

Effects of Physiotherapy Interventions (Exercise Therapy and Electrotherapy) on Knee Osteoarthritis in Patients with Different Pain Intensity Categories

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Abstract: Knee Osteoarthritis is a prevalent condition affecting millions of people worldwide. Physiotherapy is a non invasive interventions that is effective in managing knee osteoarthritis symptoms by aiming to reduce pain, improve function, and enhance quality of life. The main interventions are Electrotherapy (IFT), exercise therapy, including strength training, and patient education about self management strategies, such as weight loss, activity modification, and pain coping skills. A combination of several interventions, depending on patient preferences, is recommended for optimal outcomes in managing knee osteoarthritis. **Background:** Osteoarthritis is a major cause of musculoskeletal disability non pharmacological and non surgical treatment is preferred for management of knee osteoarthritis (OA). However, evidences are lacking regarding the effectiveness of multi - model physiotherapy programme including, combination of various physical modalities (TENS, Ultrasound, IRR) with therapeutic exercises, for the management of knee osteoarthritis. **Objectives:** To identify effectiveness of combination of IFT and exercise therapy interventions for treatment of knee osteoarthritis patients. **Method:** It is an experimental study. A Pre and Post experimental descriptive study of a total of 20 patients with OA knee (age range 35 to 70 years) are selected. The patients are divided into 3 groups according to pain. Group 1 (Mild pain), Group 2 (Moderate pain), Group 3 (Severe pain). All patients also received combined physical therapy exercise protocol were applied 6 days a week for 2 weeks. **Results:** Present outcomes shows that physiotherapy treatment is effective technique in reducing pain in patients with knee OA without adverse effects. **Conclusion:** Electrotherapy modalities in conjunction with exercise therapy program designed for treating knee OA patients proved to be more superior to exercise alone at improving Quadriceps muscle activation by reducing pain and increasing function during exercise.

Keywords: Electrotherapy, Exercise, Knee Osteoarthritis, physiotherapy.

1. Introduction

Knee joint is the most common joint affected by Osteoarthritis (OA) in patients older than 60 years. About 10 - 20% of this population experience knee pain globally [5]. Around 80% of their experience restriction in movement and remaining 20% are not able to perform activities of daily living, 11% of knee OA patients need assistance in basic individual care. Knee osteoarthritis is common degenerative disease and its prevalence and incidence are increasing [1].

Degenerative joint arthritis is the most common joint disorder that is caused by biomechanical stress affecting both articular cartilage and subchondral bone.

Knee OA is directly related to disabilities due to pain quadriceps disfunction and impaired proprioception. Exercise therapy is effective in reducing pain and improving the function of patients with OA knee [2, 5]

Unlike many others pain conditions in which underlying injuries typically heals or resolves osteoarthritis is a disease that does not resolve [3]. Thus, OA is typically accompanied by chronic pain [7].

Pain is one the most commonly reported and prominent factors that are responsible for physical activity in patient with knee OA [4].

Pain pattern and severity of knee OA as either absent, mild, moderate, severe or very severe could affect the range of

motion (ROM) that involves daily activities and quality of life, there is often discordance between reports of pain and radiographic OA [6, 8, 9, 10].

Moreover, muscle weakness in knee OA usually results in joint stiffness and decreasing ROM that involves daily activities [15].

Correct conventional treatments include non pharmacological measures and surgical procedures among non - pharmacological intervention manual therapy is widely used for musculoskeletal conditions [13].

Subject and Methods

In this study 20 patients with moderate bilateral knee OA were identified as potential participants based on orthopaedic physical therapy records.

Th participants were classified into 3 groups according to their pain intensities

- Mild Pain Group (5 subjects)
- Moderate Pain Group (8 subjects)
- Severe Pain Group (7 subjects)

At the end of 2nd week treatment period, outcome data were available for 4 or 5 patients in mild pain group, 7 or 8 patients in moderate pain group, 5 or 7 in the severe pain group.

Thus 20 subjects (males - 9, females - 11) participated in current study.

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	Mild Pain Group	Moderate Pain Group	Severe Pain Group
Age (years)	50 ± 18	52 ± 15	51 ± 13
Height (cms)	158.5 ± 5	157 ± 5	160 ± 5
Weight (kgs)	72 ± 5	73.5 ± 7	75 ± 5
BMI (kg/m ²)	28.8 ± 3	30 ± 3	29.3 ± 3
Gender (F/M)	4/1	1/7	6/1

The inclusion criteria were as follows age between 45 and 62 years <Grade 2 radiographic severity according to Kellgren Lawrence scale.

The intensity of knee pain was evaluated using VISUAL ANALOGUE SCALE (VAS) [11] after patients have remained in a weight - bearing state for five minutes (walking /standing). The pain level was rated by each patient from 0 to 10 where 0 represented no pain and 10 represented as unbearable pain.

- 0 - 2 – inappreciable pain
- 3 - 4 mild pain
- 5 - 7 moderate pain
- 8 - 10 severe pain

Measurement of active knee flexion ROM; while the patients were lying supine on examination table, active knee flexion ROM was measured using universal goniometer, while goniometers pivot tip was placed on femurs lateral epicondyle. The patient maintained maximum flexion of knee joint hip flexion and maximum extension, was described as excursion range.

The patients disability was evaluated using valid and reliable modified western Ontario and McMaster university osteoarthritis index (WOMAC) - see in the appendix [12].

2. Treatment Program:

Exercise Program:

“Exercise is a medicine”. This may seem like a paradox, but for people with knee osteoarthritis (OA) many high quality research studies show that exercise therapy is very helpful in decreasing pain and improving joint range of motion.

Strength Training:

Most activities should be strength training focused on quadriceps and hamstrings

a) Quadriceps sets:

Sit with your leg extended and your back straight, tighten your thigh muscles and push the back your knee down into the floor, hold for a count of 5 secs and then release, repeat for 10 - 15 repetitions.



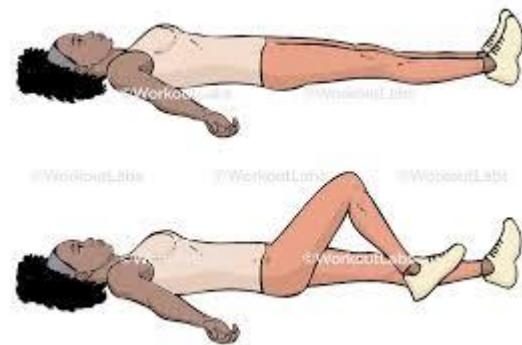
b) Straight leg raises (SLR):

lie on your back with one leg bent and the other straight, lift the straight leg to the height of the bent knee hold briefly, then lower it slowly, perform 2 sets of 15 repetitions for each leg.



c) Heel slides:

lie on your back with both knees bent, gently slide 1 heel along the floor, straightening the leg and slide it back to the bent position, complete 10 - 15 repetitions on each leg.



d) Wall squats:

stand with your back against a wall, feet shoulder width apart, slowly bend your knees sliding down the wall, hold for 5 - 10 secs then return to a standing position, repeat 10 - 15 times.



e) Step ups:

stand in front of a step or sturdy platform, step up with 1 leg then step backdown, repeat this motion for 2 sets of 15 on each leg.

**f) Hamstring sets:**

lie on a supine position and both knees flexed to 90degrees the participant was instructed to contract the hamstring by pressing the heels into the mat and holding for 5 secs, Getting through 1 set of 10 repetitions.

**g) Pelvic bridging:**

The participant was instructed to lie on their back with their legs flexed and raise their hips off the floor for 3 secs, getting through 1 set of 10 repetitions.

**h) Single leg bridging:**

The participant was instructed to lie on their back with 1 knee bent and the other leg straight with 70 degrees of hip flexion on the opposite side then instructed to lift their hips off the floor and hold for 3 secs getting through 1 set of 10 repetitions.

**Electrotherapy:**

Electrotherapy is a gentle and non - invasive modality that works by stimulating nerves and muscles through the surface of the skin. Though it varies based on which device your practitioner uses, electrotherapy is thought to work in a variety of ways:

- Send out electrical impulses that block or interfere with the body's pain signals, leading to reduced pain.
- Help release endorphins (chemical messengers) that naturally decrease pain in the body.
- Stimulate muscle tissue to contract to reduce atrophy.
- Create a heating effect within the body which improves circulation and stimulates healing.
- Stimulate cells which reduce inflammation, promote collagen production, and inhibit pain.

IFT is a technique that uses two electrical currents of varying frequencies passing through the treated area. When two currents in close proximity are found, a third frequency is created, known as an interferential current. This current interacts with nerve cells and tissue to reduce swelling, relieve spasms and muscles, and promote healing. Inter Ferential Therapy can be used on virtually any part of the body, usually by simply placing the electrodes on the topical area and then changing the intensity and pattern of the current. The results of IFT can be immediate and last for days or weeks.

There are several benefits of IFT physiotherapy. The beat frequency currents from IFT machines help stimulate the muscles to contract. Secondly, they heal the nerves that carry pain.

- Providing instantaneous pain relief to deep tissue injuries.
- Constant contraction of muscles creates relaxing effects. When spasmodic muscles relax, our blood circulation improves.
- Better blood circulation leads to faster soft tissue repair.
- Contraction of muscles reduces swelling, bruising, and inflammation.
- The vibrations eliminate harmful substances, such as toxins, from the affected areas.
- Increasing muscle stimulation improves patients' metabolic rates.
- Healthier blood circulation also leads to decreasing blood pressure.
- Treating chronic and painful ligament injuries with this non - invasive therapy is more manageable.
- Constant physiotherapy from IFT machines also eliminates long - term joint movement restrictions.
- Post - surgery IFT physiotherapy helps patients restore their lost movement of muscles.
- It is characterized by the interference of two medium - frequency currents, which combine to produce a new

medium - frequency current whose amplitude is modulated at low frequency, which produces lower impedance to the skin and allows deeper penetration into tissue

- 3) High frequencies 50 - 100 Hz may be more effective in reducing stiffness and improving blood circulation.

We used vectrostim 100 - 5 in 1 - Technomed Electronics IFT.

Number of Channels	2 Channels
Output Current	0- 75mA
Output Frequency	IFT Channel I- 4000 Hz- 4250 Hz Channel II- 4000 Hz (Constant) 2000Hz mode also available
Interference Frequency	Base- 0- Hz- 150Hz Spectrum- 0Hz- 150Hz
Modes	2EL/ 4EL/4EL45 VECTOR / 4EL90 VECTOR
Vector Scanning	45 & 90 Degrees



In the IFT, the four electrodes are positioned around the knee so that each channel runs perpendicular to the other and the two current crosses at a midpoint in the centre of the knee.

It is applied for alternate days for 2 weeks i. e., 6 sessions for 2 weeks, each session 15 minutes.

The ideal frequency may depend upon various factors such as symptoms severity and individual patient response.

However, some studies suggest that:

- 1) Low frequencies 1 - 10 Hz may be more effective in reducing pain and inflammation.
- 2) Medium frequencies 10 - 50 Hz may be more beneficial in improving in joint function and mobility.

3. Results

The pre - intervention VAS score of mild pain group was lower than those of moderate pain group and severe pain groups and the top moderate pain group was lower than that of severe pain group

There was significant reduction in pain intensity, owing to interventions in three groups

The post intervention VAS score of mild pain group was significantly lower than those of moderate and severe pain groups.

Further, the post intervention VAS score of moderate pain group was significantly lower than that of severe pain group.

Name of the Patient	VAS Score			WOMAC Score		
	Pre Rx	Post Rx	Change Score	Pre Rx	Post Rx	Change Score
Mild Pain Group						
1. Indramma - 63years/F	4	2	2	45%	28%	17%
2. Seshadri - 70years/M	4.5	3	1.5	40%	20%	20%
3. G. Munilakshmi - 43years/F	3.5	1.5	2	38%	20%	18%
4. Kadurunnisa - 35years/F	3	1.5	1.5	38%	20%	18%
5. Chittamma - 68years/F	3.5	1.0	2.5	34%	12%	22%
	3.7	1.8	1.9	39%	20%	19%

Name of the Patient	VAS Score			WOMAC Score		
	Pre Rx	Post Rx	Change Score	Pre Rx	Post Rx	Change Score
Moderate Pain Group						
1. G. Venkateshwara Rao - 63years/M	5.8	3.5	2.3	60%	40%	20%
2. C. Ranga Reddy - 63years/M	6.0	4.5	1.5	62%	42%	20%
3. Subramanyam - 66years/M	6.2	4.3	1.9	65%	46%	19%
4. M. Chinna subha Reddy - 36years/M	6.5	4.5	2.0	61%	42%	19%
5. G. Rajendra Kumar - 61years/M	6.5	4.2	2.3	63%	40%	23%
6. M. Rajesh Kumar - 37years/M	6.8	4.8	2.0	65%	40%	25%
7. Neelamma - 64years/F	6.9	4.5	2.4	68%	47%	21%
8. Venkataratnam - 78years/M	6.7	4.3	2.4	65%	43%	22%
	6.425	4.325	2.1	63.625%	42.5%	21.125%

Name of the Patient	VAS Score			WOMAC Score		
	Pre Rx	Post Rx	Change Score	Pre Rx	Post Rx	Change Score
Severe Pain Group						
1. Nagamani - 53years/F	8.0	7.2	0.8	84%	72%	12%
2. Jayamma - 64years/F	8.3	7.5	0.8	82%	70%	12%
3. Seshamma - 61years/F	7.8	6.8	1.0	81%	71%	10%
4. M. Venkateshwarulu - 63years/M	8.2	7.2	1.0	80%	69%	11%
5. R. Bharathi - 58years/F	8.0	7.0	1.0	80%	73%	7%
6. Shyamala - 61years/F	7.8	6.9	0.9	80%	70%	10%
7. Naga Malleshwari - 42years/F	8.5	7.8	0.7	85%	77%	8%
	8.08	7.2	0.8	81.7%	71.7%	10%

Total VAS Score Mean

	Pre RX	Post RX	Change Score
Mild pain group	3.7	1.8	1.9
Moderate pain group	6.425	4.325	2.1
Severe pain group	8.085714	7.2	0.8857
Total Mean	6.068	4.441	1.6

Total WOMAC Score Mean

	Pre RX	Post RX	Change Score
Mild pain group	39%	20%	19%
Moderate pain group	64%	43%	21%
Severe pain group	82%	72%	10%
Total Pain Group	61.441%	44.73%	16.708%

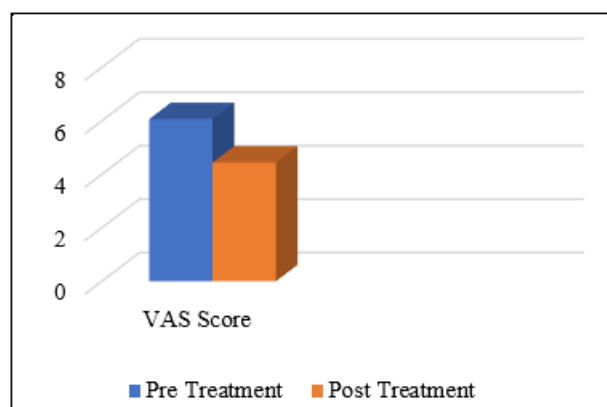
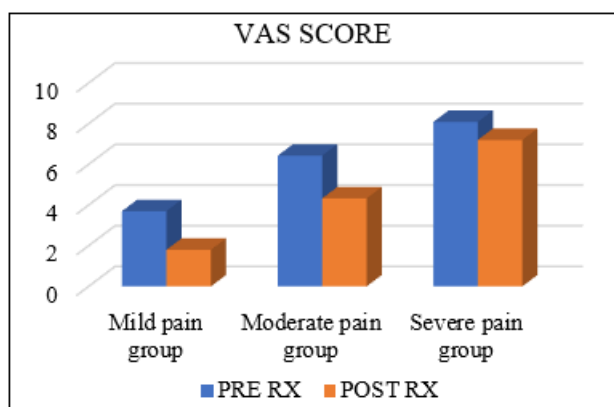
The Western Ontario and McMaster Universities Arthritis Index (WOMAC) is widely used in the evaluation of Hip and Knee Osteoarthritis. It is a self-administered questionnaire consisting of 24 items divided into 3 subscales: ^[1]

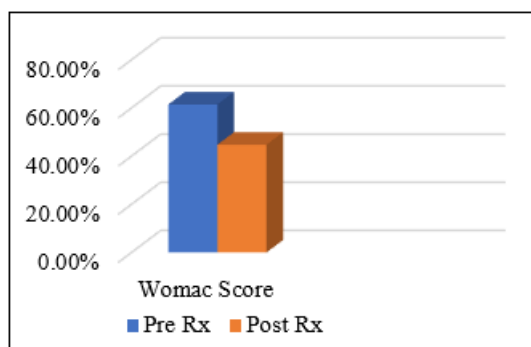
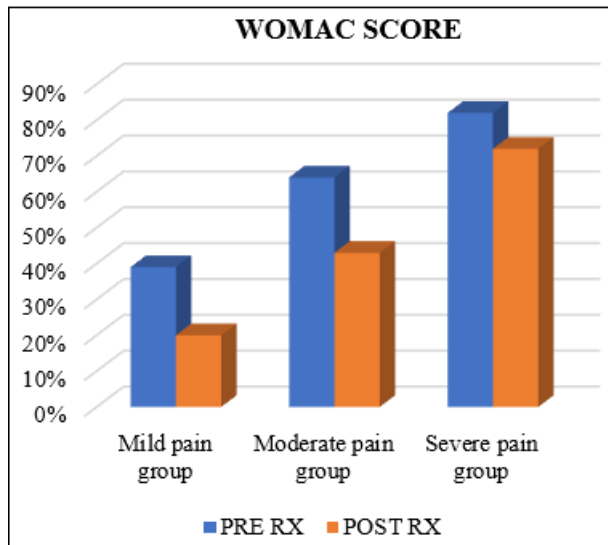
- Pain (5 items): during walking, using stairs, in bed, sitting or lying, and standing upright
- Stiffness (2 items): after first waking and later in the day
- Physical Function (17 items): using stairs, rising from sitting, standing, bending, walking, getting in / out of a car, shopping, putting on / taking off socks, rising from bed, lying in bed, getting in / out of bath, sitting, getting on / off toilet, heavy domestic duties, light domestic duties

t - Test: Paired Two Sample for Means	TOTAL VAS SCORE P VALUE	
	Variable 1	Variable 2
Mean	6.325	4.7
Variance	3.106184211	4.788421053
Observations	20	20
Pearson Correlation	0.972483961	
Hypothesized Mean Difference	0	
df	19	
t Stat	11.58422416	
p (T<=t) one - tail	2.34448E - 10	
t Critical one - tail	1.729132812	
p (T<=t) two - tail	4.68896E - 10	
t Critical two - tail	2.093024054	

t - Test: Paired Two Sample for Means	Total WOMAC Score P Value	
	Variable 1	Variable 2
Mean	0.638	0.471
Variance	0.028732632	0.043714737
Observations	20	20
Pearson Correlation	0.980052216	
Hypothesized Mean Difference	0	
df	19	
t Stat	13.68117307	
p (T<=t) one - tail	1.37299E - 11	
t Critical one - tail	1.729132812	
p (T<=t) two - tail	2.74597E - 11	
t Critical two - tail	2.093024054	

Total p value is <0.0001.





4. Limitations of the Study

Patient was unable to understand the importance of physiotherapy treatment effectiveness. One important limitation of our study is that the respondent were not asked if they were familiar with any of the existing clinical practice guidelines for the management of knee OA. The study faced dropouts and was unable to include follow up due to difficulty in contacting patients due patient's unavailability because of their working hours. Latest outcome measure tools with advanced technology were not included in the study because of limited accessibility of the resources.

5. Discussion

The best of our knowledge. This is the study of clarity patients with moderate knee OA according to their pain intensity. The result in this study support hypothesis that a physiotherapy treatment program has different effects in patients with moderate knee osteoarthritis with different grades of pain intensity, indicating that the magnitude of pain is one of the prominent factors that are responsible for improvement of knee osteoarthritis.

In the pre - treatment condition, it was observed that patients with knee osteoarthritis with moderate and severe pain showed significant decline in the range of motion, isometric Quadriceps strength, and level of functional performance, which may be due to level of pain that resulted in weakening of muscle strength instability of knee joint and decreased physical function.

The mean average VAS Score of Pre treatment is about 6.068 and the mean average VAS Score of post treatment is about 4.441. The change score between VAS Score of pre treatment and post treatment is 1.6

The mean average WOMAC Score of pre treatment is about 61.441%, and the mean average WOMAC Score of post treatment is about 44.73%, and the change score of WOMAC Score between pre and post treatment is about 16.7085%

The rehabilitation program decreased the pain intensity, and improve the knee range of motion, isometric quadriceps strength, and level of functional performance in all knee osteoarthritis groups.

In addition, it was clear that the rehabilitation program had more drastic effects in moderate pain group. Thus, the levels of improvement in the moderate pain group were superior to those in others groups in all measurement outcomes.

We asked the patients to do exercises regularly and to follow up, and also instructed the do's and dont's like DO'S: exercising regularly, swimming, yoga asanas, eat healthy food, thread mill exercises, DON'T'S: avoid heavy weight lifting, stair climbing, cross sitting, long standing etc [14].

The lesser improvement level in the severe pain group in all outcome measure may be measured by greater inactivity caused by higher pre intervention pain levels experienced by patients in this group, which had profound adverse effects on skeletal muscle function and metabolism in terms of weakness and atrophy. In addition, the knee extensors have a prominent role in resisting gravity, they undergo a greater magnitude of weakness and atrophy than other groups of muscles during inactivity.

In this study all patients with moderate knee OA with different grades of pain can benefit from physiotherapy rehabilitation program, which was shown to be highly effective in patients with moderate pain although this effect might be reduced in patients with severe pain.

Hence, the effects of physiotherapy programs might be optimised by identifying the grade of pain and subgroups of patients.

6. Conclusion

In connection, the findings from this study suggest that strengthening exercises can be an essential management plan for patients presenting with knee Osteoarthritis directed towards pain intensity reduction, improving functions of the joint, and facilitating functions relating to activities of daily living.

In the study we observed the improvement in both mild and moderate pain group patients.

It also concludes that electrotherapy and therapeutic program designed for knee OA treatment can be more effective at increasing Quadriceps muscle activation by reducing pain during exercise.

In addition, knee OA patients can improve self reported function with exercises including strength and balance training either with / without electrotherapy.

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