



A Comparative study between Whole body vibrations versus Interferential Therapy for patients diagnosed with Knee Osteoarthritis

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Abstract

Background. Osteoarthritis is a chronic, degenerative and progressive musculoskeletal disorder primarily affecting the articular cartilage of the synovial joints, with eventual bony remodelling and overgrowth at the margins of the joint. As highly effective medicinal management is not available there appears to be a need for additional viable, non-pharmacological modalities to manage knee osteoarthritis. This study will enlighten the effectiveness of Whole body vibration and Interferential current therapy which has to be given to the patient for maximum benefit of the patient. **Objectives.** To compare the effect of whole body vibration versus interferential therapy for patients diagnosed with knee osteoarthritis. **Methods.** The study performed was a comparative study involving 30 subjects fulfilling the eligibility criteria and diagnosed with knee osteoarthritis using the Clarke's test and Kellgren and Lawrence classification system. Subjects were divided into two groups using convenient sampling method, where one group was given interferential therapy and conventional exercise and the other group was given whole body vibration and conventional exercise. The outcome measure used was the WOMAC sub-scale. **Results.** The intergroup and intragroup significance was calculated using Unpaired t-test and Friedman test ($p = 0.000$, $p = 0.006$ respectively). The results of the study demonstrated that both the intervention groups showed significant improvement in the WOMAC score following 7 sessions of treatment, which showed that both techniques are effective individually in improving the symptoms of osteoarthritis, but whole body vibration and conventional exercise showed larger and more effective improvement in the WOMAC score than interferential therapy and conventional exercise. **Conclusion.** The study concluded that both the groups of Whole body vibration and Interferential therapy provided effective treatment to the patients and thus brought about changes in the WOMAC score but whole body vibration resulted in better improvement in the symptoms of osteoarthritis than interferential therapy.

Keywords : Interferential therapy , Knee osteoarthritis , Whole body vibration , WOMAC .



Introduction:

The knee joint is the largest and the most complex joint in the body. The complexity is the result of fusion of three joints in one. It is formed by the fusion of lateral femorotibial, medial femorotibial and femoro-patellar joints. It is a condylar synovial joint, incorporating two condylar joints between the condyles of the femur and tibia, and one saddle joint between femur and the patella.^[1] It is a modified hinge joint having 2⁰ of freedom.^[2]

The knee joint is supported by the ligaments of Fibrous capsule, Ligamentum patellae, Tibial collateral or medial ligament, Fibular collateral or lateral ligament, Oblique popliteal ligament, Arcuate popliteal ligament, Anterior cruciate ligament, Posterior cruciate ligament, Medial meniscus, Lateral meniscus, Transverse ligament. ^[1]

The knee joint is supplied by the anastomoses around it. The chief sources of blood supply are by five genicular branches of the popliteal artery, The descending genicular branch of the femoral artery, The descending branch of the lateral circumflex femoral artery, Two recurrent branches of the anterior tibial artery, The circumflex branches of the posterior tibial artery. ^[1] The nerve supply of the knee joint is obtained through Femoral nerve, through its branches to the vasti, especially vastus medialis, Sciatic nerve, through the genicular branches of the tibial and common peroneal nerves, Obturator nerve, through its posterior division.

Muscle group producing extension at the knee joint is done by quadriceps and flexion is performed by Biceps femoris, Semitendinosus, Semimembranosus. ^[1]

Osteoarthritis(OA) is a chronic, degenerative progressive musculoskeletal disorder primarily affecting the articular cartilage of the synovial joints, with eventual bony remodelling and overgrowth at the margins of the joint (spurs and lipping). There is also progression of synovial and capsular thickening and joint effusion.^[3] It is characterized by gradual loss of cartilage in joints which results in bones rubbing together and creating stiffness, pain, and impaired movement. The disease most commonly affects the joints in the knees, hips, hands, feet, and spine.^[4]

It is the second most common rheumatologic problem and the most frequent joint disease with a prevalence of 22% to 39% in India. OA is more common in women than men. Nearly, 45% of women over the age of 65 years have symptoms.^[4] One-third of the individuals over 65 years show radiological evidence of OA.^{[4] [5]}

Mechanical injury to the joint due to a major stress or repeated poor movement of synovial fluid when the joint is immobilized are possible causes of osteoarthritis. Rapid destruction of articular cartilage occurs with immobilization because the cartilage is not being bathed by moving synovial fluid and is thus deprived of its nutritional supply. The cartilage splits and thins out, losing its ability to withstand stress. As a result, crepitation or loose bodies may occur in the joint. Eventually, subchondral bone becomes exposed. There is increased density of the bone along the joint line, with cystic bone loss and osteoporosis in the adjacent metaphysis. Affected joints may become enlarged. Heberden's nodes and Bouchard's nodes are common. ^[3]



Figure no. 1

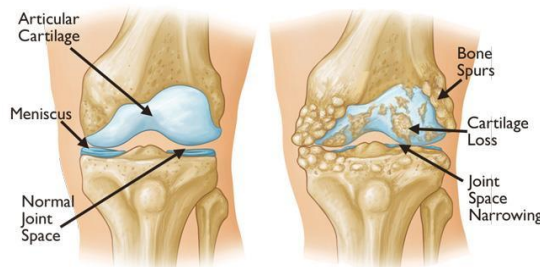
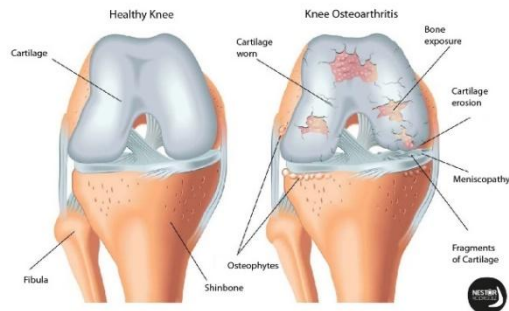


Figure no.2



The figures shows the changes occurring in the knee joint in knee osteoarthritis.

The prevalence of OA is increasing due to population ageing and an increase in related factors such as obesity, sedentary life style, weakness of the quadriceps muscles, joint impact, or sports with repetitive impact and twisting, and occupational activities such as jobs that require kneeling and squatting with heavy weight lifting.^[3]

Medical management includes Acetaminophen, oral NSAIDs, corticosteroids and hyaluronic acid. Surgical intervention includes arthroscopic debridement, osteotomy of the knee and total knee arthroplasty.^[3]

Physiotherapy management includes first educating the patient about the condition, prognosis, treatment, deforming forces and prevention. To decrease pain from mechanical stress and to prevent deforming forces, assistive devices can be given to correct faulty biomechanics and to minimise stress. Muscles around the knee joint like quadriceps, biceps femoris, semitendinosus and semimembranosus should be strengthened. In addition, physical agents, such as short-wave diathermy, transcutaneous electrical nerve stimulation (TENS), ultrasound, and hot packs are passive; non-invasive and safe modalities commonly used to control both acute and chronic pain.^[2] To decrease the effects of stiffness, active ROM and joint play mobilisation techniques can be given. In order increase ROM, stretching of muscle, soft tissue or joint should be done with specific techniques. To improve the neuromuscular control, strength and endurance low intensity muscle training and repetitions should be given. Improve balance and physical conditioning with balance training activities and low impact or non impact aerobic exercises.^[6] Insoles can be given like a lateral wedge insole for greater benefit. Weight loss is also an important adjunct to other therapies.^[3]

As highly effective medicinal management is not available emphasis should be given to preventive aspect of life style measures in the form of healthy diet and exercise. Unfortunately, many patients with knee osteoarthritis are not able to exercise due to aging and obesity. Thus, there appears to be a need for additional viable, non-pharmacological modalities to manage knee osteoarthritis.^[4]

Interferential therapy is a part of electrotherapy in which two medium frequency currents are used to produce a low frequency effect. One of the currents is kept at a constant frequency of 4000



group of 45-75. The individuals with pacemakers, implants, any knee surgery in the past 6 months, any muscular, joint or neurological condition that affects the lower limb function, Alzheimer's disease, Parkinson's disease, Motor Neuron disease, diabetes mellitus, cardiac or respiratory insufficiency and the inability to understand the procedure were excluded from the study. The materials required for the study included the whole body vibrator, interferential therapy unit, gel, tape, cotton, plinth, screen, consent form, screening form, pen. Outcome measure used was the The Western Ontario and McMaster Universities Osteoarthritis Index subscale (WOMAC).

Procedure :

Clearance was obtained from the ethical committee. Patients diagnosed with knee osteoarthritis were assessed for eligibility by special test using the Clarke's test. The patients with radiographic evidences were assessed for eligibility using Kellgren and Lawrence grading system. Patients with Grade 1 and Grade 2 were selected in the study. The patients who fulfilled the inclusion and exclusion criteria were selected. The procedure and the motive of the study was explained to the patient. Written consent forms were taken. The patients were divided into two groups using the chit method. Group A was given Interferential therapy and conventional exercise for a duration of 10 minutes. The frequency was set between 1 to 100 hertz, sweep was set at 1 Hz and spectrum was set at 100 Hz, which induces pain relief and relaxation, quickens the healing process, improves the muscle tissues and vessels tones and also promotes blood and lymphatic circulation. [12] Group B was given Whole body vibration and conventional exercise, in which patients had to stand in a squat position on the whole body vibrator for a duration of 10 minutes and the frequency was set between 12-14 Hz. Rest was given in between. To prevent the feeling of uncomfortable and tiredness, the patient could hold a handle during training. [13]

Conventional exercises included:

- 1) Active or Active-assisted ROM exercises for hip, knee and ankle.
- 2) Stretching for quadriceps, hamstrings, adductors, gastrocnemius as necessary.
- 3) Advancing strengthening to isometrics closed-kinetic chain exercises.
- 4) Hip adductor and abductor strengthening.
- 5) Straight leg raising progressive resistance exercise. [14]

A pre-intervention assessment was taken using the WOMAC scale. Seven sessions were conducted for each group. Post-intervention assessment was taken using the WOMAC scale and this was used as the outcome measure. The WOMAC questionnaire is used for evaluation of patients' functions in rheumatic diseases especially knee OA. The WOMAC is a 24-item questionnaire with 3 subscales measuring pain (5 items), stiffness (2 items), and physical function (17 items). Answers to each of the 24 questions are scored on 5-point Likert scales (none = 0, slight = 1, moderate = 2, severe = 3, extreme = 4), with total scores ranging from 0 to 96. Higher scores indicate greater disease severity. [15] Results were obtained and the result between both the groups were compared using t-test and Friedman test. Discussion was made and conclusion was drawn.



FIGURE NO. 5 AND 6 :-

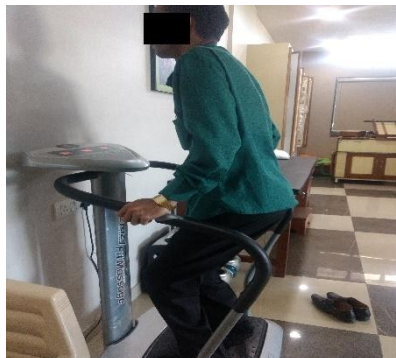
Patient performing VMO strengthening exercises with a VMO board.



Figure no.7 : Patient of group A receiving IFT treatment



Figure no.8 : Patient of group B receiving WBV treatment



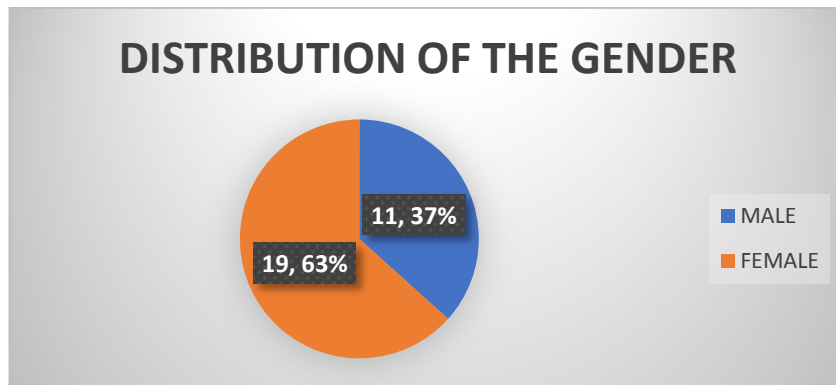


Data analysis and interpretation:

Table 1 :Comparison of number of males and females

GENDER	MALE	FEMALE
TOTAL NUMBER	11	19

Figure 5: Comparison of number of males and females



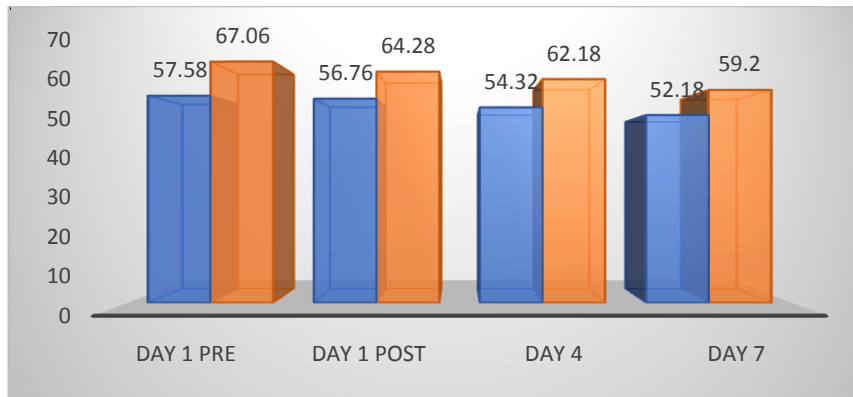
Interpretation:Table 1 and Graph 1 shows that in current study total number of males are 11 and total number of females are 19. This indicates that the total females are more than that of total males.

Table 2 :Comparison of mean of pre and post treatmentscores of group A and group B

	DAY 1 PRE	DAY 1 POST	DAY 4	DAY 7	P VALUE
GROUP A	57.58	56.76	54.32	52.18	0.000
GROUP B	67.06	64.28	62.18	59.2	0.000



Figure 6 :Comparison of mean of pre and post treatment scores of group A and groupB

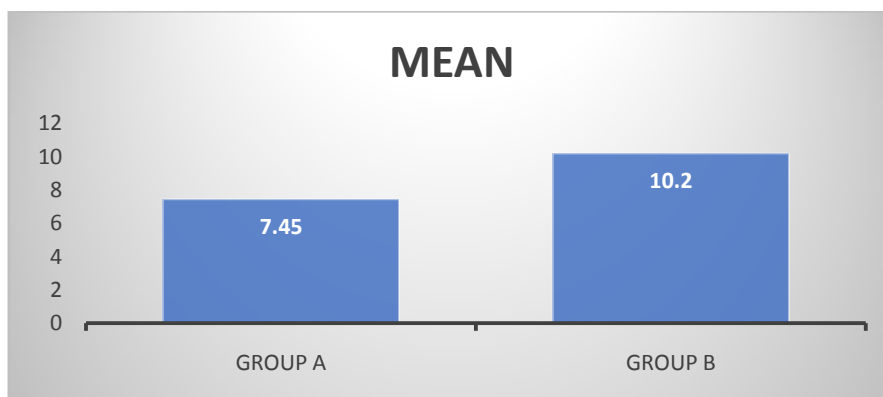


Interpretation: Table 2 and Graph 2 shows that Group A showed a mean score of 57.58 on the pre treatment score on Day 1, 56.76 on post treatment of Day 1, 54.32 on Day 4 and 52.18 on Day 7. Similarly, Group B showed a mean score of 67.06 on pre treatment score on Day 1, 64.28 on post treatment of Day 1, 62.18 on Day 4 and 59.20 on Day 7. There is a highly significant change in the pre and post treatment scores for both Group A and B as P value is 0.000.

Table 3 :Comparison of mean difference of pre and post treatment of group A and group B

	GROUP A	GROUP B
MEAN	7.45	10.2
P VALUE	0.006	0.006

Figure 7 :Comparison of mean difference of pre and posttreatment of group A and group B





Interpretation :Table 3 and Graph 3 shows the mean difference between the Day 1 pretreatment and Day 7 post treatment between Group A and Group B as 7.45 and 10.2 respectively. There is a significant difference in the Group A and B mean score as the P value is 0.006. The graph shows that the difference in Group B is more than that of Group A.

Result:

There is a highly significant change in the pre and post treatment scores on Day 1, Day 4 and Day 7 for both Group A and B as P value is 0.000. There is also a significant difference in the Group A and B mean score as the P value is 0.006. The graph shows that the difference in Group B is more than that of Group A. This indicates that there is improvement in the WOMAC score in both the groups, but the improvement is higher in the Group B than Group A.

Discussion :

Osteoarthritis is a chronic and degenerative joint disease. It is considered one of the most common musculoskeletal disorders. The main clinical symptoms of patients with knee osteoarthritis include pain, stiffness, crepitation, edema, joint deformities, instability, decrease in ROM, physical activity limitation and muscle weakness. For these reasons, several pharmacologic and non-pharmacologic strategies have been studied.

Physiotherapy is one of the professions which provide effective non-pharmacological interventions for people with knee osteoarthritis. The techniques used by physiotherapists are considered important and they play a fundamental role in patient's treatment.

Despite recent advances in osteoarthritis treatment, few studies have evaluated the effect of therapeutic modalities on patients with knee osteoarthritis. ^[16]

The whole body vibration (WBV) machinery and tools has recently been paid attention to because it seems to be easy and safe to perform. Ultrasound makes the platform to vibrate precisely vertically, which induces involuntary muscle contractions of the whole body. Various studies regarding application of WBV reported improvement of muscle strength, power, joint proprioception, balance, and flexibility, improving circulation, and altering certain hormone levels (e.g. growth hormone, IGF-1, cortisol, and testosterone). Some studies reported its effects of especially quadriceps strengthening. Improvements are thought to be due to reflex activation of the a-motor neuron, via muscle spindle activation. The WBV could also improve postural stability due to its positive effects on muscle strength, synchronization of the motor units firing and improved co-contraction of synergist muscles, that might bring about better balance control strategies in patients. The WBV exercise is a time-saving and safe method for rehabilitation of knee OA. WBV could be thought as a useful modality in the patients who are unable to participate in active modalities because of severe disability according to advancing age and progression of knee OA. ^[8]

TENS and IFT are forms of electroanalgesia based on the gate control theory of pain perception by Melzack and Wall. Interferential therapy delivers currents to deep tissues through the use of kilohertz-carrier-frequency pulsed or sinusoidal currents to overcome the impedance offered by the skin. The principle of interferential therapy, as explained by Hans Nemeč, is to pass two medium frequency alternating currents which are slightly out of phase through the tissues, where the currents intersect, a new current is set up.^[17] The basic concept behind IFT is that skin



impedance (resistance) is inversely proportional to the frequency of an applied current; therefore there is less skin resistance to a frequency of 2000Hz than to a frequency of 200Hz. It has been claimed that IFT can be used to treat deeper tissues because lower pulse amplitude is required to overcome the associated skin resistance. The two medium-frequency currents “interfere” within the tissues and produce an amplitude-modulated beat frequency, which is calculated as the difference between the values of the two currents applied.^[18] By varying the frequency of the second circuit relative to the constant frequency of the first, it is possible to produce a range of beat frequencies deep in the patient’s tissues. The physiological effects of interference currents include relief of pain, motor stimulation and absorption of exudates.^[16]

No previous trial has directly investigated the comparison between the effectiveness of whole body vibration and interferential therapy clinically, therefore, the findings of this study hopefully are a contribution to the growing evidence base in this field.

Present study was done in patients with knee osteoarthritis. They were assessed with Clarke’s test and Kellgren and Lawrence scale. The study was conducted on 30 patients. The patients were grouped into two groups- Group A and B by using the chit method which is a sample random sampling method. Of these, 15 were given Whole body vibration and conventional exercise and other 15 were given Interferential therapy and conventional exercise. The patients were given 7 sessions of each treatment. Pre-treatment assessment was taken by using WOMAC scale on the first day. Post intervention was taken on the 1st, 4th and 7th day.

Tidy’s Physiotherapy by Stuart Porter uses Clarke’s test as a diagnostic method for assessment of patella femoral joint disorders where the patient is asked to contract the quadriceps while the patella is firmly pressed down against the femur. Pain is produced in the conditions like chondromalacia and osteoarthritis indicating a positive test.^[18]

Validity and Reliability of Radiographic Knee Osteoarthritis Measures by Arthroplasty Surgeons was conducted by Daniel L. Riddle et.al which concluded that the most validity and reliability estimates of the severity of knee osteoarthritis, as measured by KL and OARSI classification systems, to be substantial or better for 2 of the 4 surgeons included in the study.^[11]

In a study, Reliability and validity of the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index in Italian patients with osteoarthritis of the knee, conducted by [F Salaffi](#). et al. on behalf of GOarthrosis and Quality Of Life Assessment (GOQOLA) Study Group resulted that all WOMAC subscales (pain, stiffness, and physical function) were internally consistent with Cronbach’s coefficient alpha of 0.91, 0.81, and 0.84, respectively and Test–retest reliability was satisfactory with ICCs of 0.86, 0.68, and 0.89, respectively. Examination of discriminant validity showed that the scores on the WOMAC and SF-36 followed hypothesized patterns: the WOMAC discriminated better among subjects with varying severity of knee problems, whereas the SF-36 discriminated better among subjects with varying levels of self-reported health status and comorbidity.^[19]

The results of the study demonstrated that both the intervention groups : Group A and Group B showed significant improvement in the WOMAC score following 7 sessions of treatment, which shows that both techniques are effective individually in improving the symptoms of osteoarthritis on the WOMAC scale.



Clinically, the results obtained for Whole body vibration and Interferential therapy on the 1st, 4th and 7th day showed high significance i.e. P value is equal to zero. Significant difference was observed in the mean difference in pre treatment score of Day 1 and post treatment score of Day 7 i.e. P value is equal to 0.006. This study indicated that Group B which were given Whole body vibration gave more effective treatment than Group A.

The result observed in treatment with Interferential therapy could be due to analgesic effect produced due to its action on the pain gate mechanism. The pain gate control mechanism was proposed by Melzack and Wall. The input provided by the mechanoreceptors reduces the excitability of the nociceptor responsive cells to pain-generated stimuli. This produces a presynaptic or segmental inhibition.^[16]

Interferential therapy creates a low frequency current effect in deep tissues by two medium frequency currents at different frequencies. These currents are able to encounter a much lower skin-impedance.

Impedance is inversely proportional to frequency : the applicable formula is

$$Z = 1 / 2fC$$

Where Z =impedance in ohms

f= frequency in Hz

C= capacitance of skin in microfarads

Thus, Interferential therapy can allow an increased dosage which can be applied in a greater depth because of the patient's tissue's better tolerance to the medium-frequency currents.^[7]

Whole body vibration showed higher significant changes in the pre and post treatment scores in the WOMAC scale than Interferential therapy. Whole body vibration reported low-amplitude and low frequency mechanical vibration is a safe and effective method to improve muscle strength. Vibration exercise imposes hyper-gravity activity.^[8] During a whole body vibration loading, skeletal muscles undergo small changes in muscle length of the muscle-tendon complex.^[20] Vibrations elicit a response called "tonic vibration reflex". It was produced by mechanical activation of muscle spindles, mediation of the neural signals by Ia afferents, and activation of muscle fibers via large α -motor neurons. The tonic vibration reflex also causes an increase in recruitment of the motor units through activation of muscle spindles and polysynaptic pathways. It is well known that the input of proprioceptive pathways (Ia, IIa and probably IIb) play an important role in the production of isometric contractions. The increase in isometric strength after Whole body vibration training might be the result of a more efficient use of the positive proprioceptive feedback loop. Increased muscle strength after Whole body vibration could be due to neural adaptation. The following mechanism showed that the principle of the Whole body vibration increased muscle strength and proprioception and thus reduce the symptoms of knee osteoarthritis.^[14]

Whole body vibration training is a safe, suitable and effective training method. It can be a feasible alternative for patients who cannot participate in conventional strength training exercises



in patients with mild to moderate knee osteoarthritis. This treatment could show similar effects as regular strength training, but with lower loads on the affected joint.^[21]

In conclusion, both the treatment options are effective but Whole body vibration and conventional exercises showed better results in the reduction of WOMAC score than that of Interferential therapy and conventional exercises.

Conclusion :

The study concluded that both the groups of Whole body vibration and Interferential therapy provided effective treatment to the patients and thus brought about changes in the WOMAC score. Whole body vibration resulted in better improvement in the symptoms of osteoarthritis than Interferential therapy.

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