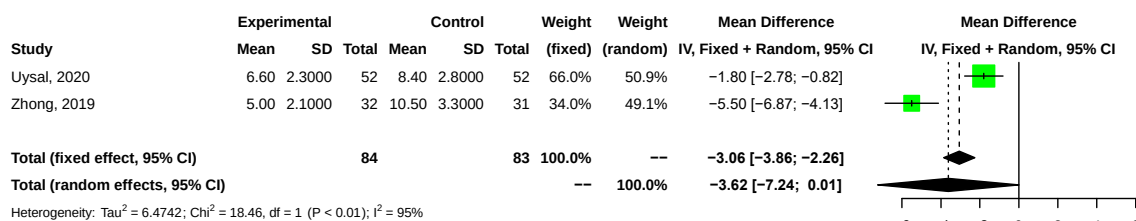


Function:

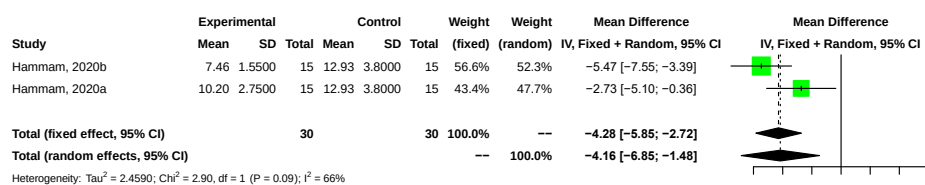
Three Studies reported functional outcomes in the post treatment phase on WOMAC scale all of the individual studies reported significant improvement in function between the treatment group vs the placebo/sham group and the pooled synthesis yielded the same conclusion



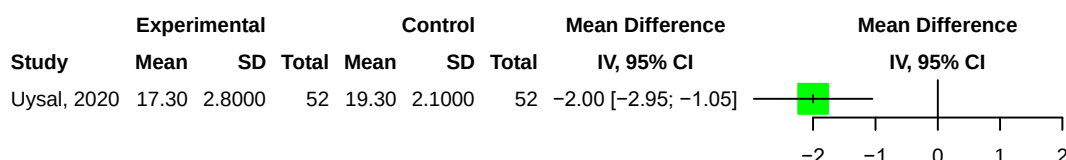
Two studies reported functional outcomes in the post treatment phase on Lequesne index both of the individual studies reported significant improvement in function between the treatment group vs the placebo/sham group, however the pooled synthesis showed no statistically significant effect



One study reported functional outcomes in the post treatment phase on KOOS and showed significant improvement both individually



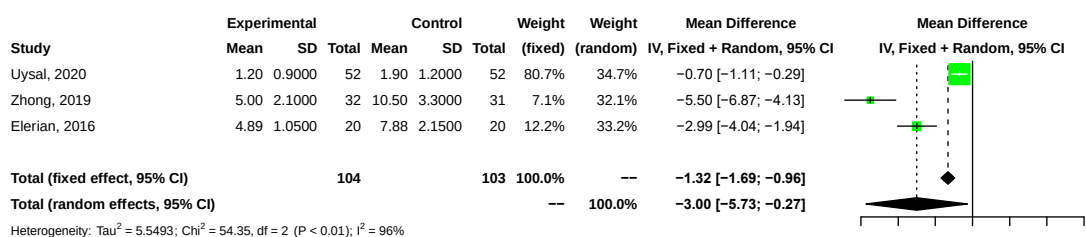
One study reported functional outcomes in the post treatment phase on 20 m walk test



Short Term phase(1-2months)post treatment

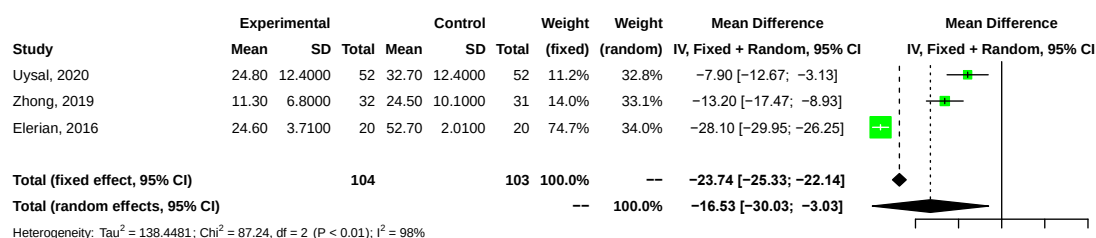
Pain:

Three Studies reported pain severity in Short Term phase, all of them used visual analogue scale

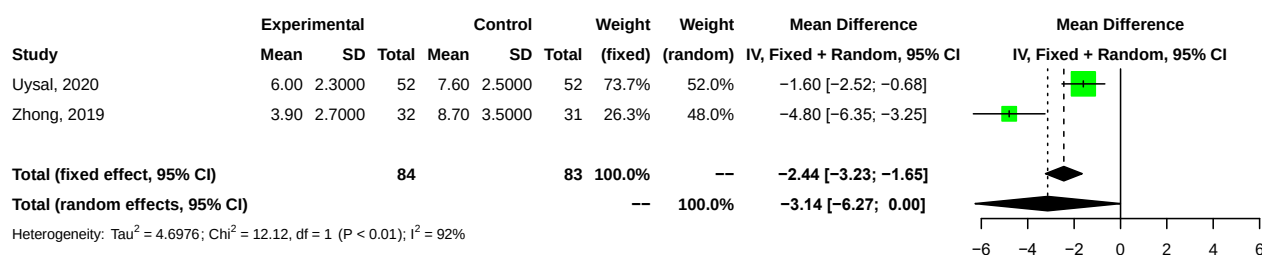


Function:

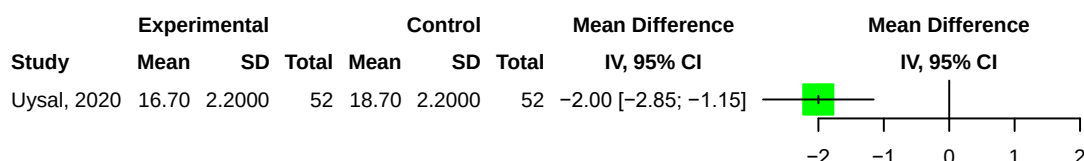
Three Studies reported functional outcome ion WOMAC in the Short Term phase



Two studies reported functional outcomes in the post treatment phase on Lequesne index however, the pooled synthesis showed no statistically significant effect

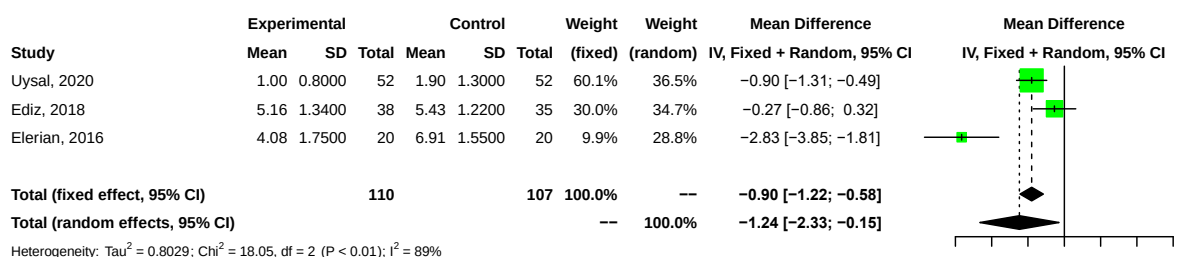


One study reported functional outcomes in the post treatment phase on 20 m walk test



Medium Term phase (3- 6 months)

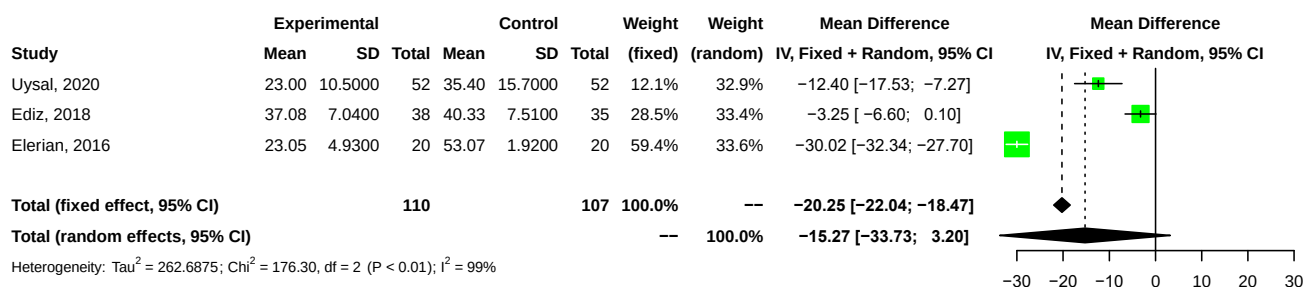
Pain:



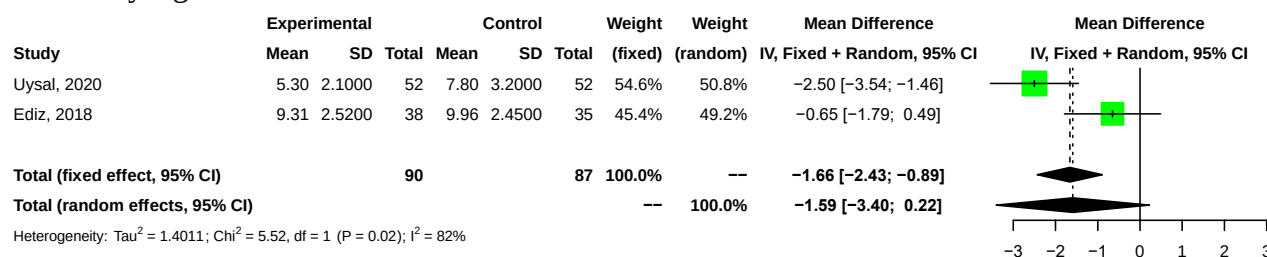
Three Studies reported pain severity in the Medium Term phase, all of them used visual analogue scale and the pooled synthesis yielded the same conclusion

Function:

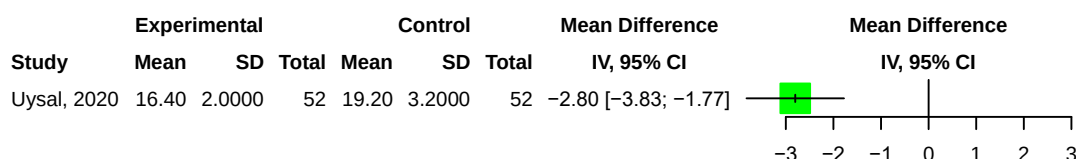
Three Studies reported Functional outcome on WOMAC in the Medium Term phase where the individual studies showed significant effect however, the pooled synthesis showed no statistically significant effect



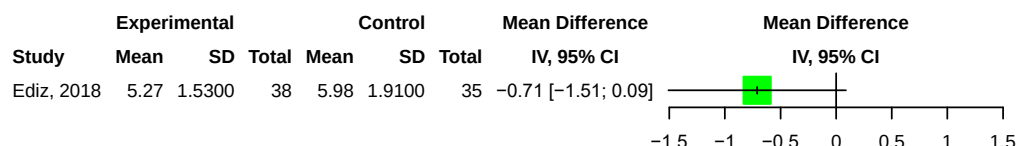
Two studies reported functional outcomes in the post treatment phase on Lequesne index where the individual studies showed significant effect however, the pooled synthesis showed no statistically significant effect



One study reported functional outcomes in the post treatment phase on 20 m walk test



Long Term phase (12 months)

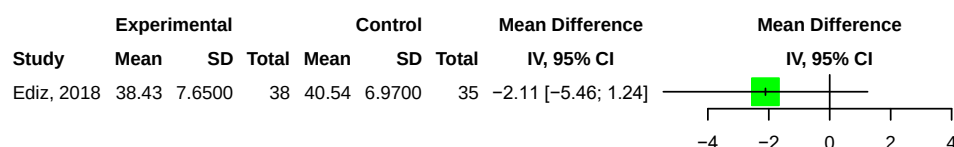


Pain:

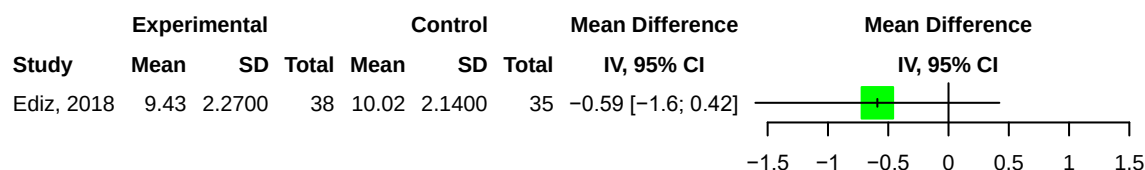
One study reported pain severity in long term phase, it used visual analogue scale

Function:

One study reported functional outcome on WOMAC in long term phase



One study reported functional outcomes in the post treatment phase on Lequesne index



Discussion

The results of this systematic review were based on seven randomized controlled trials and the meta-analysis on five RCTs which showed that ESWT had a high significant effect on pain reduction and improving function which is assessed by WOMAC, KOOS and 20 m walk test however there is no significant improvement on the lequesne index

Concerning pain control the combined analysis indicated that the shock wave group was significantly better than the placebo group in all phases the immediate, short, medium and long terms which was consistent with the individual studies,

Regarding functional outcomes, KOOS was investigated by **Hammam et al 2020** found a significant improvement in function during the immediate phase using either low and medium radial shock wave however the medium dose was more efficient and that was consistent with **Kim et al.,** study regarding dosage effect on knee OA (**Kim et al., 2015**)

The WOMAC scale was investigated in immediate and short term phases (**Elerian 2016, Zhong,2019 and Uysal et al 2020**) all of the studies showed significant improvement as well as the pooled effect. However, there were no significant effect in the medium term phases in the pooled effect. **Ediz et al 2018** found that WOMAC improved on the long term phase and it shall be noted that this study used a focused shock wave device. However one study (**Imamura et al 2017**) which was not included in the meta-analysis showed that there was no effect in all WOMAC categories except for pain.

The Lequesne index was investigated by both (**Zhong et al 2019 and Uysal et al 2020**) in both immediate and short term phases where not significant in the pooled synthesis but significant individually. **Ediz et al 2018** found that function on Lequesne index was improved on the long term.

Uysal et al 2020 found that there was a significant improvement in function using the 20 m walk test in immediate, short and medium phases. Moreover, this study applied hot pack, TENS and home based program for both groups which may affect the overall results on different outcome measures of pain and function.

The data established in this review has identical results to prior systematic review by **Tengqi Li et al, 2019 and Liao et al 2019** with regards to shock wave therapy effectiveness on various pain, function outcome measures

It shall be noted that higher Energy flux density (EFD) may have a better impact on improving outcomes than lower EFD which could be observed by the results of **Hammam et al, 2020** which compared both low and medium doses as well as **Zhao et al 2013** who used higher EFD and yielded good results versus **Imamura et al 2017** who used lower EFD and got insignificant effect.

The severity of knee OA also varied between studies which may have impacted the after treatment outcome as well as the different doses, type of shock wave and treatment sessions.

Clinical Message

Patients with primary knee OA could experience reduction in their pain level as well as improvement in their overall functional level immediately after the treatment course by ESWT. The available evidence cannot estimate the maximum adequate type, intensity, and period of treatment; However, it indicates medium dose to have a better results than lower dose

Recommendations

More RCTs are needed with larger sample sizes and with more accurate determination for the best type, dose and treatment sessions with long term follow up are required for optimal pain reduction and functional outcomes.

CONCLUSION

The meta-analysis suggests that ESWT has a statistically significant effect on pain reduction in all four phases(immediate, short, medium and long term) using VAS scale as well as significant improvement in function in all phases on WOMAC except medium term, and on KOOS in the immediate phase , and on 20 m walk test in all phases, however there was no statistically significant effect in the pooled synthesis regarding Lequesne index in immediate, short and medium phases

Declaration of Conflicting Interests

The authors pronounced no prospect conflicts of interest with honor to the research, authorship, and/or publication of this essay.

Funding

The authors did not receive any financial support to research, author and/or publish this essay.

Supplemental material

Supplemental material for this article is available online.

Appendix 1

Central Cochrane Search Strategy:

#1MeSH descriptor: [Osteoarthritis] explode all trees

#2 osteoarthritis*

#3 osteoarthro*

#4 oa

#5 degenerative joint disease

#6 degenerative arthritis

#7 djd

#8 gonarthro*

#9 arthrosis

#10 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9

#11 knee*

#12 femorotibia*

#13 tibiofemora*

#14 #11or #12 or #13

#15 MeSH descriptor: [Osteoarthritis, Knee] explode all trees

#16 #14 or #15

#17 MeSH descriptor: [Extracorporeal Shockwave Therapy] explode all trees

#18 shock wave therapy

#19 SWT

#20 ESWT

#21 rESWT

#22 radial extracorporeal shock wave therapy

#23 HIFU

#24 high intensity focused ultrasound

#25 “acoustic wave therapy”

#26 “extracorporeal pulse activation therapy”

#27 “focused shock wave therapy”

#28 #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27

#29 #10 and #16 and #28

Appendix 2**Pubmed Search Strategy:**

Query	Items found	Time
Search (((((((((((osteoarthritis) OR osteoarthritis*) OR osteoarthritis*) OR oa) OR degenerative joint disease) OR degenerative arthritis) OR djd) OR gonarthro*) OR arthrosis)) AND (((((((shock wave therapy) OR SWT) OR rESWT) OR radial extracorporeal shock wave therapy) OR HIFU) OR high intensity focused ultrasound) OR "acoustic wave therapy") OR "Extracorporeal pulse activation therapy") OR "focused shock wave therapy")) AND (((((knee) OR knee*) OR femorotibia*) OR tibiofemora*)) OR osteoarthritis,knee)	1082	04:48:15
Search (((((knee) OR knee*) OR femorotibia*) OR tibiofemora*)) OR osteoarthritis,knee)	182153	04:47:31
Search (((((((shock wave therapy) OR SWT) OR rESWT) OR radial extracorporeal shock wave therapy) OR HIFU) OR high intensity focused ultrasound) OR "acoustic wave therapy") OR "Extracorporeal pulse activation therapy") OR "focused shock wave therapy"	22358	04:44:27
Search "focused shock wave therapy"	42	04:43:09
Search "Extracorporeal pulse activation therapy"	7	04:42:19
Search "acoustic wave therapy"	15	04:41:27
Search high intensity focused ultrasound	27	04:40:20
Search HIFU	4278	04:39:51
Search radial extracorporeal shock wave therapy	622	04:39:26
Search rESWT	85	04:38:56

Search ESWT	864	04:38:44
Search SWT	1579	04:38:27
Search shock wave therapy	17072	04:37:43
Search osteoarthritis,knee	47086	04:37:02
Search (((knee) OR knee*) OR femorotibia*) OR tibiofemora*	182125	04:36:46
Search tibiofemora*	5485	04:36:09
Search femorotibia*	1973	04:35:45
Search knee*	181042	04:35:09
Search knee	170237	04:34:48
Search (((((((osteoarthritis) OR osteoarthritis*) OR osteoarthro*) OR oa) OR degenerative joint disease) OR degenerative arthritis) OR djd) OR gonarthro*) OR arthrosis	417640	04:34:19
Search arthrosis	283512	04:30:51
Search gonarthro*	1335	04:30:03
Search djd	946	04:29:49
Search degenerative arthritis	105343	04:29:31
Search degenerative joint disease	109355	04:29:06
Search oa	78609	04:28:38
Search osteoarthro*	17911	04:27:59
Search osteoarthritis*	105035	04:27:14
Search osteoarthritis	91574	04:26:33

Appendix 3

Pedro Database:

1-degenerative arthr* AND extracorporeal shock wave therapy

2-shockwave AND knee osteoarthr*

3-rESWT AND knee osteoarthr*

4-ESWT AND knee osteoarthr*

5-ESWT AND degenerative arthr*

6-djd AND Osteoarthr*

7-ESWT AND gonarthr*

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