ORIGINAL RESEARCH PAPER

Physiotherapy

EFFECTS OF HIGHTONE POWER THERAPY ALONG WITH CONVENTIONAL THERAPY IN OSTEOARTHRITIS OF KNEE

KEY WORDS:
Osteoarthritis,mobilisation,stretching,strengthening,hightonepower therapy, knee joint.

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ABSTRACT

Introduction: Osteoarthritis (OA) is a globally common joint disorder with symptoms of pain, joint stiffness and reduced function. Amongst the elderly it accounts for more disability than any other disease.**Aim of the Study:**Effect of high tonepower therapy along with conventional exercise in OA knee. **Methodology:**A total of 48 subjects with knee osteoarthritis (grade -2 or 3) both males and females with the age between 50 – 70 years were recruited randomly. Group 1 received high tone power therapy along with conventional therapy. Group 2 received conventional therapy i.e. patellofemoral mobilisation, strengthening of quadriceps, hip abductor, stretching of posterior capsule, TA, pyriformis, Hamstring,hip adductor.Treatment was given for five days/week for 4 weeks. **Outcome Measures:** Visual analogue scale and Range of motion by Goniometer,WOMAC scale. Measurements were taken before and after the end of four weeks of treatment. **Results:** Overall results of the study, both Group 1 and Group 2 showed improvement in pain and range of motion and function after four weeks of intervention.

INTRODUCTION

Osteoarthritis (OA) is a progressive degenerative disease that affects the joint cartilage, subchondral bone, synovial lining, joint capsule and affects around 60% of individuals. [1] According to Davis MA (1998) OA affects 9% of men age >50 and 18% of women over 65yr. [2]Multiple components of the joint are adversely affected by OA, including periarticular bone, synovial joint lining and adjacent supporting connective tissue elements. [3]

Aetiology of OA is more commonly viewed as a multifactorial process resulting from both mechanical joint loading and biochemical(metabolic) factors.Risk factors of OA include older age, female, obesity, occupation, previous trauma, muscle weakness, abnormal joint loading, proprioceptive deficit, genetic factors. [4]

Abnormal loading leads to alteration of joint structures and leads to softening, fibrillation, ulceration and loss of joint cartilage. Bony changes include sclerosis and erosion of subchondral bone and osteophytes and subchondral cyst formation. [5]

Earliest symptoms reported by patients with OA knee are pain, and quadriceps weakness followed closely by decrease in function and joint instability. Pain is thought to either inhibit muscle contraction or cause decline in function that leads to atrophy and may be responsible for knee extension strength decline.Muscle weakness has been found to be more problematic than radiographic severity and is considered to be major factor in disability of OA knee patients.Pain, joint stiffness, decrease muscle strength associated with disease lead to a loss of functional independence and a profound reduction in quality of life. [6]

As there is no cure for the condition and a frequent treatment for end-stage disease is joint replacement surgery, the economic impact of knee OA is considerable.Current clinical guidelines recommend non-pharmacological strategies as the first line management of OA symptoms.[7] Given the heterogeneity of knee OA with regard to aetiology, clinical presentation and natural history, the guidelines emphasize the need to tailor interventions to individuals in order to optimize treatment outcome.Considering the tri-compartmental nature of the knee joint, and the unique functions of each, tailored treatment based on compartmental involvement may be appropriate. [8]

Physical therapy is the non pharmacological treatment for treating this condition. Along with manual therapy, new developments have been seen in the field of electrotherapy. [9]For management in acute case pain reduction is the main and foremost aim for the therapist as well as for the patient, in which electrotherapy plays an important role.A recent advancement of electrotherapy named as hightone power therapy is used in this study to find out it's efficacy in management of OA knee.High tone power therapy is a new tool in the field of electrotherapy.This method is developed by Dr. Hans-Ulrich May. DR May was a medical doctor for neurology and psychiatry. He was professor at institute for medical engineering at university of Karlsruhe for 8 years.It has been patented in Japan, United State and several countries. The basic difference of hightone therapy and classical electrotherapy is the non stimulating effect i.e. unlike classical electrotherapy it will not stimulate nerve and muscle and increase mitochondria in number and size, increase acceleration of diffusion rate,wound healing and bone healing.

METHODOLOGY

Research design: Experimental two groups, pre-test – post-test structure study design.

Inclusion criteria: Unilateral or bilateral knee painof duration 3 months or more, morning stiffness,pain increases with activity and reduces with rest, X-Ray findings are diagnostic criteria of osteoarthritis., Stages of arthritis is confirmed using Kellgren and Lawrence grading scale(Grade 2 or Grade 3), pain in visual analogue scale >/=4, normal cognitive, vision, auditory, vestibular system.

Exclusion criteria: Age below 45 years, rheumatoid arthritis,neurological deficit,recent fracture, dislocation, infective arthritis, spinal cord lesions, signs of vertebral artery disease, malignancy, osteoporosis, secondary OA.

Outcome measures:

- **Visual analogue scale (VAS):** The visual analogue scale is a psychometric response scale which can be used to quantify pain. It is a numerical rating scale. The simplest

VAS is a straight line of fixed length, usually 100mm. The ends are defined as the extreme limits of pain oriented from left to right.[10]

- **Goniometer:** Goniometer is a reliable instrument to measure range of motion. It is a protractor with an extended stationary arm and fulcrum mounted moveable arm holding a protractor is placed parallel with stationary body segment and a movable arm moves along a movable body segment. The pin (axis) is placed over the joint when anatomical land marks are well defined. [11]
- **WOMAC scale:** It is a self-administered questionnaire to know about function consists of 24 items divided into 3 subscales: pain -5 items,stiffness- 2 items,physical function - 17 items. Higher scores on the WOMAC indicate worse pain, stiffness, and functional limitation. [12]

Subjects: A total of 48 subjects having bilateral or unilateral osteoarthritis were recruited randomly. Group 1 (Experimental group) – 24 subjects, Group 2 (Conventional group) – 24 subjects.

Procedure: After meeting the inclusion and exclusion criteria,informed consent was taken and subjects were divided to either of the two groups. Randomized sampling with random assignment to subgroup was done to allocate the subjects in the groups. All participants underwent an initial baseline assessment of all the dependent variables. 48 subjects both males and females (17 males and 31 females), were evaluated with the age range from 45 – 65 years.

INTERVENTION

Group 1 (Experimental): 24subjects received high tone power therapy along with conventional therapy.
Group 2 (Conventional): 24 subjects received conventional treatment that includes static quadriceps press, rhythmical patella-femoral mobilisation, posterior capsule stretch, calf stretch, hamstrings stretching, pyriformis stretching, adductor stretch,hip abductor strengthening.

Treatment was given for 5 days in a week for 4 weeks.

DATA COLLECTION

Measurements were taken prior to the beginning of (pre test) intervention for each patient and after 4 weeks of interventions (post-test).

DATA ANALYSIS

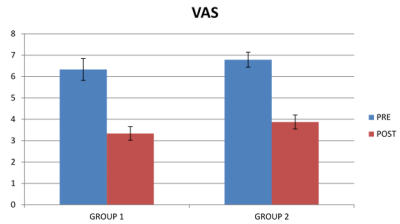
The data was analyzed with SPSS 23.0 version for windows. The dependent variables were analyzed using repeated measures ANOVA.

There was one between factor (Group) with two levels (experimental and conventional) one within factor (time) with two levels (Pre test, Post test).

Pair wise post-hoc comparisons were analyzed using a 0.05 level of significance.

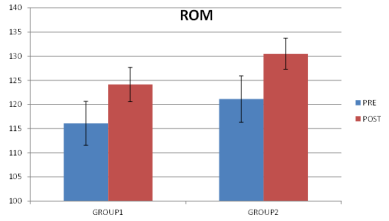
RESULTS

Graph – 1: Pain



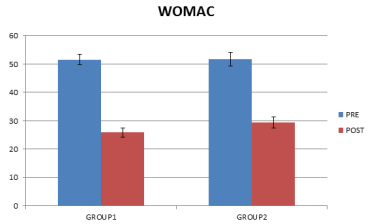
There was a main effect for time F (294.645), df (1), p= 0.000.There was no main effect for group F (9.197), df (1), p= 0.004.The main effects were not qualified to time × group interaction F (0.234), df (1), p= 0.6.

Graph – 2: Range of Motion



There was a main effect of time F (44.036),df (1),p= 0.000. There was no main effect for group F (0.975), df (1), p= 0.000. There was no effect to time × group interaction F (0.0008), df (1), p= 0.931

Graph – 3: Function (WOMAC)



There was a main effect of time F (633.607),df (1),p= 0.000. There was no main effect forgroup F (0.463), df (1), p= 0.499.There was no effect to time × groupinteractionF (633.607),df (1),p= 0.000.

DISCUSSION

The overall results of the study showed that there was an improvement in both the groups after 4 weeks of interventions in all the parameters of pain, range of motion and overall function in daily activities.

Isometric exercise of quadriceps:

Hettinger and Muller in the 1950s reported that a six-second maximal isometric contraction once a day, five times per week would result in a weekly strength gain of 5%. The magnitudes of their results were never duplicated, but other studies have proven that isometric training programs are an effective way to increase strength. [13]

The isometric exercise might have attributed to prevent neural dissociation through muscular contraction which stimulated the mechanoreceptors system in the joint capsule and surrounding ligaments and led to reduced pain. [14]

Isometric quadriceps might have helped in increasing the force production of quadriceps enabling the muscle to absorb part of the load on the joint and with strength training there would be a decrease in pain. [15]

Isometric exercises emphasize the co-contraction of antagonistic muscle groups surrounding proximal joints to increase postural control, which might have led to increment in strength gain with pain reduction in both groups in this study. [16]

Knee mobilisation exercise:

Many common manual mobilization techniques used by physical therapists when treating the knee joint are described by Maitland GD et al. (2005). Knee joint mobilization can be described as an oscillatory manual force applied to the tibiofemoral or patellofemoral joints, in a variety of directions and positions based on the patient's presentation. [17]

Pollard H et al. (2008) have studied on the effect of a manual therapy knee protocol on osteoarthritis knee pain: a randomized controlled trial and they concluded that a short-term manual therapy knee protocol significantly reduced

pain suffered by participants with osteoarthritis knee pain and resulted in improvements in self-reported knee function immediately after the end of the 2-week treatment. [18]

According to a study by NorAzlin MN and K Su Lyn University Kebangsaan Malaysia 2011, results showed that clinically, the inclusion of joint mobilization into a conventional physiotherapy reduces pain greater than conventional physiotherapy alone (44% and 20% respectively).

An in vitro animal study by Sambajon et al. (2003) found a 70% reduction in levels of cellular prostaglandin E2, a strong inflammatory mediators causing hyperalgesia in arthritic joints, within 24 hours of mobilization. [19]

Skyba DA et al. (2003) suggested that analgesic effect following knee joint mobilization was primarily due to enhancement of the descending pain inhibitory pathway in the spinal cord, which utilized serotonergic (5-HT1A) and noradrenergic receptors (alpha). [20]

Wright A (1995) Suggests that gentle repetitive movements of the joint provides hypoalgesia effects. These causes reflect changes in local cellular changes. [21]

Prabhakar S (2016) reported "Maitland Mobilization with Clinical Exercise (MMCE)" and "Maitland Mobilization alone (MM)" in chronic tibiofibular osteoarthritis. These results clearly indicate that both the treatments are effective in reducing pain, improving ROM, muscle power and functional activities. However, by comparing (i.e., testing) the effectiveness of each treatment with respect to all standard measures, we see that the treatment "Maitland Mobilization with Clinical Exercise" is more effective than "Maitland Mobilization" in terms of reducing Numeric Pain Rating Scale (NPRS) and increasing Muscle Power. [22]

Accessory movement of the knee joint might have stimulated the remaining non damaged articular mechanoreceptors and thereby reduced joint pain by inhibiting the nociceptive input at the spinal level.Although mobilization may initiate local physiological mechanisms, additional central mechanisms may also be involved. These central mechanisms could include activation of local segmental inhibitory pathways in the spinal cord, or descending inhibitory pathways from the brain stem. [23]

A study by Moss P et al. (2007), 9 minutes of accessory mobilisation immediately demonstrated a significantly greater mean (95% CI) percentage increase in pain threshold {27.3% (20.9 – 33.7)} than after manual contact {-0.4% (-4.2 to 3.5)} or no contact control {+7.9% (2.6-13.2)} in subject with mild to moderate knee OA. This study provides strong evidence that non – noxious accessory mobilization of an osteoarthritic peripheral joint can immediately decrease hyperalgesia. [24]

Stretching exercise:

Both the group received stretching of the posterior joint capsule of the knee, hip adductor, hamstring, tendoachilics, and pyriformis. According to Lloyd-Roberts GC (1953) the role of capsular changes of the hip joint in osteoarthritis shows fibrotic shortening of the capsule in the lowest part of the joint cavity explains many of the symptoms and signs of the disease: pain is caused by an attempt to stretch the capsule; muscle spasm occurs in the muscles supplied by the sensory nerves of this part of the capsule. The fibrosis of the synovial membrane and capsule follows the synovial hyperplasia which is very sensitive to traction. [25]

Stretching decreases the micro-elastic behaviour of muscle and tendon which leads to a decrease in stiffness and improvement of performance by requiring less energy to move the limb.

In a study by Ahmed AR (2010) instructed to perform home-based knee stretching exercise once a day for about 3 month and found significant improvement in knee pain (from 6.43 + 1.86to 4.21 + 1.09), knee ROM (from 117 + 12.13 to 126 + 11.34) and over WOMAC (63.54 + 8.87 to 51.63 + 7.62), similar to our study in which pain in walking reduced from 6.5 to 5.2 and in stair climbing by 6.8 to 5.9 in 10 point VAS scale. [26]

The flexors of the knee are typically tight, inhibiting the quadriceps. Sustained flexion due to degeneration shortens and thickens the hamstring and gastrocnemius attachment. Stretching the tight muscle around the knee must have resulted in a decrease in pain.

Posterior capsule structures that remove noxious substance broke the adhesion and improve the mobility and it may normalize the altered biomechanics due to tight tissue which is thought to be related to aggravation of pain. Stretching may reduce pain and probably improved the subject's ability to perform the activity with less discomfort.

In osteoarthritis of knee, the patella is laterally tract most commonly due to tight lateral retinaculum leading to over lengthening of medial capsule. Due to this, with the course of time, along with tightness of lateral retinaculum, medial retinaculum gets thickened, fibrotic, taut, and inextensible. [25]

According to a study by Vanden Dolder PA et al. (2006) six-session of manual therapy to the lateral retinaculum resulted in insignificantly greater improvement in active knee flexion and the ability to step up / down a step in people with anterior knee pain than does no intervention. [27]

Deyle GD et al. (2000) suggested that periarticular and muscular connective tissue could be implicated as symptom sources in a patient with osteoarthritis of the knee. [28]

Strengthening exercise:

Both the groups In both, the group received strengthening of quadriceps, hip abductor, glutei, straight leg raise exercise.

Strengthening the hip abductor musculature has direct influence on the frontal plane moments of force about the hip joint during gait. Hip abductor strengthening might have increased trunk stability, thus decreasing lateral trunk lean towards the stance limb. [29] The gluteus medius is the main hip abductor and a large portion of this muscle acts in the frontal plane to stabilize pelvis and lower leg during gait. [23]

Aagaard P et al. (2002) suggested that after resistance training there is a change in motor unit firing frequency or synchronization and increased recruitment in the number of motor unit firing. [30] These changes are caused by a decrease in the inhibitory function of the central nervous system, decreased sensitivity of the Golgi tendon organ (GTO), or changes at the myoneural junction of the motor unit. [31]

Improvement in the experimental group may be due to the effect of high tone power therapy. Though there are very few literature on high tone therapy, the effects might be the physiological effect of this electrotherapy approaches.

CONCLUSION

Since this study doesn't show any remarkable difference in improvement of the variables i.e. pain, range of motion and function, it is suggested that the management of osteoarthritis should be done preferably by conventional method using

manual therapy as the mainstay instead of opting for electrotherapeutic modalities like high tone power therapy. The manual therapy treatment is easily accessible and cost effective.

CLINICAL IMPLICATION

The prevalence of osteoarthritis is increasing day by day. As it is a progressive condition so prevention along with physical therapy is the best possible way to live a normal life. Further study is required to find out the exact effects of High tone power therapy and it may be used an adjunct to conventional therapy to treat the patients.

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