RESEARCH
www.commprac.com
ISSN 1462 2815

COMPARISON OF THE EFFECTS OF SHOCK WAVE THERAPY (ESWT) WITH HOLD RELAX ON REDUCING PAIN AND INCREASING RANGE OF MOTION (ROM) IN OSTEOARTHRITIS PATIENTS

Andi Irham [1], Djohan Aras [2], Aryadi Arsyad [3], Andi Aryandy [4] and Audry Devisanty Wuysang [5]

[1] Master, Biomedical Sciences, Graduate School Hasanuddin University, Makassar, South Sulawesi, Indonesia.
[2] Department of Physiotherapy, Faculty of Nursing, Hasanuddin University, Makassar, South Sulawesi, Indonesia.
[3, 4] Department of Physiology, Faculty of Medicine, Hasanuddin University, Makassar, South Sulawesi, Indonesia. [4]Email: andiirham83@gmail.com
[5] Department of Neurology, Faculty of Medicine, Hasanuddin University, Makassar, South Sulawesi, Indonesia.

DOI: 10.5281/zenodo.10972372

Abstract

Osteoarthritis is a joint disorder characterized by inflammation accompanied by pain and limited movement in the knee joint. Osteoarthritis can be caused by trauma, physical activity, age, gender, obesity and so on. This study aims to evaluate the comparative effect of Shock Wave Therapy (ESWT) and Hold Relax on reducing pain and increasing Range of Motion (ROM) in Osteoarthritis patients. This research used a quasi-experimental design with a two group pretest-posttest. The sample obtained was 20 subjects consisting of 10 people in the group given ESWT therapy and 10 people in the group given hold relax therapy with training intensity 3 times a week. This study showed that the hold relax therapy group and ESWT did not have a significant difference in effect on reducing pain (p=0.62). However, it had a significant effect on increasing knee joint flexion ROM (p=0.001). Hold Relax therapy was not more significant in reducing pain than ESWT therapy but provided a significant increase in ROM in osteoarthritis patients.

Keywords: Osteoarthritis, VAS, ROM, Hold Relax, ESWT.

INTRODUCTION

Osteoarthritis(OA) is the most common degenerative joint disease affecting weight-bearing joints. Articular cartilage damage is usually more visible on the medial than the lateral aspect of the knee. One-third of individuals older than age 65 have radiographic evidence of OA. Pain, muscle weakness, medial joint weakness, and limited joint movement affect function and cause disability. Deformities such as genu varum usually develop in the knee. Knee instability (the sensation of the knee buckling or shifting) is also frequently reported by individuals with knee OA and significantly contributes to impaired physical function [1].

The pathophysiology of OA is caused by the biomechanics and inflammatory pathogenesis of Post-traumatic OA (PTOA) which occurs at the point of injury when symptoms appear. With traumatic injury, mechanical imbalance and overloading occur which will trigger inflammation of signaling pathways such as nuclear factor kappa B (NF-kB), cyclooxygenase-2 (COX-2), inducible nitric oxide synthase (iNOS), and poly adenosine diphosphate (ADP) which is a ribose pathway in the synovial. This cascading activity and inflammation along with ongoing mechanical insults increase levels of inflammatory mediators and other matrix destruction enzymes, resulting in chondrocyte apoptosis, matrix degradation, leukocyte recruitment and other structural

and molecular changes associated with OA. The acute inflammatory phase in OA usually disappears suddenly. However, this also depends on the burden or aggravating factors. Injuries to the ligaments in the knee such as the anterior and posterior curciatum ligaments (ACL and PCL) will worsen the condition and disorders of this condition which will cause problems such as pain, limited movement, muscle weakness and disruption of daily activities [2].

Problems related to pain, limited movement and disorders due to OA can be approached conservatively, pharmacologically and also by combining physical exercise to reduce the symptoms and problems caused. Providing exercises with the aim of increasing the range of motion in the knee joint space will not only increase the range of motion (knee joint ROM) but can also reduce movement pain. There are various types of exercises that can be given in this condition, including Shock Wave Therapy (ESWT) and Hold relax.

MATERIALS AND METHODS

Location and Research Design

Sampling was carried out at RSKD. Dadi Provincial Government of Dadi Makassar. The research method was carried out using quasi-experimental research with a pretest-posttest two group design.

Research methods

The sampling method in this study used purposive sampling, namely by taking samples from the population according to the specified inclusion criteria, namely osteoarthritis patients with pain disorders and limited knee flexion ROM. Internal samples will receive intervention in the form of Hold Relax and ESWT which will measure pain using the Visual Analogue Scale (VAS) and joint range of motion using a geniometer before and after undergoing therapy.

Population and Sample

The population of this study were all osteoarthritis patients who came for treatment to RSKD. Dadi South Sulawesi Provincial Government. The research sample consisted of osteoarthritis patients with inclusion criteria. The sample size used in this researchcalculated using the formula, as follows

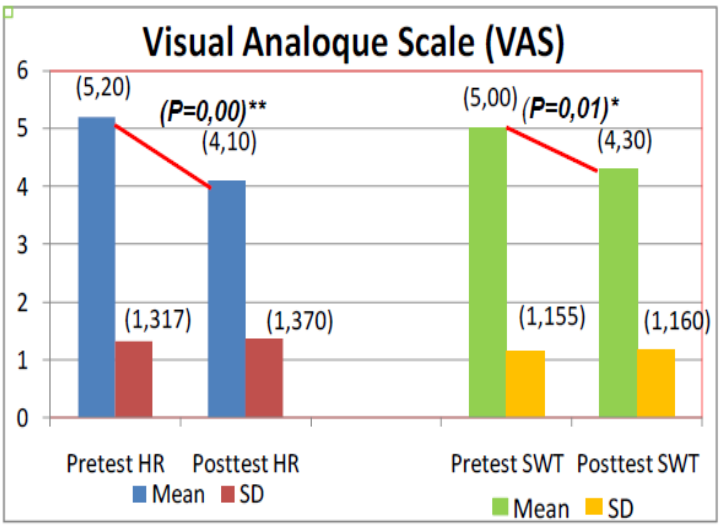
$$n1 = n2 = \frac{(\{Z\alpha + Z\beta\}S)2}{x1 - x2}$$

Based on the formula calculation above, the number of samples for each group is 10 samples. To avoid the occurrence of research samples dropping out, the sample size was revised by 10% of the sample size according to the formula with a total sample size of 24 people divided into 2 groups, namely the treatment group with ESWT therapy with a sample size of 12 people and the group given therapy. hold relax with a sample size of 12 people for 4 weeks.

RESULTS

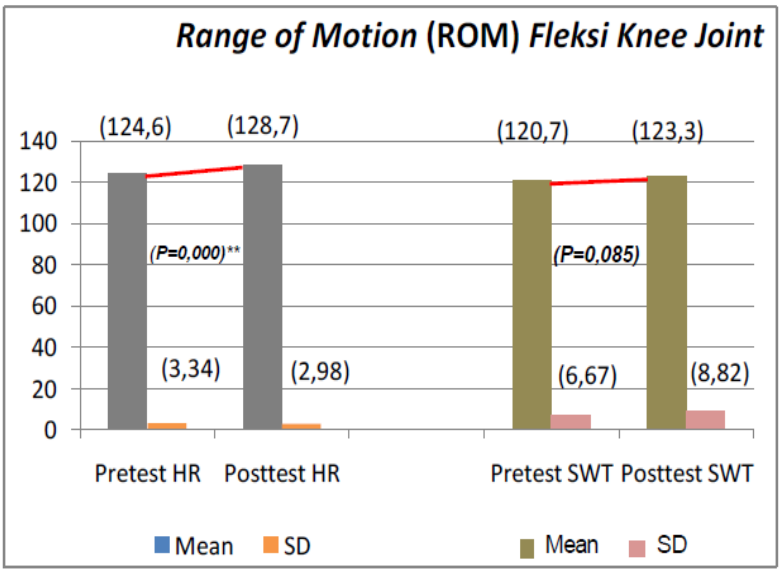
This research was conducted on osteoarthritis patients with pain disorders and limited ROM in RSKD. Dadi Makassar South Sulawesi Provincial Government for 4 weeks. The study population was all OA patients with pain disorders and limited ROM who met the inclusion and exclusion criteria. The number of samples in this study was 24 samples which were divided into 2 sample groups, namely 12 people who were given ESWT therapy and 12 people who were only given hold relax therapy. The data in this study include primary data by taking direct data on the number of respondents in this study and the results of the pretest and posttest examination of the research sample by measuring pain (VAS) and limited ROM as measured by a geniometer as well as secondary data from patient data seen from medical records patient history consisting of disease history, treatment history, CT-Scan examination. The data obtained was then processed according to the research objectives which were presented in the form of tables and diagrams to illustrate the comparison of the effects of ESWT with Hold Relax on reducing pain and increasing ROM in osteoarthritis patients.

Graphic 1: Comparison of VAS before and after Hold Relax and ESWT interventions in the Research Sample Group



Based on graph 1 above, it is known that the mean value and standard deviation in the sample group given the Hold Relax and ESWT interventions can be seen from the VAS value in the Hold Relax intervention group. The mean-SD pretest VAS value was 5.20 ± 1.317, higher than the posttest value of 4. .10 ± 1.370 with a mean difference of 1.1. From the results of the influence test in the hold relax intervention group pretest and posttest therapy, a p-value of 0.001 was obtained. Because p < 0.05 (alpha), it can be concluded that there is a very significant influence between the pretest and posttest VAS on reducing pain in the sample given the hold relax intervention in osteoarthritis patients. Meanwhile, the ESWT intervention group obtained a mean ± SD VAS pretest value of 5.00 ± 1.155, which was higher than the posttest value of 4.30 ± 1. 160 with a mean difference of 1.2. From the results of the effect test in the ESWT intervention group pretest and posttest therapy, a p-value of 0.01 was obtained. Because p < 0.05 (alpha), it can be concluded that there is a significant influence between the pretest and posttest VAS on reducing pain in the sample. given ESWT intervention to osteoarthritis patients.

Graphic 2: Comparison of ROM before and after Hold Relax and ESWT interventions in the Research Sample Group



Based on graph 2 above, it is known that the mean value and standard deviation in the sample group given the Hold Relax and ESWT interventions can be seen from the ROM value in the Hold Relax intervention group. The mean-SD pretest ROM value was 124.6 ± 3.34 lower than the posttest value. amounting to 128.7 ± 2.98 with a mean difference of 4.1. From the results of the influence test in the hold relax intervention group pretest and posttest therapy, p-values were obtained of 0.000. Because p < 0.05 (alpha), it can be concluded that there is a very significant influence between pretest and posttest ROM on increasing knee flexion ROM in samples given hold relax intervention in osteoarthritis patients. Meanwhile, the ESWT intervention group obtained a mean ± SD pretest ROM value of 120.7 ± 6.67, which was lower than the posttest value of 123. 3 ± 8.82 with a mean difference of 2.6. From the results of the effect test in the ESWT pretest and posttest therapy intervention groups, a p-value of 0.085 was obtained. Because p > 0.05 (alpha), it can be concluded that there is no significant influence between pretest and posttest knee flexion ROM on increasing knee flexion ROM in samples given ESWT intervention in osteoarthritis patients.

Table 1: Comparison of pain reduction (VAS) and increase in ROM before and after intervention between Hold Relax and ESWT

	VAS posttest			*Posttest knee joint flexion ROM*		
Group	***Mean-SD***	**Mean Difference**	***p-value***	***Mean-SD***	**Mean Difference**	***p-value***
Hold Relax	4.10±1,370	0.2	0.62	128.7±2.98	5.4	0.001
ESWT	4.30±1,160			123.3±8.82		

**Mann Whitney U-Test*

Based on table 1, it shows the mean ± SD posttest value between the Hold relax and ESWT interventions on reducing pain with the VAS measurement tool with a mean ± SD hold relax value of 4.10 ± 1.370 and a mean ± SD ESWT value of 4.30 ± 1.160 with the mean difference is 0.2 with a p-value of 0.062 (p>0.05). From these data it

can be concluded that the effect of providing Hold Relax or ESWT interventions does not provide a significant difference in reducing pain in osteoarthritis patients.

Table 1 also show the posttest mean ± SD value between the Hold relax and ESWT interventions on increasing ROM with a geniometer measuring instrument with a mean ± SD hold relax value of 128.7 ± 2.98 and a mean ± SD ESWT value of 123.3 ± 8.82 with a mean difference of 5.4 with a p-value of 0.001 ($p<0.05$). From these data it can be concluded that the effect of providing hold relax or ESWT interventions has a significant difference in increasing knee flexion ROM in osteoarthritis patients. Judging from the mean difference value of hold relax before and after giving therapy, the resulting value is higher than ESWT with a difference value of 5.4, so it can be concluded that giving hold relax therapy has a better effect on increasing knee flexion ROM compared to ESWT in osteoarthritis patients.

DISCUSSION

The results of this study show that the provision of hold relax therapy and ESWT has a significant effect on reducing pain (VAS) without a significant difference between the two interventions in osteoarthritis patients (Table 1) with a mean difference between the hold relax and ESWT intervention groups of 0.2 with a p-value of 0.73 ($p>0.05$) seen from the VAS value. Providing both hold relax and ESWT therapy before and after therapy had an effect on reducing pain, but after comparing the effect between these two types of intervention, it did not have a significant effect on reducing pain in osteoarthritis conditions.

Pain in OA sufferers is caused by shortening of the hamstring muscles which will induce abnormal loading on the knee joint so that it will affect the work of the quadriceps femorish muscles. When the quadriceps femorish muscle maintains the stability of the knee joint, it will cause the hamstring muscles to shorten which will affect circulation thereby increasing pain. The mechanism for reducing pain when stretching techniques are given is by increasing the space between the knee joint which will increase the space for the meniscus to move when movement occurs. By increasing the range of motion of the knee joint, when given stretching techniques, especially passive techniques, will increase hamstring flexibility [3]. Pain usually occurs due to a buildup of lactic acid, muscle spasms, damage to connective tissue, damage to muscle tissue, inflammation and lack of collagen and enzymes in the joints resulting in movement pain in OA sufferers [4].

One of the reasons for the decrease in pain sensitivity in OA conditions is a decrease in muscle spasms due to inhibition of movement after isomentric contractions in the hamstring muscles which experience tension. Providing exercises that focus on stretching techniques for the hamstring muscles turns out to provide more significant results in reducing pain in hamstring movements. Other research shows that stretching techniques using proprioceptive stimulation to relax (inhibit) muscle groups by inhibiting the reflective component in muscle contractions will increase the range of motion of joints (LGS) so that pain is reduced by reducing the load on the joints [5].

According to "Gate control theory" when administering this technique pain and peripheral pressure receptors are connected to the same interneurons as the dorsal spinal cord. Pain receptors connect to pressure receptors of unmyelinated or lightly myelinated afferent nerves to thickly myelinated afferent fibers. Pressure signals are transmitted to the vertebrae before pain signals are transmitted when the pain signals

of both receptors are stimulated simultaneously. During this technique, pressure impulses from the Golgi tendons, joints, tendons and capsule can inhibit the transmission of pain to the dorsal lamina in the spinal cord. During contraction and relaxation and stretching of antagonist muscles, the muscles will be stretched beyond the joint range of motion (LGS). When stretching resistance occurs [6]. This is in line with research Aras et al., (2018), that when hold relax is applied sequentially, at the same time there is inhibition of sensory interneurons and alpha neurons which causes the knee joint extensor muscle group to relax which will reduce pain by reducing the inflammatory reaction in the synovial by stretching the joint capsule.

Likewise, the sample group that was given the ESWT intervention showed that the level of pain reduction from when the patient initially experienced pain in the knee joint with severe intensity after being given ESWT therapy decreased to moderate or mild pain, although the increase in value was not significant. Giving ESWT is a shock wave in the form of a type of sound wave that can be transmitted through soft tissue without losing energy and its gentle, repeated stimulation will reduce pain. The stimulation generated by the shock wave forms new muscle fibers by facilitating the secretion of substances that produce blood vessels around the affected area [8].

The effect of reducing pain when ESWT therapy is given is influenced by the size and number of shocks produced which will affect endothelial progenitor cells when low intensity shocks are given (0.04 – 0.13 mJ/mm2), the expression of endothelial nitric oxidant synthase will increase when cells are given a shock at high intensity (0.16mJ/mm2), most cytokine expression decreases, causing cells to undergo apoptosis. Shock intensity with shocks of 0.10 – 0.13 mJ/mm2 and shock number of 200 – 300 impulses is the optimal dose for administering ESWT with the aim of stimulating cells in vitro. Other research states that a shock intensity of 0.10 – 0.16 mJ/mm2 with a shock number of 2000 impulses is more effective in reducing pain for 4 weeks [9]. The concept of reducing pain by administering ESWT is by increasing nonvascular substance P in sensory nerve fibers by increasing neovascularization which can increase blood supply and repair inflamed tissue through tissue regeneration which will then reduce levels of calcitonin gene-related peptide (CGRP) at the ends of dorsal ganglia neurons (DRG) which is associated with pain in the joints. ESWT will inhibit the increase in pain transmission through sensory nerve fibers by degeneration of nerve endings. This degeneration will help to reduce the number of DRG and CGRP neurons which will reduce pain in OA [10].

The results of this study show that administering hold relax therapy and ESWT has a significant effect on increasing ROM without a significant difference between the two interventions in osteoarthritis patients (Table 4.3/diagram 4.3) with a mean difference between the hold relax and ESWT intervention groups of 5.4 with a p-value of 0.81 ($p>0.05$) seen from the ROM value. However, providing both hold relax and ESWT therapy before and after therapy had an effect on increasing knee joint flexion ROM, but after comparing the effect between these two types of intervention, it did not have a different effect in increasing knee joint flexion ROM in conditions of osteoarthritis. The group of samples that were given hold relax therapy showed an increase in ROM, where initially the patient's knee flexion ROM was on average below 135 degrees, although not all samples could achieve normal ROM, but there were several samples that could achieve this ROM. Although the increase in ROM values was not significant in this intervention group, the research sample showed an improvement in ROM for the better.

Hold relax training using the mechanism of reciprocal muscle inhibition and rhythmic contraction and relaxation using a technique of holding for 5 seconds and relaxing for 10 seconds with 5 sets of repetitions will increase the ROM of knee joints that experience limited movement due to contractures. In addition, along with increasing ROM, muscle strength and muscle flexibility will increase [11]. Other research states that the hold relax technique will have an effect on proprioception and activation of the Golgi tendon organs which inhibit muscle excitation and provide muscle relaxation. Autogenic inhibition, relaxation of stress and muscle tendons and stimulation of mechanoreceptors in the skin, joint capsule and connective tissue around the knee joint will increase proprioception. This increase in ROM can also be associated with the "Sarcomere Give and Autogenic Mechanism" which states that during stretching of muscle tension, Golgi tendon organs, afferent stimulation is sent through 2β fibers, inhibiting α motor activity which will reduce tension in the muscles resulting in relaxation and lengthening muscle fibers [12].

Likewise, the sample group that was given ESWT intervention showed an increase in ROM values, although not significant, initially the patient's knee flexion ROM was on average below 135 degrees, although not all samples could achieve normal ROM, but there were several samples that could achieve this ROM. Although the increase in ROM values was not significant in this intervention group, the research sample showed an improvement in ROM in a better direction. However, judging from the statistical value of sig 0.085 ($p>0.05$) in graph 4.3 and the posttest comparison value between the two forms of therapy of sig 0.81 ($p>0.05$), it states that giving ESWT therapy does not have a significant effect on increased ROM in the knee joint but in terms of improvement value there was a change in ROM in knee flexion movements.*vessel endothelial growth factor* (VEGF) which is beneficial for neovascularization [13].

Giving ESWT does not have an effective effect in increasing the range of motion of the joint, not because the application of the ESWT working method provides shock therapy to the affected tissue without paying attention to the movement activity or limited range of motion of the knee joint so that the effect obtained is more on improving the tissue rather than increasing the range of motion of the joint. So, in the application of ESWT, apart from reducing pain and increasing joint range of motion, ESWT therapy must be combined with exercise to get a maximum effect of increasing ROM. The type of exercise must also focus on increasing the space between the menismus in the knee joint and strengthening it so that apart from increasing the range of motion of the joint, it will also increase muscle strength to stabilize movement during activity. This is also in line with research Lee et.al [14], states that ESWT therapy combined with physical exercise can relieve OA conditions and restore function. Because when you combine these exercises, there will be an increase*cartilage oligomeric matrix protein* (COMP) and collagen 2-1 (Coll2-1) for cartilage synthesis. This protein not only stabilizes collagen tissue but also effectively maintains joint stability and the physiological function of articular cartilage [13].

Research Limitations

This study has several limitations, namely the small sample size because there are not enough OA sufferers who go to hospital for treatment, so the research sample is relatively small. This study also did not carry out CT-Scan examinations and molecular reactions of pain substances after therapy so that the results related to the increase in

space between the meniscus in the knee joint could not be seen and measured. Obesity factors and analgesic users contribute to reducing pain intensity and increasing knee joint ROM. The 4 week duration of training carried out in this study may have been too short to produce an impact on reducing pain, increasing knee joint ROM and strength of the knee moving muscles, thereby influencing the results of the study to be less than optimal.

CONCLUSION

Giving Hold Relax therapy was more effective in reducing pain and increasing knee joint flexion ROM in osteoarthritis patients compared to ESWT therapy, although statistically there was no significant change.

Acknowledgement: "Andi Irham, Department of Biomedical Sciences, Faculty of Postgraduate Studies, Hasanuddin University, compiled this journal article based on the report " Comparison Of The Effects Of Shock Wave Therapy (ESWT) With Hold Relax On Reducing Pain And Increasing Range Of Motion (ROM) In Osteoarthritis Patients".

Funding: This work was funded by the research. The opinions expressed here are those of the author and do not necessarily reflect the views of the funding agency.

References

1) "Therapeutic-exercise.-Foundations-and-techniques-by-Colby-Lynn-Allen-Kisner-Carolyn-z-lib.org_".

2) Salman, G. Ahmed, S. G. Dakin, B. Kendrick, and A. Price, L. A. "Osteoarthritis: a narrative review of molecular approaches to disease management," *Arthritis Research and Therapy*, vol. 25, no. 1. BioMed Central Ltd, Dec. 01, 2023. doi: 10.1186/s13075-023-03006-w.

3) Ghafoor, F. "Comparison of Effectiveness of Muscle Energy Technique Versus PNF in Individuals with Hamstring Shortness,'" *Biomed J Sci Tech Res*, vol. 50, no. 1, Apr. 2023, doi: 10.26717/bjstr.2023.50.007891.

4) Gala S. and Akhter Rizvi, S. R. "To Compare the Immediate Effect of Hold-Relax Technique Versus Myofascial Release on Delayed Onset Muscle Soreness of Quadriceps Muscle in Runners," *International Journal of Science and Healthcare Research*, vol. 7, no. 2, pp. 305–316, May 2022, doi: 10.52403/ijshr.20220442.

5) Nafees, K., Baig, A. A. M. Ali, S. S. and Ishaque, F. "Dynamic soft tissue mobilization versus proprioceptive neuromuscular facilitation in reducing hamstring muscle tightness in patients with knee osteoarthritis: a randomized control trial," *BMC Musculoskelet Disord*, vol. 24, no. 1, Dec. 2023, doi: 10.1186/s12891-023-06571-y.

6) Gao, B. *et al.*, "Effects of proprioceptive neuromuscular facilitation stretching in relieving pain and balancing knee loading during stepping over obstacles among older adults with knee osteoarthritis: A randomized controlled trial," *PLoS One*, vol. 18, no. 2 February, Feb. 2023, doi: 10.1371/journal.pone.0280941.

7) Aras, D. Hatta, M. Islam, A. A. and Arif, S. K. "Hold relax technique and oral glucosamine are effective on decreasing pain, joint stiffness, functional limitation and serum level of comp in people with osteoarthritis," *Indian J Public Health Res Dev*, vol. 9, no. 6, pp. 403–407, Jun. 2018, doi: 10.5958/0976-5506.2018.00587.9.

8) Lee, J.-H., Lee, S., Choi, S., Choi, Y.-H., and Lee, K. "The effects of extracorporeal shock wave therapy on the pain and function of patients with degenerative knee arthritis."

9) Zhang, Y. F., Liu, Y., Chou, S. W., and Weng, H. "Dose-related effects of radial extracorporeal shock wave therapy for knee osteoarthritis: A randomized controlled trial," *J Rehabil Med*, vol. 53, no. 1, Jan. 2021, doi: 10.2340/16501977-2782.

10) An, S., Li, J., Xie, W., Yin, N., Li, Y., and Hu, Y. “Extracorporeal shockwave treatment in knee osteoarthritis: Therapeutic effects and possible mechanism,” *Bioscience Reports*, vol. 40, no. 11. Portland Press Ltd, Nov. 01, 2020. doi: 10.1042/BSR20200926.

11) Jawade, S., Vardharajulu, G., and Naidu, N. “Comparison of effectiveness of hold-relax technique and maitlandfs mobilization in improving range of motion in posttraumatic stiffness of knee joint,” *Journal of Datta Meghe Institute of Medical Sciences University*, vol. 15, no. 3, p. 402, 2020, doi: 10.4103/jdmimsu.jdmimsu_243_20.

12) Nathani, S. and Tank, K. D. “Effect of Pnf Stretching on Proprioception and Physical Function in Individual with Knee Osteoarthritis: An Experimental Study,” 2020.

13) Chen, L., Ye, L., Liu, H., Yang, P., Yang, B., and Seixas, A. “Extracorporeal Shock Wave Therapy for the Treatment of Osteoarthritis: A Systematic Review and Meta-Analysis,” *Biomed Res Int*, vol. 2020, 2020, doi: 10.1155/2020/1907821.

14) Li, W., Chen, X., Tang, A.I., Wen, C., and Wu, X. “Effect of extracorporeal shock wave treatment combined with rehabilitation therapy on early and middle stage knee osteoarthritis,” 2020. [Online]. Available: www.ijcem.com/