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Effects of Hemibridge with Ball and Balloon Exercise As An Adjunct To Conventional Therapy In Knee Osteoarthritis Patients: A Randomized Controlled Trial

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ABSTRACT

A Randomized Controlled Study. Quadriceps, hamstrings and hip muscles are significantly impaired in patients with knee osteoarthritis. The hemibridge with ball and balloon exercise provides an optimal zone of apposition (ZOA) of the diaphragm that may help to address trunk instability and also strengthening of hamstrings and hip muscles. The present study intends to evaluate the effects of hemibridge with ball and balloon exercise as an adjunct to conventional therapy in knee osteoarthritis patients. Twenty patients were randomly assigned to 2 groups (Experimental and control). The experimental group along with conventional therapy received hemibridge with ball and balloon exercise while the control group just received the conventional therapy for 10 sessions over 10 days. The difference between pre and post of VAS in both the groups was statistically highly significant (p=0.0001) but clinically more percent of change was seen in experimental group. The p value of Lequesne index for knee OA by paired t test was statistically highly significant with *p value of* 0.0001.Patients in the experimental group who received an additional hemibridge with ball and balloon exercise had superior outcome measures to those in the control group who just received conventional therapy.

Keywords: *hemibridge, Lequesne, ball, balloon*

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INTRODUCTION

The term arthritis is derived from Greek words arthon meaning joint and "itis" meaning inflammation.[1]Osteoarthritis (OA) is defined as a non-inflammatory disorder characterized by loss of articular cartilage within the synovial joints, associated with hypertrophy of bone and thickening of the capsule.[2]The disease processes affect articular cartilage, subchondral bone, synovium, capsule and ligaments. Cartilage degenerates with fibrillation, fissures, ulceration and full thickness loss of joint surface.[3] OA of knee is most commonly affected joint in human body.[4]

Knee OA is the most common arthritic condition in the developing countries. Its prevalence was reported to be 4.14% in Brazil and 11.7% in Luba. In Asian countries the prevalence was reported as 3.1-4.6% in urban and 3.6% in rural north Pakistan, 7.5% in rural and 10.6% in urban Bangladesh, 5.78% in rural western India and 12.2% in urban and 5.1% in rural north India.[5]Osteoarthritis is the most frequent joint disease encountered in clinical practice with prevalence rate of 22% to 39% in India and is the most common cause of locomotor disability in elderly.

There are several pathogenic mechanisms involved in development of OA. These include subchondral bone overload, joint instability, synovitis-capsulitis, hypoxia, body mass index as it relates to obesity and heredity.[7]

Subchondral bone overload: It has been postulated that articular overload mainly of subchondral bone produces micro trauma, remodeling, hardening and displacement of the osteochondral line. These changes reduce the elasticity and energy dissipation capacity of the articular cartilage during locomotor. The results of these forces are mechanical lesions that affect the joint tissue and its extracellular matrix (ECM) which may account for the common findings of OA in knee joint of human athletes.[7]

Joint Instability: Joint instability can be due to ligament laxity, tear or strain in alignment or poor conditioning of the muscles that affect the joints. Poor development of quadriceps muscles increases incidence of OA knee. Joint instability can also occur as a result of synovitis that generates excessive amounts of synovial fluid. It is an important cause of OA and should always be considered in affected patients.[7]

Synovitis: The synovitis can be due to joint trauma or articular overload or an aftereffect of intraarticular drug injection or infection.[7]

Osteoarthritis of knee has a multifactorial etiology which includes increased mechanical stress, obesity, age, genetic predisposition and greater bone density.[8]Major risk factors of OA are age, female sex, obesity, geographic factors, smoking, occupational kneeling or squatting,

lifting heavy weights, genetic influence race, trauma, immobilization, increased joint mobility and crystals in knee joint.[5,9]

Pain is the most common symptom in knee OA. It exacerbates by activity and relieves by rest. In advanced cases synovitis may develop and lead to pain at rest or night. Short duration of stiffness less than 30 minutes may be seen in OA patients in the morning or following periods of inactivity. On physical examination of the involved joints tenderness to palpation may be present. Joint effusions may be present. Crepitus is common during walking and joint movement. Restriction of joint range of motion is the common sign of OA of the knee. In advanced cases deformity may be evident such as genu valgus and genu varus.[10]

Extensive research has been done on conventional physiotherapy for knee osteoarthritis but, there is no evidence on knee osteoarthritis as an adjunct to conventional therapy using hemibridge with ball and balloon exercise. Hence the need arises to evaluate the effects of hemibridge with ball and balloon exercise on pain and functional abilities in patients with knee osteoarthritis using Visual Analogue Scale (VAS) and Lequesne index for knee osteoarthritis.

MATERIALS AND METHOD

The study was approved by institutional review committee and was conducted in conformity with the principles outlined in declaration of Helsinki

Participants:

Participants were recruited from tertiary care hospitals at Belagavi. Twenty participants were included in the study from tertiary care hospital. The inclusion criteria was: patients with age group 50 years and above, primary osteoarthritis and grade 2 and 3 by Kellgren and Lawrence severity of knee OA. The exclusion criteria was: central nervous system dysfunction (hemiparesis, myelopathy, cerebellar ataxia). Amputation of lower limb, bed sores, Bell's palsy, dyspnea, spinal deformity, angina and other cardiac conditions. After meeting the inclusion and exclusion criteria patients were randomly allocated to the experimental group and the control group respectively.

Interventions:

Patients in the control group received Continuous Short Wave Diathermy (CSWD) on the affected knee joint for 15min[11, 12] after which they underwent Transcutaneous Electric Nerve Stimulation (TENS) for a maximum duration of 20 min followed by the manual intervention using conventional therapy which included 3 stretching exercises and 3 strengthening exercises for muscles around the knee joint (hamstrings, quadriceps and calf muscles). Patients were asked to perform the stretching exercises daily and keep doing each exercise for a minimum of 15 seconds in stretching form and repeat them 4 times. Strengthening exercises

were performed daily and each time every exercise was repeated 10 times in three sets. There was 1-3 min rest between each set[13] and was given for 10 sessions over 10 days. During the therapy the patients were instructed to lie in the supine position stay relaxed and not to sleep during procedure. If any discomfort or pain is felt the patient were asked to report to the therapist giving the treatment.

Participants in the experimental group received the same intervention as that of control group along with the hemibridge with ball and balloon exercise for 10 sessions over 10 days

Instructions given to the participants performing hemibridge with ball balloon exercise.

1. Lie on back with feet on a wall and knees and hips bent at 90^0 angle
2. Place a 4-6" ball between knees
3. Place right arm above head and a balloon in left hand
4. Inhale through nose and as exhale through mouth perform a pelvic tilt so that tailbone is raised slightly off the mat. Keep low back flat on the mat. Do not press feet flat in the wall; instead dig down with heels
5. Shift left knee down so that it is below the level of right without moving feet. Should feel left inner thigh engage.
6. With left knee shifted down, take right foot off the fall should feel the back of the left thigh engage. Maintain this position for the remainder of the exercise.
7. Now inhale through nose and slowly blow out into the balloon
8. Pause 3 seconds with tongue on the roof of mouth to prevent airflow out of the balloon.
9. Without pinching the neck of the balloon and keeping tongue on the roof of the mouth, inhale again through nose.
10. Slowly blow out as stabilize the balloon with hand.
11. Do not strain neck or cheeks as blow.
12. After the fourth breath in, pinch the balloon neck and remove it from mouth. Let the air out of the balloon.
13. Relax and repeat the sequence 4more times.[14]

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OUTCOME MEASURE:

Age, height, weight were gathered by patient self-report or from hospital charts.

PAIN ASSESSMENT

Pain intensity was assessed with visual analog scale (VAS). The VAS is a 10-cm line, anchored with 0 at one end, representing no pain, and 10 at the other end, representing the worst pain imaginable.

Lequesne index for severity of knee OA

It looks at pain, maximum distance walked and activities of daily living. These indices are more difficult for patients to self-administer and may require an interviewer. Questions are asked and points allocated according to the patient's reply and a high score indicates greater severity. Minimum points for each section is 0, maximum points for each section 8, minimum index score 0, and maximum index score 24.

RESULTS AND DISCUSSION

Demographic data of the participants are provided in Table 1. The participants in the experimental group treated with additional exercise called as hemibridge with ball and

balloon exercise for knee OA had statistically significant post-intervention reduction in pain ($p<0.05^{*}$). But showed minimal clinical difference. Post intervention they also demonstrated significantly greater change in functional ability in the participants ($p<0.0001$). Complete results of paired-t test and unpaired-t test are given in TABLE 2 and TABLE 3 respectively. No adverse effects were reported.

This study is the first to investigate the effectiveness of hemibridge with ball balloon exercise as an adjunct to conventional therapy in patients with knee OA. Patients in the experimental group who received additional exercise intervention known as hemibridge with ball and balloon exercise, demonstrated clinically significant greater improvement in pain and functional ability than the control group, however both the groups showed statistically greater difference. The observed improvements are most likely attributable to the hemibridge with ball and balloon exercise. The present study reports VAS in both the groups with statistically highly significant but clinically more percent of change was seen in experimental group than in control group

The average BMI of the study in group A was 25.52kg/m^2 and in group B was 25.24kg/m^2. High body weight and BMI are considered as risk factors of knee osteoarthritis. Studies have shown that overweight or BMI more than or equal to 25kg/m^2 has high incidence and prevalence of knee OA.[11,12,13,14] Majority of participants had high BMI i.e. above 25kg/m^2 which supports the statement that overweight or high BMI is associated with OA knee. The high prevalence of OA knee in population with high BMI could be due to excessive joint loading during weight bearing activities resulting in damage to the soft tissue structures around the joint and damage to the articular cartilage.[15]

In a literature review done by Marks R in 1999, reports that short wave diathermy is used in relieving pain in OA knee patients. Short wave diathermy is a non-pharmacological treatment approach dissipates heat which acts on deep tissues and this treatment has been reported to have measurable effects for patients with knee OA. Increase tissue temperature increases circulation and helps in reduction of pain, deep heat dissipated by short wave diathermy increases the pain threshold and helps in pain reduction.[16]

A study done by Pearl P.W. Law on optimal stimulation frequency of TENS concluded that high frequency TENS (100Hz) significantly reduces osteoarthritic knee pain across treatment sessions. The present study have also used the high frequency TENS (100Hz) for 20min as a conventional treatment and have produced similar analgesic effects on OA knee pain over 10 days.[17]

The therapeutic regime includes quadriceps strengthening as a part of conventional treatment. The strength of quadriceps muscle in participants could not be assessed since research

supports the association of quadriceps weakness in OA knee. Literature states that intervention should target strengthening of quadriceps muscle to improve function and thus it has been included in therapeutic regime.[18] Majority of subjects had difficulty while squatting, climbing stairs and stiffness in knee joint during morning as measured on function and stiffness domains of Lequense Index for Knee OA. After administering the exercise sessions which is a low intensity exercise regime of the participants had experienced a gradual improvement in function and reduce stiffness.

Literature also supports weak lower limb musculature a risk factor of OA and showed high incidence of disease in population. Lower limb musculature is considered as the natural brace of the knee joint, quadriceps weakness or weakness of the hamstrings relative to the quadriceps is associated with muscle dysfunction which is usually assessed by the quadriceps: hamstrings(Q:H) ratio. Muscle weakness and atrophy of muscles of lower limb contribute to the disease process. Therapeutic exercise regime should focus on strengthening and stretching exercises and aerobic exercises and should be done on regular basis to avoid muscle atrophy.[19] The therapy protocol has included stretching and strengthening exercises but aerobic exercises were not considered for advice and suggestion.

The experimental group includes hemibridge with ball and balloon exercise as an adjunct to conventional therapy. The hemibridge with ball and balloon exercise is designed to promote optimal posture by utilizing the diaphragm in the most efficient way and correcting the lumbar spine position. This exercise promotes optimal Zone of Apposition (ZOA) that helps to address the impaired trunk stability by decreasing lumbar lordosis and also activates the hamstrings and hip adductors.

There are studies reporting that impaired muscular control of hip, pelvis and trunk affects the tibiofemoral and patellofemoral joint kinematics and kinetics. When the hemibridge with ball and balloon exercise is performed by the patient with hamstrings and gluteus maximus activation the pelvis moves into posterior pelvic tilt and ribs into depression and internal rotation. This pelvic rib position helps to optimize ZOA.

Activation of these muscles may have contributed to gain control over the hip, pelvis, trunk improving tibiofemoral and patellofemoral joint kinematics and kinetics and thus reducing pain and improve functional ability of the patient.

The pain parameter was measured on VAS; a well validated and reliable scale to assess chronic pain in different musculoskeletal conditions was highly significant in with group comparison after intervention.[20]

CONCLUSION

This study indicates that the addition of hemibridge with ball and balloon exercise to the conventional therapy for knee osteoarthritis is beneficial to reduce pain and improve functional abilities of the patient.

Future scope:

The study can be done with a large sample size to get better and appropriate results.

Limitations:

More valid and reliable Pain measuring scale can be used. As range of motion (ROM) is not evaluated in the study the further research can be done using ROM as the primary outcome.

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