

FACT SHEET

The effect of shockwave on knee osteoarthritis

INTRODUCTION

Arthrosis (osteoarthritis) is the most common rheumatic disease and is characterized by joint pain and loss of functional capacity. In the Health and Morbidity Surveys (SUSY), 19% or almost one in five Danes stated that they had symptoms of arthrosis. A total of DKK 2.4 billion for treatment and DKK 2.2 billion due to lost production. That's how much it costs society to have citizens with arthrosis. (1) It is to be expected that these costs exceed these figures, as the figures are about 9 years old.

The basic treatment for arthrosis consists of training, information and weight loss. These methods of treatment should be offered to everyone with arthrosis as early as possible in the course of the disease.(2)

In recent years, ESWT began to gain ground as a possible treatment in arthrosis patients. The studies include knee osteoarthritis, but are likely to have an impact on arthrosis in general.

METHOD

We have searched PubMed with the following search string: "extracorporeal AND shock AND wave OR ESWT OR SHOCKWAVE AND OSTEOARTHRITIS" WITH FILTER: "HUMANS"; "English"; "meta-analysis"; "Systematic Review" (see details by references)

We selected the latest analytics for this review.

We find 18 articles: 8 excluded due to language, scoping review, narrative review, non-specific pathologies, comment on other studies
10 articles reviewed in abstract: 5 excluded due to year of publication include articles that are not in English
5 articles are downloaded for full text review. 1 is excluded as it also contains cohort studies.

4 meta-analyses are included: 3 are from 2020 that includes different studies, and the latest news from 2023, (Silva et al.) that do not include all previously found studies in the previous 3 from 2020. We therefore consider it relevant to keep the 4 latest ones.

The following compilation of the latest documentation is based on 4 review articles (3 from 2020, 1 from 2023) that have investigated the effect of shockwave treatment on patients suffering from knee osteoarthritis. The studies included include randomized studies. These studies compare a group receiving shockwave treatment with a group receiving another treatment or cheat/sham ESWT.

Predominant use of rESWT (radiating ESWT)

The 4 meta-analyses reviewed are the following:

Avendaño-Coy, J., Comino-Suárez, N., Grande-Muñoz, J., Avendaño-López, C., & Gómez-Soriano, J. (2020). Extracorporeal shockwave therapy improves pain and function in subjects with knee osteoarthritis: A systematic review and meta-analysis of randomized clinical trials. *International journal of surgery (London, England)*, 82, 64–75. (3)

Hsieh, C. K., Chang, C. J., Liu, Z. W., & Tai, T. W. (2020). Extracorporeal shockwave therapy for the treatment of knee osteoarthritis: a meta-analysis. *International Orthopaedics*, 44(5), 877–884. (4)

Silva, A. C., Almeida, V. S., Veras, P. M., Carnaúba, F., Filho, J. E., Garcia, M., & Fonseca, D. S. (2023). Effect of extracorporeal shock wave therapy on pain and function in patients with knee osteoarthritis: a systematic review with meta-analysis and grade recommendations. *Clinical rehabilitation*, 37(6), 760–773.(5)

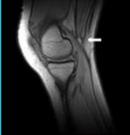
Wang, Y. C., Huang, H. T., Huang, P. J., Liu, Z. M., & Shih, C. L. (2020). Efficacy and Safety of Extracorporeal Shockwave Therapy for Treatment of Knee Osteoarthritis: A Systematic Review and Meta-analysis. *Pain medicine (Malden, Mass.)*, 21(4), 822–835. (6)

The meta-analysis by Avendaño-Coy et al., Wang et al., and Silva et al. describes only those studies not seen in Hsieh et al's study, thus 25 studies are included.

RESULTS

Below is an overview of the method and effect of the included studies.

Hsieh et al. 2020			
9 studies included. 705 patients 332 in intervention groups 373 in control groups	7 studies with fESWT 2 studies with rESWT	Measurement parameters: Visual Analogue Scale (VAS) Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)	
The treatment effect followup: Effect after 2 weeks Between 4-6 weeks after treatment Between 6 and 12 months after treatment	1 bar = 0.1 mJ/mm2 1MPa = 10 bar		

STUDIO	DOSE	CONTROL GROUP	EFFECT	METHOD
Chen (2014) (7)fESWT Knee arthrosis with cyamella in the popliteus (bone formation in the popliteus) 	0.03–0.4 mJ/mm2 , frq 1–8 Hz, 11–82 MPa, 2000 pulses	1. strength program (isometric) 3x per week for 8 weeks 2. ultrasound + exercises 3. fESWT + exercises 4. No intervention	ROM: significant in all groups but shockwave had the greatest improvement Pain subsides in all groups, mostly in the shockwave and ultrasound groups, but worsens in the "no intervention" group. Disability via questionnaire (Lequesne's index): All groups are improved: group 1 least, group 3 greatest improvement in intervention groups. No change in size was observed at 3 months of control, decreased size was seen in 9 patients in the shockwave group.	Intensity is determined by the size of the cyamella. Prominent The area is marked after ultrasound scan. Transducer placed over marked cyamella group.
Cho (2016)(8) fESWT	1000 pulses every week, for 3 weeks. total energy quantity per treatment(s) 0.05 mJ/mm2	sham (false) fESWT	Significant pain improvement Significant functional improvement in relation to transfers from bed, chair and	Back lying with flexed knee Application to proximal surface medial on tibia

Chronic hemiplegics with knee arthrosis			toilet. Improved walk and climbing stairs)	
Imamura (2017) (9) rESWT Severe primary knee arthrosis	3 treatment(s) per week, for 3 weeks, 2000 pulses per treatment session, pressure between 2.5 and 4.0 bar, energy flux density (EFD) from 8Hz between 0.10 and 0.16 mJ/mm ²	sham (false) fESWT		Treatment is carried out at the site that is most pain affected. Intensity depending on the patient's pain tolerance. Starting position unknown
Lee J-H (2017) (10) fESWT Patients with degenerative knee arthrosis	Frq. 4 Hz, 1000 pulses + conservative treatment	Conservative treatment (heat, ultrasound, pain suppression with electrical impulses)	At 4 weeks of control improvement in both groups, but significantly better function and decreasing pain in the ESWT group.	Treatment focused on medial and lateral condyl Treatment focused on either trigger point, patellofemoral joint or tibiofemoral transition
Lizis (2017) (11) fESWT fESWT vs. kinesiology for knee arthrosis	5 treatments for 5 weeks, one week apart 8000 pulses, 0.4 mJ/mm ²	Kinesiotherapi/ kinesiology	At 5 weeks control significant improvement in the ESWT group in terms of pain, stiffness in the joint o functional level improvement.	Back lying with flexed knee approx. 90°. Treatment focused on trigger point, patellofemoral joint or tibiofemoral transition
Lee J-K (2017) (12) fESWT fESWT vs blocade with hyaluronic acid (HA)	3 treatments at intervals of one week 1000 pulses, 0.05 mJ/mm ²	Injection hyaluronic acid (HA)	Significantly decreasing pain after 1 and 3 months in both groups. No significant differences between groups. Significant functional improvement both groups. No significant difference between the groups.	Back lying with flexed knee approx. 90°. Treatment is focused on the most tender spot on the medial tibial plateau.
Ediz (2018) (13) fESWT primary knee arthrosis with and without bone marrow edema	2500 pulses, with pressure 3 bar, FRQ. 12 Hz (3 bar = 0.12 mJ/mm ²)	Sham ESWT	Improvement of pain and function in the ESWT group, including radiological improvements. Improvement continued for at least 1 year, and patients with bone marrow edema achieved the greatest improvement.	Back-lying Knee in 90 degree flexion Medial tibia and femur plateau are treated
Kang (2018) (14) fESWT	3000 to 4000 pulses > 0.44 mJ/mm ² Frq. between 2 and 3 Hz	Alendronate (used in osteoporosis or to counteract decalcification of bones in patients on long-term corticosteroid therapy.)	Pain and functional level improve significantly in both groups. The ESWT Group experienced earlier and greater improvements in pain and	Completed with analgesic treatment and ESWT apparatus that has penetration capacity of up to 150 mm. Treatment focused around the circumference of the joints

Painful bone marrow edema associated with knee arthrosis	2 treatments at intervals of one week		functional level during the 12-month course. Especially the pain continued to be prepared significantly compared to the control group throughout the course.	
Li (2018) (15) rESWT ESWT for the treatment of knee arthrosis	3000 pulses, 0.11 mJ/mm ² with frq 15 Hz (1 bar = 0.12 mJ/mm ²) 5 treatments 3 days apart. Total 12 weeks	Laser (0.2 J/point – total dose 20J)	Compared to laser, there is significant improvement in the ESWT group in terms of pain function level at 6 and 12 weeks of control	Back lying with outstretched knee. The focus of treatment was trigger points around the knee

The authors' own conclusion when comparing all the results found in the included studies:

" The most important finding of this meta-analysis was that ESWT was an effective treatment for knee OA. ESWT relieved knee pain immediately, within two weeks after treatment. The effect lasted for at least six months. ESWT also improved functional outcomes for patients with knee OA. The pooled results showed significantly improved WOMAC scores four to six weeks after ESWT. These trends continued for one year. There was no serious adverse effect reported in any of the included articles. ESWT can be considered a choice of treatment for patients suffering from knee OA."

Avendaño-Coyet al. 2020

14 studies included
 782 patients, 877 knees analyzed
 410 treated with shockwave
 467 received second treatment
 9 rESWT, 6 fESWT (1 study comparing fESWT with rESWT)

Previously discussed: Cho et al. (8) Ediz et al. (13) Imamura et al. (9)
 Lee JH et al. (10) Lee JK et al. (12) Lizis et al. (11)

The treatment effect is measured:

Baseline, 2 weeks
 Baseline, 4 weeks
 Baseline, 5 weeks
 Baseline, 5, 12 weeks
 Baseline, 4 and 6 weeks after treatment
 Baseline, 6 and 12 months

Endpoints:

Visual Analogue Scale (VAS)
 6 minute walk test
 Western Ontario and McMaster Universities
 Osteoarthritis Index (WOMAC)

STUDIO	DOSE	CONTROL GROUP	EFFECT	METHOD
Ammar. (16) rESWT	ESWT 1 time per week for 4 weeks 1000 pulses, 0.05 MJ/MM2	A: ESWT + conservative physio (exercises + hot water bottle treatment) B: Interferential flow 20 min + conservative physio (exercises + hot water bottle treatment)	Both groups exhibit significant improvement with both pain reduction and improved function. The group with ESWT has the greatest improvement	Back lying with 90 degree flexion in knees. Treats the medial tibia plateau, at the most tender points
Elerian, 2016 (17)(rESWT) Comparing treatment of arthrosis knee with 2 group women	2000 pulses, 5 Hz, 2MPa (20 bar), 1 treatment per week for 3 weeks.	A: fESWT B: Intraarticular cortisone injection C: Sham shockwave	Both shockwave and cortisone, improve pain, improve functional level, increase mobility.	Most painful area on the joint line is found via palpation. 3 treatments 1 week apart (3 treatments in total)
Lizis et al. (18) rESWT	5 treatments 1 x per week, 8 Hz, 2.5 bar	A: ESWT B: Ultrasonics 10 treatments, 2 x per week	ESWT results in significantly better endpoints (decreased pain and improved functional level) an ultrasound	Back lying with 90 degree flexion in knees. Stationary treatment with probe on pain points

	1 treatment(s): 1000 pulses 2 treatment(s): 1500 pulses 3-4-5 treatment(s): 2000 pulses	Continuous, 1MHz, 0.8 watts/cm ²		
Lizis et al.(19) rESWT	5 treatments 1 x per week, 8 Hz, 2.5 bar 1 treatment(s): 1000 pulses 2 treatment(s): 1500 pulses 3-4-5 treatment(s): 2000 pulses	A: ESWT B: Exercises 10 sessions 2x per week for 5 weeks	ESWT improved functional level and diminished pain experience significantly more than the exercise program.	
Shenouda. (20) rESWT	2000 pulses over 5 weeks, 1 x per week. 0.18 mJ/mm ² 6Hz	A: ESWT+ exercises B: Mulligan (MWM) + exercises C: exercises	All groups showed progress ESWT or Mulligan + exercises improve pain experience and functional level. ESWT+ exercises improve ROM more than Mulligan+ exercises (MWM)	Seated, with small flexion in the knee, abduction and outward rotation of the hip. Most painful place medially on the knee is treated
El-Sakka, 2019. (21) fESWT Comparing shockwave up against ultrasonic treatment	1000 pulses, 2.5 – 4 mJ/mm ² , 8 Hz with radiating head, 1000 pulses, 0.15 mJ/mm ² , 6 Hz with focusing head 1 x per week for 3 weeks Continuous ultrasound 1 MHz, 1 watt/cm ² , 10 minutes 3 treatments per week, for 3 weeks	A: Shockwave B: Ultrasonics Continuous ultrasound 1 MHz, 1 watt/cm ² , 10 minutes 3 treatments per week, for 3 weeks	Greater improvement in pain and mobility in the shockwave group. Functional level improvement in both groups, greatest in the ultrasound group, but not significant	With the radiating head treatment roughly in the area around the joint line. With the focusing, the most painful point of the joint line is treated.
Zhong et al.(22) rESWT	4 treatments 1 x week, 4 weeks 2000 pulses, 2.5 bar, 8 Hz	A: rESWT + home exercises B: sham rESWT + home exercises	Significant improvement in pain at 5 and 12 weeks in group A compared to group B. Same goes for feature level. MRI also showed less cartilage reduction in group A joint line compared to group B	Back lying with knees in 90 degree flexion Treats on pain points with even distribution over pain points. Last 1000 pulses distributed over patellofemoral and tibiofemoral articular surfaces
Zhao et al.(23) fESWT	4000 pulses, 0.25 mJ/mm ² , 1 x per week for 4 weeks	A: 4000 pulses, 0.25 mJ/mm ² , 1 x per week for 4 weeks	Improvement with decreased pain and increased functional level in the intervention group	Back lying with knees in 0 or 90 degrees. TrP around the knee, patellofemoral and tibiofemoral joint lines is treated by holding the probe stationary over the painful areas.

		W: 4000 pulses, 0.00 mJ/mm ² , 1 x per week for 4 weeks		
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The authors' own conclusion when comparing all the results found in the included studies:

"The current review supports ESWT as being effective for improving pain and functionality in patients with mild and moderate KOA in the short term (≤ 12 weeks) and with few, minor side effects. However, the certainty of this evidence was graded "moderate". Energy flux density for applying ESWT can be a key factor for treatment effectiveness, yet further investigation is required to determine the optimal dosage and parameters for its application. This work found a superior effect of ESWT compared to other conservative treatments, so this therapy should be considered as first line treatment prior to using them or others of an invasive or surgical nature."

Wang et al. 2020

9 studies included
 8 RCT
 1 retrospective study
 431 incl. Participant
 Discussed earlier: Kang et al. (14) Ediz et al. (13) Liziz et al. (11)
 Cho et al. (8) Elerian et al. (17) Chen et al. (7) Lee JK et al. ((12)
 Lee JH et al. (10)

The treatment effect is measured:

1 study effect measured after 1 week
 1 study 4 weeks after treatment
 1 study 5 weeks after treatment
 2 studies 3 months after treatment
 1 study 5 months after treatment
 1 study 8 months after treatment
 2 studies 12 months after treatment

Between 6 and 12 months after treatment

Endpoints:

Visual Analogue Scale (VAS)

Western Ontario and McMaster Universities
 Osteoarthritis Index (WOMAC)

STUDIO	DOSE	CONTROL GROUP	EFFECT	METHOD
Kim et al. 2015 (24) fESWT	Different dosages 3 treatments, 1 x per week for 3 weeks	A: 1000 pulses, 0.040 mJ/mm ² W: 1000 pulses, 0.09 mJ/mm ²	Significant pain reduction in both groups (12 weeks after) Significant functional improvement in both groups But overall, a mean dose level is lower than low	Back-lying The knee placed in 90 degree flexion The sorest spot on the medial tibia plateau

Dose related treatment of knee arthrosis.			(low below 0.08 mJ/mm ² , medium 0.08-0.28 mJ/mm ² , high above 0.28 mJ/mm ²)	
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The authors' own conclusion when comparing all the results found in the included studies:

"This was the first time that the efficacy and safety of ESWT for the treatment of knee OA were assessed using a systematic review and meta-analysis. This study provides results that suggest that using ESWT for treatment of knee OA has a beneficial effect on pain relief and physical function for up to 12 months, and only minor complications occurred after ESWT treatment. However, there remains a lack of clarity regarding the frequency and dosage levels of ESWT required to achieve maximum improvement."

Silva et al	
<p>12 studies 403 participants intervention 331 participants control 9 rESWT, 1 fESWT, 2 n.a.</p> <p>Previously mentioned: Imamura et al. (9) Elerian et al. (17) Lizis et al. (11) Zhong et al. ((22) Zhao et al. (23)</p> <p>The treatment effect is measured:</p> <p>Baseline, 3.7 weeks Baseline, 6, 12 weeks Baseline 4, 12 weeks Baseline 5, 10 weeks Baseline, after each treatment, 4 weeks after last treatment Baseline, 1, 4 and 12 weeks Baseline, 5 and 12 weeks</p>	<p>Endpoints:</p> <p>Visual Analogue Scale (VAS) Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Lequesne index Isokinetic test Timed Up and Go (TUG) ROM (flex/ext) 10m walk test 20m walk test KOOS</p>

STUDIO	DOSE	CONTROL GROUP	EFFECT	METHOD
Eftekharsadat et al.(25) rESWT	5 treatments in 3 weeks 2000 pulses, 0.18 mJ/mm ² , frq 10-16 Hz	A: ESWT+ exercises B: Physio + exercises C: exercises (Physio 10 treatment(s). 3 treatment(s) per week. Heating (TENS/UL 20 min)	After 7 weeks phys and exercises equally good ESWT best for pain posture and increasing functional level	Sitting with small flexion in the knee, with abduction and outward rotation of the hip

		(Exercises isometric quads, 3 x sub max contractions with progression)		
Günaydin et al. (26) fESWT	6 treatments in 6 weeks 2000 pulses, frq 6-8 Hz, 0.25 mJ/mm ²	A: kinesiotape + exercises B: ESWT + exercises C: exercises	No difference between the groups After 6 and 12 weeks	Back lying with 90 degree flexion Treats tibiaphim morality and patellofemorally
Hammam et al.(27) rESWT	A: 2000 pulses, 10 Hz, 0.02 mJ/mm ² 1 x per week for 4 weeks W: 2000 pulses, 10 Hz, 0.178 mJ/mm ² 1 x per week for 4 weeks C: cheat rESWT + exercises 1x a week for 4 weeks	A:low energy fESWT + exercises B: medium energy rESWT + strength C: cheat rESWT + strength	Significant improvement in pain and function in A+B. Greater power in B than A	Back-lying, 90 degree flexion in knees Treatment in the most painful places with medial tibia plateau
Uysal et al. (28) rESWT	2000 pulses, 2-3 bar, 10 Hz 5 treatments over 3 weeks	A:40 min heat packing, 30 min TENS (5 treatment(s) per week for 3 weeks), home program 30 min every day for 3 weeks + rESWT 3 x once per week B: 40 min heat packing, 30 min TENS (5 treatment(s) per week for 3 weeks), home program 30 min every day for 3 weeks + cheat rESWT 3x once a week	Significant improvement in pain, functional level, strength target group A versus group B After 4 weeks and 12 weeks	Back-lying with 90 degree flexion, focal depth 5-20 mm, Stationary treatment over the most painful places tibiofemoral and patellofemoral
Zhang et al. (29) rESWT	4 treatments at intervals of one week Different doses, but fixed 8 HZ	A:0.12mJ/mm ² , 2000 pulses W: 0.24mJ/mm ² , 2000 pulses C: 0.12mJ/mm ² , 4000 pulses D: 0.24mJ/mm ² , 4000 pulses	Significant improvement in all intervention groups 4 weeks after last treatment, both with reduced pain and improved function Greatest effect achieved with higher intensity (0.24mJ/mm ²) but no difference whether treated with 2000 or 4000 pulses.	Back-lying position with different degrees of flexion in the knee to expose the most painful areas. Painful areas are found on palpation. Painful areas are treated.

		E: placebo 0.02 mJ/mm ² , 1000 pulses		
Cavalieri et al. (30) fESWT	1 treatment per week, for 4 weeks 7000 pulses, 0.07 - 0.15 mJ/mm ²	A: fESWT + exercises B: cheat fESWT + exercises	No difference between the groups 9 in each group	Back-lying 3000 pulses anteriorial quadrant the first 500 pulses 0.1 mJ/mm ² , with slow increase in intensity up to between 0.12 - 0.15 mJ/mm ² . Next with max flexion knee: 2000 pulses with intensity between 0.07 and 0.15 mJ/mm ² on the trochlea, and the fossa intercondylaris. Finishes with abdominal 2000 pulses posteriormedial quadrant 0.15 mJ/mm ²
Wang et al. (31) fESWT	3 treatment(s) per week in 10 treatments 4000 pulses, 15 Hz, 0.25 mJ/mm ²	A: ESWT B: cheat ESWT	Significant improvement in pain and function in group A after 5 and 10 weeks	Supine with both legs stretched

The authors' own conclusion when comparing all the results found in the included studies:

"Shockwave therapy may improve functionality in patients with knee osteoarthritis in the short term and pain in all follow-up moments, compared with sham. When associated to kinesiotherapy, it may improve function in the short term and pain in all follow-up time points, although improvement in pain may not be clinically significant."

CONCLUSION

Based on these 4 meta-analyses, it is recommended to use ESWT as a possible treatment method in arthrosis patients, although these studies include arthrosis of the knees. It is seen that ESWT can reduce pain and improve ADL functions in arthrosis patients. rESWT has predominantly been used in the studies.

ESWT should be seen as a partial treatment as part of a rehabilitation program, where active training remains the first priority. But a pain reduction might form a window to optimize the active training part.

In addition, it suggests that ESWT achieves better results than laser and ultrasound as treatment.

Fewer treatments are needed with ESWT (usually 3 at intervals of one week), whereas laser (9 treatments in 3 weeks) and ultrasound (9 treatments in 3 weeks) seem to require more treatments - thus more costly, and possibly more difficult for the individual patient as more consultations are needed.

ESWT has the same effect as intra-articular cortisone injection, thus possibly an alternative treatment method if injection will be avoided.

RECOMMENDATION

Dose fESWT: 3 treatments one week apart, between 1000 and 3000 pulses, below 0.28 mJ/mm² (to the individual's pain threshold), between 8-15 Hz. Back lying with knees in 90 degree flexion. The number of pulses is distributed on the most painful on the joint line and patellofemoral joint, and then relevant trigger points (most often VMO and rectus femoris). Adapted from Lizis et al(11)

Dose of rESWT: between 2000 and 3000 pulses, between 1 and 3 bar, between 8 and 14 Hz. Starting position as described in the fESWT recommendation. The individual's pain threshold must be respected; therefore one can expect the necessity for different doses in the clinical everyday life.

REFERENCES:

1. Koch MB, Davidsen M, Juel K. The societal costs of arthrosis. Available from: https://www.sdu.dk/da/sif/rapporter/2017/de_samfundsmæssige_omkostninger_ved_muskel_og_skeletlidelser_i_danmark
2. Thorstensson AC, Roos E. Basic treatment of arthrosis. 2011;1-50.
3. Avendaño-Coy J, Comino-Suárez N, Grande-Muñoz J, Avendaño-López C, Gómez-Soriano J. Extracorporeal shockwave therapy improves pain and function in subjects with knee osteoarthritis: A systematic review and meta-analysis of randomized clinical trials. *Int J Surg.* 2020;82(August):64-75.
4. Hsieh CK, Chang CJ, Liu ZW, Tai TW. Extracorporeal shockwave therapy for the treatment of knee osteoarthritis: a meta-analysis. *Int Orthop.* 2020;44(5):877-84.
5. Silva AC, Almeida VS, Veras PM, Carnaúba FRN, Filho JE, Garcia MAC, et al. Effect of extracorporeal shock wave therapy on pain and function in patients with knee osteoarthritis: a systematic review with meta-analysis and grade recommendations. *Clin Rehabil.* 2023;37(6):760-73.
6. Wang YC, Huang HT, Huang PJ, Liu ZM, Shih CL. Efficacy and safety of extracorporeal shockwave therapy for treatment of knee osteoarthritis: A systematic review and meta-analysis. *Pain Med (United States).* 2020;21(4):822-35.
7. Chen TW, Lin CW, Lee CL, Chen CH, Chen YJ, Lin TY, et al. The efficacy of shock wave therapy in patients with knee osteoarthritis and popliteal cyamella. *Kaohsiung J Med Sci.* 2014;30(7):362-70.
8. Cho SJ, Yang JR, Yang HS, Yang HE. Effects of extracorporeal shockwave therapy in chronic stroke patients with knee osteoarthritis: A pilot study. *Ann Rehabil Med.* 2016;40(5):862-70.
9. Imamura M, Alamino S, Hsing WT, Alfieri FM, Schmitz C, Battistella LR. Radial extracorporeal shock wave therapy for disabling pain due to severe primary knee osteoarthritis. *J Rehabilitative Med.* 2017;49(1):54-62.
10. Lee JH, Lee S, Choi S, Choi YH, Lee K. The effects of extracorporeal shock wave therapy on the pain and function of patients with degenerative knee arthritis. *J Phys Ther Sci.* 2017;29(3):536-8.
11. Lizis P, Kobza W, Manko G. Extracorporeal shockwave therapy vs. kinesiotherapy for osteoarthritis of the knee: A pilot randomized controlled trial. *J Back Musculoskeletal Rehabil.* 2017;30(5):1121-8.
12. Lee J-K, Lee B-Y, Shin W-Y, An M-J, Jung K-I, Seo-Ra Yoon. Effect of Extracorporeal Shockwave Therapy Versus Intra-articular Injections of

- Hyaluronic Acid for the Treatment of Knee Osteoarthritis. *Ann Rehabil Med*. 2017;41(5):828–35.
13. Ediz L, Özgökçe M. Effectiveness of extracorporeal shock wave therapy to treat primary medial knee osteoarthritis with and without bone marrow edema in elderly patients. *Turk Geriatr Derg*. 2018;21(3):394–401.
 14. Kang S, Gao F, Han J, Mao T, Sun W, Wang B, et al. Extracorporeal shock wave treatment can normalize painful bone marrow edema in knee osteoarthritis. *Med (United States)*. 2018;97(5):1–6.
 15. Li W, Pan Y, Yang Q, Guo Z, Qi Yue, Qing-Gang Meng. Extracorporeal shockwave therapy for the treatment of knee osteoarthritis A retrospective study. *Medicine (Baltimore)*. 2018;97(27):E11418.
 16. Ammar T. Shock Wave Therapy Versus Interferential Therapy in Knee Osteoarthritis. *Int J Physiother Res*. 2018;6(3):2771–6.
 17. Elerian AE, Ewida. TtMA, Ali N. Effect of Shock Wave Therapy Versus Cortico-. *Int J Physiother*. 2016;3(2):246–51.
 18. Lizis P, Kobza W, Manko G. Extracorporeal Shockwave Therapy is More Effective than Ultrasound on Osteoarthritis of the Knee: A Pilot Randomized Controlled Trial Pawel. *Int j gen med surg*. 2017;1(3):113.
 19. Lizis P, Kobza W, Manko G, Para B. The Influence of Extracorporeal Shockwave Therapy and Kinesiotherapy on Health Status in Females with Knee Osteoarthritis: A Randomized Controlled Trial. *Int j gen with surg*. 2017;1(2):108.
 20. Mishel M, Shenouda SS. Efficacy of Extracorporeal Shock Wave Therapy Versus Mobilization with Movement on Pain, Disability and Range of Motion In Patients With knee Osteoarthritis. *Bull Fac Ph Th Cairo Univ*. 2013;18(1):65–74.
 21. El-Sakka SS, Hussein MI, El-Barbary AM, Rehan FS. The Effect of Shock Wave Therapy as a New Modality for Treatment of Primary Knee Osteoarthritis. *Egypt J Hosp Med*. 2019;75(1):2092–7.
 22. Zhong Z, Liu B, Liu G, Chen J, Li Y, Chen J, et al. A Randomized Controlled Trial on the Effects of Low-Dose Extracorporeal Shockwave Therapy in Patients With Knee Osteoarthritis. *Arch Phys with Rehabilitative [Internet]*. 2019;100(9):1695–702. Available from: <https://doi.org/10.1016/j.apmr.2019.04.020>
 23. Zhao Z, Jing R, Shi Z, Zhao B, Ai Q, Xing G. Efficacy of extracorporeal shockwave therapy for knee osteoarthritis: A randomized controlled trial. *J surg res [Internet]*. 2013;185(2):661–6. Available from: <http://dx.doi.org/10.1016/j.jss.2013.07.004>
 24. Kim JH, Kim JY, Choi CM, Lee JK, Kee HS, Jung KI, et al. The dose-related effects of extracorporeal shock wave therapy for knee osteoarthritis. *Ann Rehabil Med*. 2015;39(4):616–23.
 25. Eftekharsadat B, Jahanjoo F, Toopchizadeh V, Heidari F, Ahmadi R, Babaei-Ghazani A. Extracorporeal Shockwave Therapy and Physiotherapy in Patients With Moderate Knee Osteoarthritis. *Crescent J Med Biol Sci*. 2020;7(4):518–26.
 26. Günaydin ÖE, Bayrakci Tunay V. Comparison of the added effects of kinesio taping and extracorporeal shockwave therapy to exercise alone in knee osteoarthritis. *Physiother Theory Pract [Internet]*. 2022;38(5):661–9. Available from: <https://doi.org/10.1080/09593985.2020.1780657>
 27. Hammam RF, Kamel RM, Draz AH, Azzam AA, Abu El Kasem ST. Comparison of the effects between low- versus medium-energy radial extracorporeal shock wave therapy on knee osteoarthritis: A randomised controlled trial. *J Taibah Univ with Sci [Internet]*. 2020;15(3):190–6. Available from: <https://doi.org/10.1016/j.jtumed.2020.04.003>
 28. Uysal A, Yildizgoren MT, Guler H, Turhanoglu AD. Effects of radial extracorporeal shock wave therapy on clinical variables and isokinetic performance in patients with knee osteoarthritis: a prospective, randomized, single-blind and controlled trial. *Int Orthop*. 2020;44(7):1311–9.
 29. Zhang YF, Liu Y, Chou SW, Weng H. Dose-related effects of radial extracorporeal shock wave therapy for knee osteoarthritis: A randomized controlled trial. *J Rehabilitative Med*. 2021;53(1).
 30. Cavalieri F, Shinzato GT, Leite VF, Uchiyama SST, Miyazaki MH, Kirihara AK, et al. Terapia de ondas de choque focal para osteoartrosis de joelho: um ensaio clínico randomizado duplo-cego. *Acta Fisiátrica*. 2017;24(4):175–9.
 31. Wang TS, Guo P, Li G, Wang JW. Extracorporeal shockwave therapy for chronic knee pain: A multicenter, randomized controlled trial. *Altern Ther*

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#10	...	>	Search: extracorporeal AND shock AND wave OR ESWT OR shockwave AND osteoarthritis Filters: Meta-Analysis, Review, Systematic Review, in the last 5 years, English Sort by: Most Recent	25	14:03:57
#8	...	>	Search: extracorporeal AND shock AND wave OR ESWT OR shockwave AND osteoarthritis Filters: Meta-Analysis, Review, Systematic Review, in the last 5 years Sort by: Most Recent	25	13:35:03
#9	...	>	Search: extracorporeal AND shock AND wave OR ESWT OR shockwave AND oseoarthritis - Spellcheck off Filters: Meta-Analysis, Review, Systematic Review, in the last 5 years Sort by: Most Recent	0	13:33:19
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#3	...	>	Search: extracorporeal AND shock AND wave OR ESWT OR shockwave AND oseoarthritis - Spellcheck off Filters: Meta-Analysis Sort by: Most Recent	0	13:33:02
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#1	...	>	Search: extracorporeal shock wave Sort by: Most Recent	6,101	13:32:11