Comparison of Effects of Interferential Therapy (IFT) And Combination Therapy (IFT+Ultrasound Therapy) on Pain, Range of Motion and Function in Patients With Osteoarthritis of Knee: A Hypothesis

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Abstract

Background: Osteoarthritis (OA) is the most common type of arthritis and knee OA, being highly prevalent, accounts for as much or more lower extremity disability. Limited disease-modifying treatment exists and still under investigations, and knee OA may progress from a dynamic process of injury and repair to irreversible joint damage requiring joint replacement to treat the unrelenting pain and/or significant disability. Nonsurgical management is an important first step to prevent disability and maintain quality of life in the growing number of people with knee OA[1]. In clinical practice, physiotherapists tailor multicomponent interventions to the needs of the individual with knee OA in order to attain the goals of treatment. For example, physical agents may be administered as adjunctive to exercise interventions. Efficacy of therapeutic ultrasound (US) and interferential therapy (IFT) is of particular interest as this is the physical agent most commonly used by physiotherapists for treatment of painful musculoskeletal conditions and, therefore, widely available[1]. Electrotherapeutical modalities of rehabilitation are important resources in the treatment of musculoskeletal pain[2]. Theoretical, biological, and clinical rationales for the use of US and IFT in the management of nonsurgical knee OA have been reported. Besides different sites of action, the combination of interferential therapy and ultrasound is more effective than each of them separately because it provides localized analgesia on previous detected painful areas. Despite the fact that US and IFT are an adjunctive therapy, the effectiveness of specific combinations of interventions for knee OA has yet to be established[1]. The benefits of both modalities may be achieved at the same time, making the therapy time efficient for the therapist and patient[3].

Hypothesis: There will be improvement with combination therapy on pain, range of motion and function in osteoarthritis of knee.

Clinical Importance: Help us formulate a better training approach osteoarthritis of knee management. By combining the two treatment modalities, none of the individual effects of the treatments are lost, but the benefit is that lower treatment intensities can be used to achieve the same results, & there are additional potential benefits in terms of outcome measure[4].

Future Research: Further study with the long term follow up could be done to see the effect of combination therapy.

Keywords: Combination Therapy, Osteoarthritis, Knee, Pain.

THESIS SUMMARY

Introduction

Osteoarthritis (OA) is the most common type of arthritis and knee OA, being highly prevalent, accounts for as much or more lower extremity disability. Limited disease-modifying treatment exists and still under investigations, and knee OA may progress from a dynamic process of injury and repair to irreversible joint damage requiring

joint replacement to treat the unrelenting pain and/or significant disability. As the population ages and at the same time is becoming increasingly heavier, the prevalence of knee OA and the associated economic and personal burden are expected to rise. Nonsurgical management is an important first step to prevent disability and maintain quality of life in the growing number of people with knee OA[1].

In clinical practice, physiotherapists tailor multicomponent interventions to the needs of the individual with knee OA in order to attain the goals of treatment. For example, physical agents may be administered as adjunctive to exercise interventions. Efficacy of therapeutic ultrasound (US) and interferential therapy (IFT) is of particular interest as this is the physical agent most commonly used by physiotherapists for treatment of painful musculoskeletal conditions and, therefore, widely available[1].

Electrotherapeutical modalities of rehabilitation are important resources in the treatment of musculoskeletal pain[2]. Theoretical, biological, and clinical rationales for the use of US and IFT in the management of nonsurgical knee OA have been reported. In pulsed ultrasound therapy, therapeutic acoustic radiation is transmitted into the target tissue via US as high-frequency pressure waves generated by a piezoelectric crystal in the sound head of the US device. These pressure waves produce mechanical effects and/or thermal effects aiming to promote tissue healing, favour microcirculation and vascular permeability, promote muscle relaxation stimulate angiogenesis, and increase the metabolism and permeability of the cell membrane, thereby justifying its analgesic effects[1,2].

IFT is a popular treatment for pain and dysfunction associated with musculoskeletal conditions. Interferential electrotherapy with amplitude modulated at low frequencies reaches deep muscles and nerves, stimulates voluntary muscles, promotes an increase in peripheral blood flow, accelerates bone healing, and reduces pain. There is evidence that Interferential Therapy (IFT) may inhibit the nociceptive stimulus, possibly due to the stimulation of large diameter afferent fibres that inhibit the entrance of algid stimuli into the posterior horn of the medulla through small diameter afferent fibres [3].

Besides different sites of action, the combination of interferential therapy and ultrasound is more effective than each of them separately because it provides localized analgesia on previous detected painful areas. Ultrasound may reduce muscle tension and increases microcirculatory flow at tender points and that interferential current may increase pain threshold, we hypothesize that the Combined Therapy with Ultrasound and Interferential Current might be of greater clinical benefit than individual therapies in OA[3]. Despite the fact that US and IFT are an adjunctive therapy, the effectiveness of specific combinations of interventions for knee OA has yet to be established[1]. The benefits of both modalities may be achieved at the same time, making the therapy time efficient for the therapist and patient[4].

Hypothesis

A lot studies have been done on osteoarthritis with use of different modalities but unfortunately combination therapy is often missed which in turn is a new modality in rehabilitation and there are a few studies done only for combination therapy[2, 3]. At the present time and in the absence of any specific evidence of additional effect when used in combination, this would seem to be the sole justification for the modality[5].

Evidence to support the use of combination therapy in patients with fibromyalgia has been reported[2, 3], yet, because the treatment pattern of each modality varies, It would be useful to determine if combination therapy offered similar benefits in patients with osteoarthritis of knee.

By combining the two treatment modalities, none of the individual effects of the treatments are lost, but the benefit is that lower treatment intensities can be used to achieve the same results, & there are additional potential benefits in terms of outcome measure[5].

Many unanswered questions still exist regarding the optimal treatment modality in treating osteoarthritis of knee. Hence it is important to know whether combination therapy or interferential therapy which is more effective when compared to each other in the patients with osteoarthritis of knee.

Thus, it is hypothesized that combination therapy is more effective as compared to IFT in pain, knee ROM and functional status of OA knee patients. 60 subjects will be participating in this study. Subjects who fulfil the inclusion criteria will be included in the study and a written consent will be taken from them.

Before conducting the actual treatment, the patients of osteoarthritis of knee will be evaluated by using an evaluation format. Patients will be assessed on the first day before treatment and at end of 6th day for following:

a) Pain evaluation by numerical rating scale
b) Knee range of motion
c) Knee pain scale

Patients will be randomly assigned into 2 groups (group A and group B of 30 each) Each group will receive conventional therapy.

Apart from the common conventional therapy of these groups will receive additional therapy:

GROUP A: Combination therapy (IFT+US)

GROUP B: Interferential therapy

Demographic data will be collected for each patient including age, sex, occupation, height, weight, duration of symptoms, presence of symptoms, medications and present activity level. For pain evaluation Numerical rating scale will be used. Knee pain scale will be used to assess functional ability of patient.

Both the groups will receive treatment for 6 sessions for 6 days

GROUP A: COMBINATION THERAPY (IFT+US)

Patient Position: Supine Lying

Technique:

- Three Interferential pad electrodes will be placed around the affected knee joint.
- US treatment head to be applied over the site of maximum pain of the affected knee joint.
- The patient will be explained that he will feel a tingling sensation which should not be unpleasant
- US dose:
  Frequency = 1 MHZ
  Intensity = 0.8 W/cm2,
  Mode = Pulse (1:1)
  Duration = 10 minutes
- Interferential dose:
  Frequency = 4000 Hz
  Base = 90Hz

Sweep = 40Hz
AMF / Beat Frequency = 90-130 Hz
Quadripolar / Two channel
Duration = 10 minutes

- First US will be turned on , followed by the IFT (parameters as above)
- Starting with the US head over the maximum painful area of the joint, gradually the IFT output intensity will be increased until the `normal' tingling is encountered by the patient[5].

GROUP B: INTERFERENTIAL THERAPY
Patient Position: Supine Lying
Technique:

- Four interferential pad electrodes will be placed around the affected knee joint.
- The patient will be explained that he will feel a tingling sensation which should not be unpleasant.
- Interferential dose:

Frequency = 4000 Hz
Base = 90Hz
Sweep = 40Hz
AMF / Beat Frequency = 90-130 Hz
Quadripolar / Two channel
Duration = 10 minutes

- IFT will be turned on (parameters as above)
- Gradually the IFT output intensity will be increased until the `normal' tingling is encountered by the patient[5].

Conventional Therapy
Knee Exercises:

1. Isometric quadriceps contraction
   Position and technique, sitting with straight out toes pointed up to the ceiling. Tighten the quadriceps muscles on top of the thigh. Patient should see knee cap move up toward the hip. Patient's knee may push down toward the floor and foot may come on the floor.
2. Terminal knee extension with lower limb in lateral rotation.
   Patient position and procedure: Supine. A towel or bolster will be placed under the knee to support it in flexion. Patient will be asked to extend the knee in the terminal 30 degrees only.
3. Dynamic exercises for knee joint
   Dynamic quadriceps
   Position and technique in sitting patient extends the knee from 90 degrees to full extension
   Hamstring curls-
   Prone: Place a small towel roll under femur just proximal to the patella to avoid compression of the patella between the treatment table and femur. Have the patient to flex the knee to only 90 degrees
4. Mini squats
   Patient will stand with feet 15cms apart (roughly shoulder width) and squat till 15 degrees initially and gradually progress to 45 degree.
   Maintain for 5 seconds.
   Frequency: 5 reps in sets of three with adequate rest pause.
5. Partial lunges
   The patient has to assume a step forward stance position and rock his body weight forward, allowing the knee to flex slightly (approximately 30 degrees) and then rock backwards and control knee extension.
6. One leg balance
   The patient will stand on his left foot with relaxed, upright posture and with his right leg flexed at the knee so that the right foot is off the floor or ground. His left, weight-bearing leg will be lightly flexed at the knee, hip and ankle. The patient will hold this position for 10 to 20 seconds and then will rest for 10 to 20 seconds, and this will be repeated twice more. After a brief rest, complete three similar repetitions will perform with his right leg as the weight-bearing limb.

Self stretching will be taught for the tight muscles on evaluation and given as home program.

1. To stretch the hip flexors:
   - Patient position: Prone lying with the knee flexed on the side to be stretched.
   - Procedure:
   - Have the patient grasp the ankle on that side (or place a towel or strap around the ankle to pull on) and flex the knee.
2. To stretch the hip extensors:
   - Patient position: Supine with a towel under the thigh.
   - Procedure:
   - Have the patient perform straight leg raising with one extremity and apply the stretch force by pulling on the towel to move the hip into more flexion.
3. To stretch the hip abductors:
   - Patient position: Side-lying, with the leg to be stretched uppermost.
   - Procedure:
   - The bottom extremity is flexed for support and the pelvis tilted laterally so the waist is against the mat or floor.
   - Abduct the top leg and align it in the plane of the body.
   - While maintaining this position, have the patient externally rotate the hip and then gradually lower the thigh to the point of stretch.
4. To stretch the hip adductors:
   - Patient position: Standing in a fencer's position but with the hind leg externally rotated.
   - Procedure:
   - Have the patient shift the weight onto the front leg until a stretch sensation is felt along the medial thigh in the hind leg.
5. To stretch the knee flexors:
   - Patient position: Place the patient in prone with a belt or sheet strapped around the ankle and the other end placed over the shoulder and held in the hand.
   - Procedure:
   - Have the patient perform knee flexion with one extremity and apply the stretch force by pulling on the belt or sheet to move the knee into more flexion.
6. To stretch the knee extensors:
   - Patient position: Standing with the foot of the involved knee on a step.
   - Procedure:
   - Have the patient rock forward over the stabilized foot, flexing the knee to the limit of its range, then rock back and forth in a slow, rhythmic manner or hold the stretched position[6].

CORE STABILITY EXERCISE:

The patient is in supine lying with hip and knees flexed. Tactile cue will be given medially and inferiorly to anterosuperior iliac spine and lateral to rectus abdominis muscle.
Patient is then asked to pull in the lower abdomen.
Patient will be instructed prior to this to relax completely and that he has to draw the abdomen in without breathing in.
If the patient will be unable to do this, the procedure will be altered by allowing patient to draw the abdomen in without altering breathing pattern.
With the correct pattern of activation, narrowing of the waistline will be noted, with the smooth, slow and controlled contraction.

STATISTICAL ANALYSIS TESTS
Intra group analysis will be by the paired t-test for assessment of range of motion while pain and function shall be assessed by Wilcoxon test. Inter group shall be by unpaired t-test for range of motion and Man-Whitney U-test for pain and function.

Discussion

There is a significant lack of research in this area. It is suggested that by combining US with IFT, the effects of each treatment modality can be achieved but lower intensities are used to gain the effect. The main advantage of such type of combination is said to be in localized, deeper lesions and trigger points to give better effect. The combination of US with IFT appears to give rise to less adverse treatment effects than are associated with the combination of US with Diadynamic Currents or other electrical stimulations[5].
The interferential electric current is characterized by a medium frequency wave with low frequency modulated amplitude[3]. IFT is widely used for pain control. The rationale for this was provided by the gate control therapy of pain proposed by Melzack and Wall. The input of the mechanoreceptors reduces the excitability of the nociceptor responsive cells to pain generated stimuli; thus producing a presynaptic or segmental inhibition.
Therapeutic US is frequently used in physiotherapy clinics to treat various musculoskeletal disorders. Non thermal effects include molecular vibration, which increases cell membrane permeability and thereby enhances metabolic product transport[7].
Tim Watson the great pioneer, electrotherapy specialist suggests that a more effective treatment depth can be gained with the US - IFT combination though there is no direct evidence for this. Exposure of a peripheral nerve to US reduces the membrane resting potential by increasing its permeability to various ions specially Sodium and Calcium. Because of this adjusted permeability, the nerve membrane is taken closer to the point where it depolarizes, though doesn't usually make the nerve fire. The simultaneous application of the Interferential current through the nerve induces the depolarisation potential, though it will take a smaller current than usual to achieve this due to the potential effect of the US. As a treatment, it is appropriate when the therapeutic effects of US and IFT are both justified. Currently and in the absence of any specific evidence of additional effect when used in combination, this would seem to be the sole justification for the modality. The individual doses for the US and IFT should be those which are appropriate for the condition and the required effects. There is no research that 'special' treatment doses are required. It should be noted that the intensity of the IFT required to gain the usual effect is likely to be lesser than normal[5].
Specifically in osteoarthritis, Erkan Kozanoglu et al. demonstrated that phonophoresis and ultrasound both therapeutic modalities were found to be effective. Ibuprofen PH was not superior to conventional ultrasound[7]. Boyaci A et al. showed that in comparison of ketoprofen phonophoresis, ultrasound, and short-wave diathermy in patients with OA knee there was no significant difference between the three modalities in terms of efficacy. There was also no significant difference between the three groups in terms of post-treatment general evaluation of the physician and the patient.8
Atamaz FC et al. studied that use of physical therapy agents like transcutaneous electrical nerve stimulation (TENS), interferential currents (IFCs), and shortwave diathermy (SWD) with exercise training and education provided additional benefits in improving pain as compared to sham intervention with exercise training and education in knee OA[9]. Pelin Oktayoğlu et al found that phonophoresis (PH) and conventional US both therapeutic modalities were effective. They suggest neither therapy is superior to the other but PH can improve painless walking duration more successfully than US[10].
Gundog M et al demonstrated the superiority of the IFC with some advantages on pain and disability outcomes when compared with sham IFC for the management of knee osteoarthritis. However, the effectiveness of different amplitude-modulated frequencies of IFC was not superior when compared with each other[11].
Adalberto Loyola Sánchez et al. showed that low intensity pulse ultrasound (LIPUS) has a benefic effect over pain and functionality/severity in patients with Kellgren and Lawrence grade 2 and 3 osteoarthritis of the knee[12] Dr John Z Srbely demonstrated that US demonstrates the ability to evoke a broad range of therapeutically beneficial effects which may provide safe and effective applications in the management of osteoarthritis[13].
Cakir S et al. study demonstrated that all assessment parameters in patients with OA knee significantly improved in all groups i.e. continuous US, pulsed US and sham US without a significant difference. This result suggested that therapeutic US [14]. Yang PF et al showed that Ultrasound treatment significantly alleviates joint symptoms, relieving joint swelling, increasing joint mobility and reducing inflammation, in osteoarthritis patients[15]. Tascioglu F et al, suggested that pulsed ultrasound therapy is a safe and effective treatment modality in patients with knee OA[16] Ozgönenel L et al study suggested that therapeutic US is safe and effective treatment modality in pain relief and improvement of functions in patients with knee OA[17]. C. Zeng et al showed that pulse ultrasound (PUS), with a greater probability of being the preferred mode, is more effective in both pain relief and function improvement when compared with the continuous US[18].
Tatiana F. Almeida et al showed that combination therapy with pulse US and IFT can be an effective therapeutic approach for pain and sleep manifestations in FM[3].
Thus, the study hypothesis states that a combination therapy is more effective as compared to IFT in pain, knee ROM and functional status in patients with OA knee.

Clinical Importance

Help us formulate a better treatment option for management of osteoarthritis of knees. By combining the two treatment modalities, none of the individual effects of the treatments are lost, but the benefit is that lower treatment intensities can be used to achieve the same results, & there are additional potential benefits in terms of outcome measure[5].

Future Direction

Further study with the long term follow up could be done to see the effect of combination therapy.

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