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Comparative study of effect of isometric exercises Vs ultrasound on pain and muscle strength in knee osteoarthritis patients

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Abstract
Background: Osteoarthritis is the most common type of arthritis in middle aged and older people. It often occurs in weight bearing joints, such as knee and hip. The pain may limit ability to get up from a chair, stand and walk or climb stairs. The pain tends to get worse with activity, so that pain is worst at the end of the day. Treatment is aimed mainly at relieving symptoms and maintaining functions. Treatments include simple painkiller drugs, weight loss if needed, physical therapy and regular exercise. In addition, strengthening the muscles around affected joints may help relieving pain and improve functions in short term. The actual relationship between muscle strength and the course of the disease itself, however is not clear.
Methodology: 20 subjects, aged 40-80 years with unilateral knee pain due to according to Grade 1, 2 or 3 (Kellgren-Lawrence grading system of osteoarthritis) osteoarthritis and pain symptoms provoked by activity for at least 6 months were included in the study. After the initial assessment using Visual Analogue Scale (VAS) for pain and Manual Muscle Testing (MMT) for Quadriceps muscle strength of affected side at 0^{th} week, the subjects were randomly divided into 2 equal Groups (Group A & B) with each group consisting of 10 subjects. The subjects in Group A were given Isometric exercises of knee joint. The subjects in Group B were administered with Ultrasound Therapy. The treatment duration was 4 weeks. Pain and quadriceps muscle strength of affected knee joint was re-assessed using VAS and MMT respectively at the end of each week (i.e. 1^{st}, 2^{nd}, 3^{rd}, 4^{th} week).
Conclusion: The results of this study showed that though both isometric knee exercises and Ultrasound are helpful in reducing Osteoarthritis Knee paint but efficacy of isometric training is greater than ultrasound. Also, there was increase in muscle strength in Group A subjects with isometric exercises in Osteoarthritis Knee.

Keywords: Isometric exercises, Osteoarthritis, Ultrasound therapy

Introduction

Osteoarthritis (OA) is a degenerative joint disease. The etiology is multifactorial still not understood but commonly it is thought to be wear and tear of the joints as one ages. Mainly two types – Primary and secondary are recognized. Primary OA is articular degeneration without any apparent underlying reason. It occurs in old age mainly in weight bearing joint (Knee and Hip). Primary OA is more common than Secondary OA. In Secondary OA, there is underlying primary disease of joint which leads to the degeneration of the joints often may years later. There are some predisposing factors such as Congenital mal development of joint, irregularity of the joint surfaces from the previous trauma, previous diseases producing a damaged articular surface, internal derangement of knee, such as loose body, mal-alignment (bow legs), obesity and excessive weight. Biomechanical and biochemical forces are involved in cartilage destruction which is at the core of osteoarthritis, cytokines and growth factors to play a role in the pathophysiology of the disorder. Interleukin-1 and tumor necrosis factor-b may function to activate enzymes involved in proteolytic digestion of cartilage. Growth factors such as tissue growth factor-ß and insulin growth factor-1 may play a role in the body's attempts to repair cartilage through cartilage synthesis, OA develops. Collagenolytic enzymes are thought to contribute to the breakdown of cartilage. Collagenase 1 (matrix metalloproteinase 1 (MMP-1) is a fibroblast collagenase and collagenase 2 (MMP-8) is a neutrophil collagenase. Symptoms of an OA patient are joint pain, morning stiffness lasting less than 30 minutes, joint instability or bucking and reduction or loss of function of the joint/s. Signs are bony enlargement at affected joints, limitation of range of motion, crepitus on motion, pain with motion, mal alignment and or joint deformity [1, 2]

Material and methods

A total of 20 subjects, 40-80 years aged, diagnosed with Unilateral Knee OA [Grade 1, 2 or 3 (according to Kellgren-Lawrence grading system of osteoarthritis)], having pain for at least 6 months with symptoms provocation by activity and no need of any assistive device during ambulation were included in study whereas subjects with functionally limiting cardiac disease or dyspnea on exertion, exercise induced angina, uncontrolled hypertension, knee flexion contracture, history of intra-articular steroids administration in the past 3 months, knee arthroscopy of other side in past years, symptomatic spine, hip, ankle or foot disease other than OA that would interfere with assessment of the knee and participants of any strengthening program were excluded.
After the initial assessment using Visual Analogue Scale (VAS) for pain and Manual Muscle Testing (MMT) for Quadriceps muscle strength of affected knee at 0^{th} week, the subjects were randomly divided into 2 equal Groups (Group A&B) with each group consisting of 10 subjects. The subjects in Group A were given Isometric exercises of affected knee joint. The subjects in Group B were administered with Ultrasound Therapy at affected knee joint and the subjects in control group were devoid of any

treatment. The study duration was 4 weeks. Pain and Quadriceps muscle strength of affected knee was re-assessed using VAS and MMT respectively at the end of each week (i.e. 1st, 2nd, 3rd, 4th week).

For VAS, subjects were asked to assign a number from o to 10 to his pain according to his perception of the severity of the pain with o being no pain and 10 being worst pain. For MMT, Oxford scale for MMT was used according to which score 0,1,2,3,4,5 was assigned to muscle with no contraction, flicker of contraction, small movement with gravity counter balanced, movement against gravity, movement against gravity with some resistance, movement against gravity with maximum resistance respectively [3, 4]

Interventions

Group A: Subjects in group A were given Knee Isometric exercises for affected side for four weeks using following technique

- Positioning of patient- supine lying on a couch with both legs extended.
- A rolled towel is placed under the patient's knee.
- Patient is asked to press the towel strongly downwards causing strong contraction in quadriceps & gliding of patella of patella upwards.
- 10 repetitions of Maximal voluntary isometric contractions along with relaxation of 5 seconds [5].

Group B: Subjects in group B were given Ultrasound Therapy on the affected knee joint. Treatment was given with patient in supine lying or half lying and direct contact method was used. Coupling medium (Ultrasonic Gel) was applied on the affected area in order to eliminate air between the skin and the treatment head transmitted ultrasonic beam to the tissues. The treatment head was moved in small concentric circles over the skin in order contact with skin. The dose given to the subjects was 0.2w/cm square. The subjects were given the treatment for 4-8 min in each treatment session [6, 7, 8].

Results

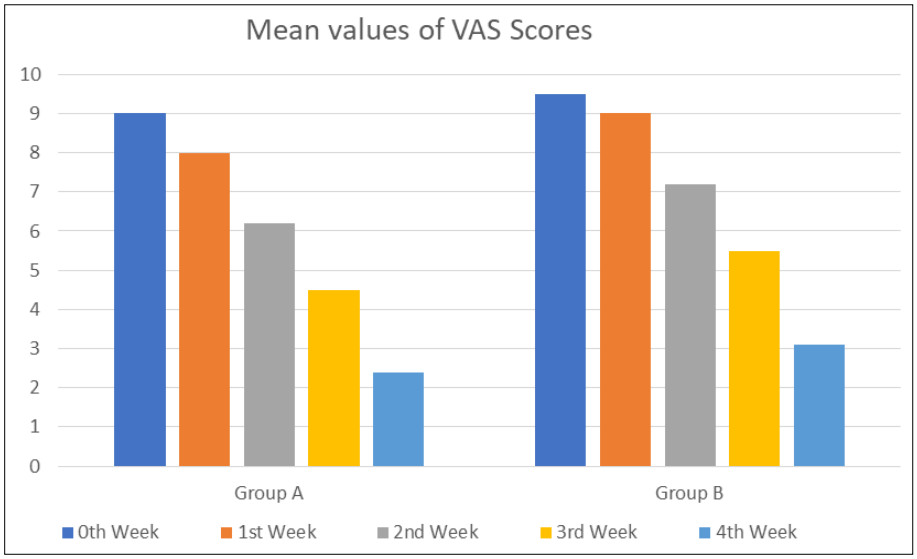

Fig 1: Graphical representation of comparison of mean values of VAS scores at 0th, 1st, 2nd, 3rd, 4th week in Group A and Group B.

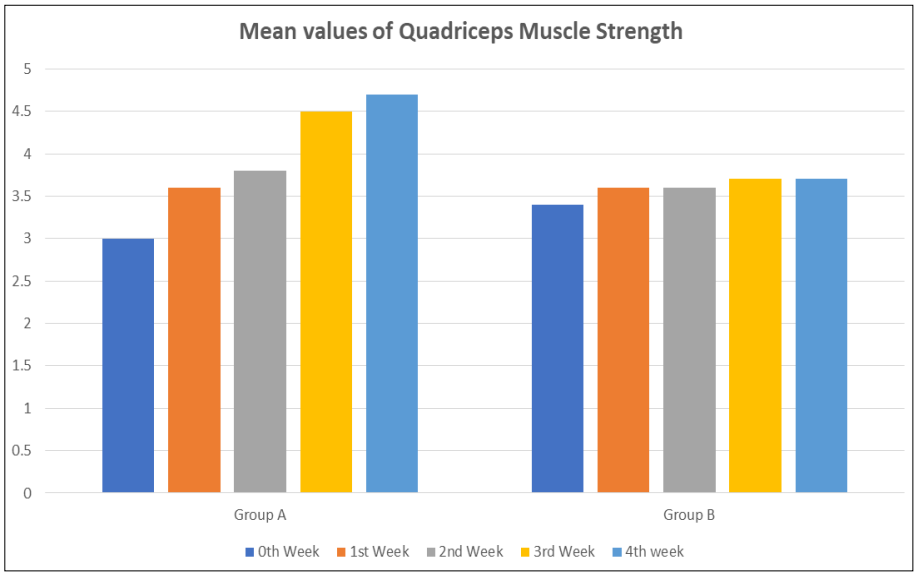

Fig 2: Graphical representation of comparison of mean values of Quadriceps muscle strength scores at 0th, 1st, 2nd, 3rd, 4th week in Group A and Group B

Discussion

The results of this study showed the significant reduction in the mean values of VAS from 0th to 4th week in both the groups but there was more significant reduction in pain in Group A subjects who performed Maximal Voluntary Isometric Quadriceps muscle contractions as compared to Group B subjects who only received Ultrasound Therapy as the intervention over a period of 4 weeks. Also, on comparing both the groups, there was a significant increase in pre- and post-treatment mean values of MMT Scores of quadriceps muscle in Group A subjects when compared to Group B subjects. Rutherford DJ *et al* [5] conducted a methodological investigation in moderate knee osteoarthritis. Their study suggested that both ultrasound and isometric resistance training reduced perceived knee joint pain and had no effect on perceived joint stiffness. Only the isometric training reduced perceived functional limitations, and the control group did not change their measures on any of the outcome variables over the duration of the study.

McCarthy CJ [9] *et al* conducted a study on the reliability of isometric strength and fatigue measures in patients with knee osteoarthritis and concluded that the reliability of the maximum voluntary isometric extension peak torque test was excellent, with an excellent ICC statistic, narrow 95% CIs and low SEM and SDD values. The initial median frequency indices also demonstrated excellent ICC and SDD statistics for all three heads of the quadriceps.

Zhang C *et al* [10] conducted a study on Effects of therapeutic ultrasound on pain, physical functions and safety outcomes in patients with knee osteoarthritis and concluded that ultrasound is beneficial for reducing knee pain and improving physical functions in patients with knee osteoarthritis and could be a safe treatment. Topp R *et al* [11] also conducted a study on the effect of dynamic versus isometric resistance training on pain and functioning among adults with osteoarthritis. The results of their study support the efficacy of prescribing various resistance-training programs to patients with OA of the knee as a method to enhance their functional ability and to reduce their knee joint pain. The findings of different studies [8, 9, 11] showed the improvement in muscle strength by isometric exercises.

Therefore, our study concludes that both ultrasound and isometric exercises are helpful to reduce pain and to increase muscle strength, isometric exercises are more beneficial as compared to ultrasound therapy in case of knee osteoarthritis. However, this study has limitations such as small sample size, lack of control subjects, lack of X-ray imaging measures, lesser number of outcome measures and lack of a proper treatment protocol for Knee osteoarthritis patients.

Conclusion

The results of this study showed that though both isometric knee exercises and Ultrasound are helpful in reducing Osteoarthritis Knee paint but efficacy of isometric training is greater than ultrasound therapy in reducing pain and increasing muscle strength.

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