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EFFECT OF SHOCK WAVE THERAPY VERSUS CORTICOSTEROID INJECTION IN MANAGEMENT OF KNEE OSTEOARTHRITIS

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ABSTRACT

Background: knee Osteoarthritis is the most common cause of musculoskeletal pain and disability. Shockwaves have been used as an alternative treatment for musculoskeletal disorders; intra-articular injection of steroid is a common treatment for osteoarthritis of the knee. This study aimed to investigate the efficacy of Shock wave therapy versus Corticosteroid intra articular injection in case of knee osteoarthritis.

Methods: Sixty patients were diagnosed mild to moderate knee osteoarthritis; they were included in the study. Their ages were 43:65 years with mean age 50 ± 3.5 years. Patients were divided randomly into three equal groups, group (A) received shock wave therapy, group (B) received two intra-articular injections of corticosteroid at 1-month intervals and group (C) received sham shock wave. The outcome measurements were Western Ontario and McMaster Universities arthritis index (WOMAC) values, knee ROM, and pain severity using the visual analogue scale (VAS) were recorded. The patients were evaluated for these parameters before allocated in their groups then after 1, 2, and 6months later.

Results: compared to sham group there were significant improvement of VAS and ROM of shock wave group and corticosteroid injection group than sham (placebo) group ($p<0.000$), ($p<0.006$, and 0.02) respectively. Furthermore there was significant improve of shock wave group than corticosteroid injection group where p was <0.000 for VAS, ROM and (WOMAC).

Conclusion: The results of this study suggested that shock wave therapy may provide effective modality for relieving pain, increase Range of motion and improve function in knee osteoarthritis patient than intra articular corticosteroid injection.

Keywords: Shock wave, Corticosteroid, intra articular, injection, Knee joint, osteoarthritis.

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INTRODUCTION

Osteoarthritis OA is a complex syndrome with a number of underlying biomechanical, physical and metabolic factors, with the knee joint being the most commonly affected. Despite its global prevalence the exact causative events of OA are yet to be clearly elucidated, (OA) is an age-dependent disease caused by degenerative and healing processes in subchondral tissue of articular and bone cartilage, resulting in an alteration of its biomechanical properties that eventually causes pain, stiffness, and decreased articular function [1].

"Osteo", meaning "of the bone", "arthro", meaning "joint", and "it is", meaning inflammation, however some clinicians refer to this condition as osteoarthrosis to signify the lack of inflammatory response [2].

Osteoarthritis considered a disease of articular cartilage because it involves the entire joint tissues, synovium, capsule, bone and ligaments leading to subchondral bone attrition and remodelling, meniscal degeneration, ligamentous laxity, fat pad extrusion, and impairments of neuromuscular control. The cartilage is poorly innervated and is not the cause of pain. The diagnosis must be made clinically because laboratory test may not be helpful and radiological findings do not necessarily correlate with the symptoms [3].

OA knee increases with age (older than 50 years), especially in women. According to a number of published reports, anywhere from 6% to over 13% of men, but between 7% and 19% of women, over 45 years of age are affected, resulting in a 45% less risk of incidence in men [4]. Additional factors that increase the risk of developing OA of the knee include genetics and obesity [5].

Genetic factors appear to influence risk of developing primary OA though they may influence disease differently in men and women. Twin studies suggest that generalised OA in women has a heritability rate of 39 to 65%, with a concordance rate in monozygotic twins of 0.64 [6,7,8].

There are many symptoms of knee osteoarthritis, including pain in knee joint and associated muscles and tendons [9], which may lead to decrease range of motion of stiffness, crepitus with movement, and joint effusion is a common presented in patient with knee effusion [10].

Many musculoskeletal disorders were treated with shock wave therapy[11,12,13]. Mechanical acoustic waves that are transmitted through liquid and gaseous media [14,15] are the main core in treatment of Shock wave therapy, while the main biological effect comes from the ultrasonic vibrations on tissues [16].

Shockwaves produce mechanical and biological effects including destruction of fibrosis and stimulation of neovascularization in treated tissues [12]. It involves focused single-pressure pulses of microsecond duration and was first used for medical purposes in the treatment of renal calculi. In the 1990s, shock wave became popular in Germany for certain soft-tissue disorders, including calcifying tendonitis of the rotator cuff, humeral epicondylitis and plantar fasciitis. It is now employed worldwide for the treatment of musculoskeletal complaints [17]. The effect of shockwaves has been shown to cause disintegration of fibroses and calcifications and increase blood circulation at the treated location [15].

Knee intra-articular injection of steroid is a treatment modality for knee osteoarthritis,while its effect is short lived, usually one to four weeks [18,19]. The short term effect of steroids shown by controlled trials and clinical experience vary, pain scores may also be an insensitive outcome measure [20].

There are few treatment methods for moderate to severe OA; most focus on relieving the symptoms but do little to change the biochemical environment of the joint or on the disease process. Current therapies include simple analgesics, anti-inflammatory drugs, muscle strengthening exercises, physical therapy, intra-articular injection of cartilage supplements such as hyaluronic acid agents, arthroscopic surgery, and arthroplasty [21,22].

It should be noted that the number of elderly people in society is increasing and musculoskeletal disorders, mainly OA in this population, are very common. Routine treatments for pain and disability in these patients have low efficacy, and some treatments, including hyaluronic acid injection therapy, have high costs. It is possible that shock wave has acceptable effects on OA in these patients (shock wave)

Therefore, we designed this study to investigate the effectiveness of shock wave versus Corticosteroid Injectionin decreasing pain, improving daily functional ability, and increasing the joint range of motion (ROM) in patients with knee OA.

METHODS AND MATERIALS

60 adult patients (50 female and 10 male) their ages were 45:65 years old with mean age 51 ± 3.5 year diagnosed with bilateral knee OA based on the clinical criteria of the American Rheumatological Association [23]. Who met the inclusion and exclusion criteria, were recruited from physical therapy clinics and orthopedic clinics in Cairo city.

The inclusion criteria were patients aged 45 – 65 years old who had: (a) moderate or moderate to severe knee OA (grade II or III according to the radiological classification of knee OA defined by Kellgren and Lawrence.

The exclusion criteria were patients who had: (a) severe OA (grade IV according to the Kellgren–Lawrence system of classification) [24]; (b) history of rheumatologic or inflammatory diseases; (c) received oral or systemic corticosteroids during the 6 months prior to treatment; (d) received an intra-articular injection of hyaluronic acid agents during the previous month; (e) poorly controlled diabetes mellitus with fasting blood sugar greater than 11.1 mmol/L; (f) history of anticoagulation therapy; (g) history of prior total knee replacement surgery.

The radiological criteria of knee joint OA severities used in

this study were based on the Kellgren–Lawrence classification: grade 0: normal; grade I: small osteophytes without clinical importance; grade II: definite osteophytes but normal joint space; grade III: definite osteophytes with moderate narrowing of joint space; grade IV: definite osteophytes with severe narrowing of joint space [24].

Research ethics

The study procedure was in accordance with the ethical standards of the responsible local committee on human experimentation of faculty of physical therapy, Cairo University. Before participating in the project, the aims of the study were explained orally to all the patients and written informed consents were obtained from all study participants.

Study design

This study was randomized placebo-controlled, double-blind study. Patients were randomly assigned into 3 groups each containing 20 patients with bilateral knee osteoarthritis. Group (A) Radial shockwave therapy: These patients were treated with applications of radial shockwaves, which were always administered by the same physiotherapist. LONGEST LGT-200S equipment was used with a low-intensity applicator (figure 1).

Two thousand beats were applied at a frequency of 5 Hz and a pressure of 2MPa. The impulses would be applied at the most painful site of the knee joint interface on manual palpation as shown, for three consecutive weeks. The sessions were performed once per week for a total of three sessions[16].

Figure 1: LONGEST LGT-200S Shock wave

Figure 2: Application of shock wave

Group (B) Each patient received intra-articular corticosteroid injection using 3-mL syringe for injection with 1-inch (25-gauge needle), 2 mL of 2% lidocaine for local anesthetic, 40 mg/mL of methylprednisolone, a marker, and alcohol swabs. Technique of application of corticosteroid was as following: The patient was sitting with the knee flexed at 90˚. Locate the apex of the patella by palpation. This was also the apex of the triangle. Draw a line from the apex to the lateral upper pole of the patella and another line from the apex to the medial upper pole of the patella. Join these lines, with the base of the triangle forming the upper border of the patella. This position with the knee flexed is used for injecting the knee, mark the midpoint with ink. This is where the needle entry for injection would be (approximately midpatella).Mix 1 mL of 40 mg/mL of methyl prednisolone with 2 mL of lidocaine. Draw up the 2 mL of lidocaine first and then the methyl prednisolone as it mixes better that way. Clean the area with alcohol or iodine. Insert the needle into the space between the patella and femur parallel to the middle facet of the patella using the ink spot as the point of entry. Angle the needle to the center of the patella and inject the mixture into the space between the patella and the femur [25].

Group (C) received sham shock wave for three consecutive weeks. Randomization was allocated using the numbered envelop method. 20 Subjects were chooses for intra articular while other 40 subjects were divided randomly into group A and C, subjects were blinded about which group they were allocated.

Outcome measures: Baseline demographic findings and Western Ontario and McMaster Universities arthritis index (WOMAC) values, knee ROM, and pain severity at rest (seated) and in activity (after walking 6 m) using the visual analogue scale (VAS) were recorded. The patients were evaluated for these parameters before allocated in their groups then after 4, 8, and 24 weeks later. Knee ROM in flexion was determined in prone position using an international standard 360º electro goniometer. The validity and reliability of this measuring device has been demonstrated by other researchers [26]. Pain was measured using a 10 cm VAS. Pain intensity is classified using a range from 0 to 10, in which 0 = no pain at all and 10 = the worst possible pain. Patients were asked to sign the place on the VAS scale that corresponded to their pain level.

The WOMAC questionnaire is used to evaluate a patient's functions when diagnosed with rheumatic diseases, especially knee OA. The WOMAC is a 24-item questionnaire with three subscales measuring pain (five items), stiffness (two items), and physical function (17 items). Answers to each of the 24 questions are scored on five-point Likert scales (none = 0, slight = 1, moderate = 2, severe = 3, extreme = 4), with total scores ranging from 0 to 96. So, the maximum possible scores for WOMAC, pain, stiffness, and function are 96 (most severe), 20, 8, and 68, respectively. Higher scores indicate greater disease severity [27]. Achievement of minimal clinical difference with regard to similar studies was calculated as 20% for total WOMAC score and 50% for overall improvement in this score. Repeated measures analysis of variance (ANOVA) was used to evaluate the serial changes of different variables during the treatment period. All data were analyzed using the Statistical Package for Social Sciences, version 16.0; $p< 0.05$ was considered to be statistically significant.

RESULT

This study demonstrated that both shock wave and intra articular corticosteroid injection improved knee ROM and decrease pain, improve functional abilities as well as improve functional use of affected limbs as shown in tables (1, 2, and3). While table (4) represent the results of post hoc test for comparison between each two groups at post treatment and showed that, compared to control group there were significant improvement of VAS and ROM in shock wave group (p<0.000). Also there were significant improvement of corticosteroid intra articular injection group than placebo (p<0.006, and 0.02) respectively. Furthermore there was significant improve of shock wave group than corticosteroid intra articular injection group where p was <0.000 for VAS, ROM and (WOMAC).

Table 1: Changes in range of motion, visual analogue scale and Total Western Ontario and McMaster Universities arthritis index of group (A) during the study periods (24 weeks).

Evaluation intervals variable	At initial evaluation (0 week)	2nd evaluation (4 weeks)	3rd evaluation (8 weeks)	Final evaluation (24 weeks)	*p* value
Range of motion (°)	100.14± 8.14	113.30± 6.30	120.25± 2.23	130.67±5.67	*< 0.001
Percentage$ changes	_	29.66%	32.53%	51.83%	
Point changes±	_	11.16± 3.01	18.11± 4.10	28.52± 4.67	
Visual pain analogue scale	8.38 ± 1.01	5.67 ± 1.15	4.89 ± 1.05	4.08 ± 1.75	*< 0.001
Percentage changes$	_	27.1%	34.9%	43%	
Point changes±		-2.71± 0.04	-3.49± 0.94	-3.96± 0.04	
Total Western Ontario and McMaster Universities arthritis index	50.13 ± 12.32	28.15 ± 5.11	24.6 ± 3.71	23.05 ± 4.93	*< 0.001
Percentage$ changes	_	43.96%	52.26%	54.16%	
Point changes±	_	-21.98± 5.31	-25.53± 6.31	-27.08± 8.41	

p is two-sided significant (< 0.05) using repeated measures of analysis of variance statistical test. Improvement percentage of measured values is calculated by dividing the amount of changes at each level on the maximum of expected change (155±5) and multiplying it by 100.

Table 2: Changes in range of motion, visual analogue scale and Total Western Ontario and McMaster Universities arthritis index of group (B) during the study periods (24 weeks)

Evaluation intervals variable	At initial Evaluation (0 week)	2nd evaluation (4 weeks)	3dr evaluation (8 weeks)	Final of evaluation (24 weeks)	*P* value
Range of motion (°)	101.00± 9.12	102.33± 8.40	103.35± 8.23	102.97±8.56	*< 0.13
Percentage$ changes	_	4.88%	4.92%	8.09%	
Point changes±	_	2.49± 0.28	2.51± 0.89	4.13± 0.56	
Visual pain analogue scale	8.28 ± 1.01	8.01 ± 2.13	7.88 ± 2.15	6.91 ± 1.55	*< 0.72
Percentage changes$	_	3.7%	5%	4.7%	
Point changes±		-0.37± 0.04	-0.5± 0.94	-0.47± 0.04	
Total Western Ontario and McMaster Universities arthritis index	49.13 ± 4.12	51.12 ± 4.32	52.7 ± 2.01	53.07 ± 1.92	*< 0.12
Percentage$ changes	_	1.98%	5.14%	5.88%	
Point changes±	_	.99 ± 0.20	2.57 ± 2.11	2.94 ± 2.2	

p is two-sided significant (< 0.05) using repeated measures of analysis of variance statistical test.$Improvement percentage of measured values is calculated by dividing the amount of changes at each level on the maximum of expected change (155±5) and multiplying it by 100.

Table 3: Changes in range of motion, visual analogue scale and Total Western Ontario and McMaster Universities arthritis index of group (C) during the study periods (24 weeks)

Evaluation intervals variable	At initial Evaluation (0 week)	2nd evaluation (4 weeks)	3dr evaluation (8 weeks)	Final of evaluation (24 weeks)	*P* value
Range of motion (°)	100.84± 9.12	104.33± 8.40	104.35± 8.23	102.97±8.56	*< 0.13
Percentage$ changes	_	4.88%	4.92%	8.09%	
Point changes±	_	2.49± 0.28	2.51± 0.89	4.13± 0.56	
Visual pain analogue scale	8.38 ± 1.01	8.01 ± 2.13	7.88 ± 2.15	7.91 ± 1.55	*< 0.72
Percentage changes$	_	3.7%	5%	4.7%	
Point changes±		-0.37± 0.04	-0.5± 0.94	-0.47± 0.04	
Total Western Ontario and McMaster Universities arthritis index	50.13 ± 4.12	51.12 ± 4.32	52.7 ± 2.01	53.07 ± 1.92	*< 0.12
Percentage$ changes	_	1.98%	5.14%	5.88%	
Point changes±	_	.99 ± 0.20	2.57 ± 2.11	2.94 ± 2.2	

p is two-sided significant (< 0.05) using repeated measures of analysis of variance statistical test.$Improvement percentage of measured values is calculated by dividing the amount of changes at each level on the maximum of expected change (155±5) and multiplying it by 100.

Table 4: Post hoc comparison of the tested parameters at post treatment

	VAS		ROM		(WOMAC)	
	t	p	t	p	t	p
Control Group VersusShock wave G	7.8	< 0.000*	10.7	<0.000*	11.8	< 0.000*
Control Group Versus Corticosteroid Injection	4.1	< 0.006*	3.7	0.01	8.9	0.001*
Shock waveGroup Versus Corticosteroid Injection	8.6	<0.000*	9.5	< 0.000*	10.4	< 0.000*

DISCUSSION

Osteoarthritis, commonly known as wear-and-tear arthritis, is a condition in which the natural cushioning between joints -- cartilage -- wears away. When this happens, the bones of the joints rub more closely against one another with less of the shock-absorbing benefits of cartilage. The rubbing results in pain, swelling, stiffness, decreased ability to move and, sometimes, the formation of bone spurs [28], this study was conducted to investigate the effectiveness of shock wave versus Corticosteroid Injection in decreasing pain, improving daily functional ability, and increasing the joint range of motion (ROM) in patients with knee OA. Knee OA increases with age (older than 50 years), especially in women. According to a number of published reports, anywhere from 6% to over 13% of men, but between 7% and 19% of women, over 45 years of age are affected, resulting in a 45% less risk of incidence in men ,also knee osteoarthritis is associated with obesity[21]. In the present study, patients were more frequently female (83.33%), mostly overweight (86%), and their mean age was with mean age 51 ± 3.5 year.

The results of this study showed that shock wave therapy as well as intra articular corticosteroid injection were effective in relieving knee pain, improving functional disability and increasing range of motion of the knee joint. There was no difference between the effects of shockwave and intra articular corticosteroid injection in relieving knee pain and

improving functional disability as both were more effective than the control group.

Shock wave therapy was effective in relieving knee pain. This result comes in agreement with many studies reported that shock wave therapy is an effective method for treating knee osteoarthritis pain in patients scheduled for a total knee replacement [29,30]. Visual analogue scale score (VAS score) was improved after ESWT treatment of knee osteoarthritis maybe due to the theory of cartilage cell growth stimulation and matrix formation [31]. The analgesic effect of shock wave therapy could be attributed the induced analgesic effect by over stimulating the axons (gate-control theory) thereby increasing a person pain threshold [32]. Other hypothesized mechanism of action include the physical alteration of small axons, this inhibit pain impulse conduction, and chemical alteration of pain receptors neurotransmitters, thereby preventing pain perception [33]. Endorphins that are released locally after a certain number of shocks might help in pain reduction [34]. Besides, ESWT cause reduction of substance P in the target tissue in conjugation with reduced synthesis of these molecules in dorsal root ganglia cells as well as by selective destruction of unmyelinated nerve fibers within the focal zone of ESWT [35].

Our study found that shockwave therapy improved the range of motion of the knee joint. This result comes in agreement with Arno et al., who reported that (SWT) increases perfusion in ischemic tissues, stimulates growth factors, decreases inflammation and accelerate healing which could help in improving function [36]. The improvement of knee range of motion in osteoarthritis patients in this study could be attributed to the positive analgesic effect, anti inflammatory effect and tissue regeneration after using Shock Wave [37]. Our results showed that intra articular cortico steroid injection alone were effective in relieving knee pain and disability besides improving the range of motion. These results came in agreement with several authors who found almost the same results [38].

Clinical evidence suggests that benefit of corticoesteoid-intraaarticular injection is short lived, usually one to four weeks [18], the short term effect of steroids shown by controlled trials and clinical experience vary [19]. Also long term treatment with corticosteroid intra articular injection could promote joint destruction and tissue atrophy [18]. There were many factors that affect the efficacy of intra articular corticosteroid injection in knee osteoarthritic patient [39,40]. So we concluded that shock wave therapy may provide more safe and effective modalities for relieving pain, increase Range of motion and improve function in osteoarthritic patient than intra articular corticosteroid .

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