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Effect of Graded Motor Imagery for Kinesiophobia on Pain and Function for Institutionalised Elder People with Knee Osteoarthritis

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Abstract: ***Purpose: To evaluate the degree of kinesiophobia using the TAMPA scale pre and post treatment and the effect of graded motor imagery for kinesiophobia for pain, function and osteoarthritis by using the Pain Self Efficacy scale and WOMAC scale respectively pre and post treatment. Methods: The present experimental study was conducted among 28 participants which included both male and female symptomatic participants between the age of 65 to 85 years with knee osteoarthritis. The participants were given graded motor imagery which is a three stage process involving Left/Right discrimination training, Explicit motor imagery and mirror therapy which was given for 6 weeks, per phase given for two weeks each. Outcome measures like TAMPA was used to evaluate the degree of kinesiophobia. WOMAC scale to evaluate components like pain, stiffness and physical function in patients with osteoarthritis and Pain Self Efficacy scale to evaluate the degree of pain in the participants. Result: The pre intervention scores for TAMPA were 51.04 and post intervention it decreased to 33.32. The p value was found to be (p=0.001*) which was highly significant. The pre test score for pain self efficacy was 39.82 and post test score decreased to 31.36. The subjects mean pre test scores for WOMAC in the experimental group were 67.07 and post intervention it decreased to 46.75. Conclusion: The study concludes that the effects of graded motor imagery shows improvement in pain and function for institutionalised elder people with knee OA. It also decreases kinesiophobia.***

Keywords: Graded Motor Imagery, kinesiophobia, Osteoarthritis, Tampa, Womac, Pain efficacy

1. Introduction

"Aging is a universal phenomenon and not just a uniform experience."[1] The Society for Study of Human Biology has defined aging as "The physical changes that take place in individuals which are manifested as a decline in variety of body functions."[2] Osteoarthritis does not represent a single disease entity but is a common pathway for many disorders. It is defined as "a group of overlapping distinct diseases which may have different etiologies but with similar biologic, morphologic and clinical outcome."[3] Osteoarthritis is a leading cause of chronic disability in the geriatric age group.[4] Example: osteoarthritis of knees, hands, spine and feet being most common. Knee osteoarthritis has a Higher prevalence as compared to other types of osteoarthritis. Knee osteoarthritis is a clinical syndrome of joint pain accompanied by varying degrees of functional limitation and reduced quality of life[5]. Kinesiophobia is defined as "an excessive, irrational and debilitating fear of physical movement and activity resulting from a feeling of vulnerability due to painful injury or re-injury.[6] Kinesiophobia or "pathological fear of movement" is a well documented disorder where a person believes that movement can cause more injury and pain. The term is used in the context of rehabilitation medicine and physiotherapy to describe people's pain due to movement. Graded motor imagery can be defined as covert cognitive process of imagining a movement of one's own body without actually moving the body. It is a therapeutic strategy [targeting] the activation of different networks in a graded manner.[7] India ranks second for the largest aged population in the world.[8] The United Nations Population Fund and Help Age International (October 2012) states that India has 8.3% (100 million) elderly people at present. According to the Ministry of Home Affairs (august 2013) the census of geriatric population in India are as follows:

AGE GROUP	CENSUS 2011
60-90	103.2
100+	0.6

Osteoarthritis of the knee is the second most common rheumatological problem. Half of all the population aged over 65 years suffer from osteoarthritis and is the most frequent joint disease with a prevalence of 22% to 39% in geriatric population leading to locomotive disability in India. 10% of men and 13% of women have symptomatic O.A knee.[9] Graded motor imagery targets the activation of different brain regions in a graded manner. It progressively engages the cortical neural networks in order to improve the cortical neural recognition through neuroplasticity[10]. Graded motor imagery applies the principle of Graded Exposure in which a stage wise stimulus response link is obtained. Graded Motor Imagery is a three stage procedure in which the first and second stage is given through an application of Recognise Knee by the **NOI*** group.[11] LEFT/RIGHT DISCRIMINATION TRAINING: the capability to recognise left or right images of the painful body parts. The functional representation gets replaced by perceptual disorganisation of pain. EXPLICIT MOTOR IMAGERY: when movements are imagined one uses similar brain areas as used while actually performing the movement. Imagined movements impart practical substitutes activating primary motor areas. MIRROR THERAPY: This depends on visual stimulation and functions on the mechanism of activating mirror neurons in the areas of the brain that are adversely affected by learned disuse[11].

2. Methods

The study was designed as an experimental study that involved one group.

3. Participants

In the present study 28 participants of the elderly population with knee osteoarthritis were selected. The inclusion criteria consisted of both genders, age group 65 to 85 years, TAMPA score more than 37 out 68 and Mini mental state examination score more than 23 out of 30.

The exclusion criteria was cognitive disorders, conditions following stroke, congenital deformities of the lower extremities, any known peripheral vascular disease, any persons with past history of knee surgery and fractures and persons on oral analgesics or intra articular medication.

4. Instruments

Outcome measurement

1) **Pain Efficacy Scale:** The pain self efficacy scale is used in people with chronic pain by reference to confidence in ability to perform specific tasks or confidence in performing more generalized constructs like coping with pain. (α=0.95, r= 0.90). It is strongly associated with perceived work capacity with chronic pain. Consists of 10 questions ranging from 0 to 6 where 0 is not at all confident and 6 is completely confident. This questionnaire is not taken to assess how you have been doing these things but how confident you are doing them at present regardless of the pain
2) **WOMAC SCALE:** evaluation of hip and knee osteoarthritis can be done using the Western Ontario and McMaster Universities arthritis index. The questionnaire consists of 24 items that are divided into 3 subscales 1).pain that further consisted on5 components 2.stifness with two components and 3) physical function that consisted of 17 items. The score of each should be summed up with a score range of 0-20 for pain, 0-8 for stiffness, 0-68 for physical function.
3) **Tampa Scale:** The TAMPA scale of kinesiophobia is a 17 item self report checklist using a four point Likert scale which was developed as a measure of fear of movement or injury. The scale is based on the model of fear avoidance, fear of work related activities, fear of movement and fear of re-injury (Vlaeynan et al 1995). Validation studies confirm the predictive validity supported by moderate correction coefficients with performance or physical performance tests like lifting tasks or bicycle tasks. (Roelofs et al 2004)
4) **Mini Mental State Examination:** This is a tool to assess the mental status. A questionnaire that consists of 11 questions that will test 5 areas of cognitive function, orientation, registration, attention, calculation, recall and language. The maximum score that can be obtained is 30. A score of 23 or lower indicates cognitive impairment. This test takes 5 to 10 minutes to administer. It is one of the most effective tools for cognitive impairment with older, dwelling and institutionalized adults.

5. Procedure

A baseline assessment of pain, cognitive level, osteoarthritis, level of function and Kinesiophobia was done using the Pain efficacy scale, Mini Mental State Examination, WOMAC scale, special tests like Patellar Tap Test, Clarke's test and TAMPA scale. This was done pre treatment. Graded motor imagery was a three stage process that included (i) left/right discrimination (ii) explicit motor imagery (iii) mirror therapy. The duration of the intervention was 6 weeks in which per stage was given for 2 weeks each. The first stage was done using the Recognise Knee application by the **NOI*** group. The patient was made to sit in a relaxed position and the images were shown to them through the app. They were then asked to identify left or right images of the painful body part. In the second stage, the patient was asked to imagine movement of the painful limb and had to essentially think about moving without moving the limb. By this, similar brain areas would get activated which usually got activated during an actual movement. In the third stage, a mirror was used. One limb was placed behind the mirror and the other limb was placed in front of the mirror. The patient was then be made to perform movement. With the reflection of the limb in front of the mirror, the patient was made to believe that the limb behind the mirror is performing a similar kind of movement. All the outcome measures were assessed again at the end of the treatment.

6. Statistical Analysis

A total of 28 participants with knee osteoarthritis and who were Kinesiophobic were chosen and included in the study via convience sampling method and received intervention for 6 weeks in which all 28 participants were included in one experimental group. The statistical analysis for the present study was done manually as well as using statistical package of social sciences (SPSS) version 20 so as to verify the results obtained. For this purpose data was entered into an excel spread sheet, tabulated and subjected to statistical analysis. Various statistical measures such as mean, standard deviation, and test of significance such as paired t – test were used. Nominal data from patient's demographic data i.e. the comparison of age, weight, height and BMI was taken in one experimental group and was analysed using the ANOVA test. Comparison of pre and post intervention outcomes within the experimental group was done by paired t – test. The normality of pre test and post test scoring was done using the KOLMOGOROV SMRINOV test. Probability values <0.05 was considered as minimal statistical significant, probability values of less than 0.01 and 0.001 was considered highly significant and very significant respectively.

7. Results

Out of the 28 osteoarthritic patients 24 were females and 4 were males. There were 85.71% that belonged to the female category and 14.29% that belonged to the male category.(table no 1). Age of the participants in the present study was between 63 to 83 years. The mean age of the participants in the experimental group was 73.86%. The values showed no significant difference in age within the groups.(table 2) The maximum weight of the participants in the study was 85kgs and minimum was 45kgs. The mean weight of participants in the group was 58.54%. The maximum height in cms of the participants in the study was 160cms and minimum 135 cm. The mean BMI of the

subjects in the study was 26.15 with a standard dev of 3.57. (table no2). There was a distribution of patients in the study by their affected limb. Out of 28 patients the left limb was affected in 46.43% of patients and the right limb was affected in 53.57% of patients (table no 3). Within the group pre and post test scores of left and right discrimination in the experimental group. The comparison of left laterality was done using paired t test. The mean score pre test was 44.29 and post test score 60.36 with a mean difference of -16.07 and percentage of change was 36.29. The p value was found to be (p=0.0001*). (table no.5). The comparison of right laterality was done using paired t test. The mean score obtained pre test was 44.29 and post test score 57.14 with a mean difference of -12.86 and the percentage of Change was 29.03. The p value obtained (p=0.0001*).(table no.6) The comparison of pain (VAS) pre and post test score within the experimental group. The mean value pre test was 6.46 and post test score 4.89 with a mean difference of 1.57. the p value obtained (p=0.0001*) (table no.7). The comparison of explicit motor imagery was done using the paired t test. The mean value pre test was 72.46 and post test was 66.37 with a mean difference of 6.08 and percentage of change 8.40. the p value obtained (p=0.0004*) (table no.8)

Analysis of Outcome Measures

TAMPA: Comparison of the TAMPA scorings was done using the paired t test. The scale contained a 17 component questionnaire which was analysed pre and post intervention. The pre intervention scores were 51.04 and post intervention it decreased to 33.32 with a mean difference of 17.71 and percentage of difference was 34.71. The p value was found to be (p=0.001*) which was highly significant (table no 9). The normality of the scoring of TAMPA was done using the KOLMOGOROV SMRINOV test in which the p value of the pre-test intervention was (p= 0.3530) and post intervention was (p=0.5550), with a difference of (p=0.7100). (table no 4)

PAIN SELF EFFICACY: The comparison of the pre and post intervention was done using the paired t test. The pre test score was 39.82 and post test score decreased to 31.36. Mean difference being 8.46 and percentage of difference 21.26% with the p value being (p=0.0001*) (table no.10) The normality of the scoring was done by the KOLMOGOROV SMRINOV TEST in which the p value score pre test was (p=0.8150) and post test was (p=0.1920) with a mean difference of (p=0.4180). (table no 4)

WOMAC: Comparison of the WOMAC scale was done using the paired t test. The questionnaire consisted of three components which included pain, stiffness and physical function. The subjects mean pre test scores in the experimental group were 67.07 and post intervention it decreased to 46.75, with a mean difference of 20.32 and the (p=0.0001*).(table no.11) The normality of the scoring was done using the KOLMOGOROV SMRINOV test in which the p value score pre intervention was (p= 0.2500) and post intervention was (p=0.1610) with a mean difference of (p=0.7590). (table no 4)

8. Discussion

The present experimental study was conducted to evaluate the effect of graded motor imagery for kinesiophobia on pain and function for institutionalised elder people with knee osteoarthritis. Graded motor imagery was the intervention given to 28 elderly. It was a 3 stage procedure that included left/right discrimination, explicit motor imagery and mirror therapy which was given over a period of 6 weeks to the participants. The mean age of the participants in the present experimental study was 65 years and above. OA is commonly seen in the geriatric age group as it is one of the most prevalent conditions resulting in disability particularly noted in the elderly population. It is a natural and degenerative process of a joint which is directly associated with progressive age. This is supported by a study to evaluate the decline in knee position sense with age.[12] The aging cartilage may be more susceptible to fatigue fractures producing osteoarthritis. OA also can occur due to the neuromuscular changes with age that may predispose to joint damage.[46] Based on geographical variation the age associated OA varies, this was explained further by the epidemiological study done in 2011 on Osteoarthritis in Asia stating that the prevalence of OA increases with age and the percentage of people over 65 years and above in Asia will be more than double in next two decades from 6.8% in 2008 to 16.2% in 2040.[13] In the present study the targeted geriatric population and the severity of the disease strikes attention towards the painful disability faced by increased age. This is proved in a study that up to a third of older adults in general population show radiological evidence of knee OA which is strongly age related.[14] Studies have shown that along with progressive age, the female gender is more common at risk for osteoarthritis of knee.[15] In the present study too the number of female participants was more as compared to male gender which summed up to 85.71% of the participants in the study. The variation in the gender in India maybe due to the lifestyle led by them. The women in India perform their activities of daily living mostly in cross leg sitting and excessive squatting, these activities can lead to early mechanical wear and tear of the cartilage. Post menopausal women also are at a higher risk of OA as the relationship between estrogen hormone and OA is directly associated. Estrogen hormone is considered is considered as a stimulant for the bone mineral resorption and articular rigidity. This is explained by Jorge a roman blas et al 2009. This review states that estrogen influence the activities of joint tissues through complex molecular pathways that act at multiple levels.[16] According to WHO the standard BMI is in the range of 18.5 – 24.9, but in the present experimental study, majority of the population was overweight with a BMI of 26.15. A cohort study on Body Mass index associated with onset and progression of O.A of knee but not of hip suggested that BMI is associated with incidence and progression of knee O.A was done on 3583 people in 2006 in which a systematic metabolic effect of obesity that influences the onset or progression of osteoarthritis was explained and that BMI is associated with the incidence of knee OA. Moreover it stated a relationship between BMI and osteoarthritis that is mediated by another local factor such as changed mechanical loading of the joint, by mal-alignment. Another study reported the relationship between obesity and osteoarthritis is modified by the presence of

mal-alignment of the knee.[17] Left/Right discrimination was the first phase of the intervention for this, an application Recognise Knee by the NOI* group was utilized. This involved the capability to recognise left or right images of the painful body parts, it involved two distinct processes. The first is an immediate and unconscious judgement and second is mental movement in which a body is moving in the mind by using the same brain neurotags that are used to move the body part.[11] The application was given to the participants for two weeks. For the second phase that was explicit motor imagery the application by the **NOI*** group was utilized again and given for the following two weeks. In this the subject was made aware about imagining the movement to confirm initial judgement. This phase was given to the participants in the following two weeks via the Recognise knee application by the **NOI*** group. This study was based on the idea of applying established principles of rehabilitation to training the brain. That limb laterality recognition activates premotor cortices but not primary motor cortex, whereas imagined movements activate both, 30 and that the order of hand laterality recognition, imagined movements, Perhaps practicing laterality recognition is to limb movement 31 as practicing knee movement is to walking.[18] The primary goals of this study were to relieve pain and maintain or improve function, for this the third phase of graded motor imagery, mirror therapy was used which was given to the participants in the present study for the next two weeks. A mirror was used for the participants. The unaffected limb was placed in front of the mirror and the affected limb was placed behind. A case report on Mirror therapy in patients with causalgia (complex regional pain syndrome type 2 following peripheral nerve injury suggested that the decrease in experienced pain may be the result of a mismatch between motor intention and proprioceptive or visual feedback. This depends on visual stimulation and functions on the mechanism of activating mirror neurons in the areas of the brain that are adversely affected by learned disuse. The intervention was carried out for 6 weeks, per stage was given for 2 weeks each. The outcome measures used were the tampa scale for kinesiophobia, womac scale for osteoarthritis and the pain self efficacy questionnaire for evaluating pain. It was suggested that the participants in the experimental group improved in some parameters after receiving the intervention. An observational study on psychometric properties of Tampa Scale for Kinesiophobia and fear avoidance beliefs questionnaire in acute low back pain stated TSK is a reliable questionnaire with good internal consistency and substantial test reliability. The total scores of the participants of TSK in the present study showed a very significant value.[19] In the present experimental study, WOMAC scale was used to assess the overall pain, stiffness and physical function, which showed a very significant difference as WOMAC is more sensitive to change and has a higher efficiency than most other instruments used to assess OA. A comparative study on Rasch analysis of WOMAC in 2205 patients with OA, RA and Fibromyalgia also stated that WOMAC generally satisfies all requirements and is an appropriate measure of lower body function of OA.[20] In the present study, results of pain efficacy scale showed very significant differene. This maybe the effect of motor imagery which activates cortical networks to executed movements but does not involve movement.[21] In the first stage of GMI pain was taken into consideration via the application Recognise knee by the **NOI*** group. The result of which showed a highly significant decrease. Hence based on the results above Graded motor imagery can be effective in improving pain and function in patients with osteoarthritis. This is supported by a systematic review and meta analysis on the effects of Graded Motor Imagery and its components on chronic pain where it was increasingly used in the treatment of chronic pain conditions and GMI favoured reduction of pain. Other studies suggested that in GMI mirror therapy alone maybe most effective. Therefore on the results of the present experimental study it can be concluded that graded motor imagery can be effective in improving kinesiophobia, pain and function in elderly patients with knee osteoarthritis.

9. Conclusion

The experimental study of Graded Motor Imagery showed significant improvement in pain and physical function of the geriatric people with knee osteoarthritis. This also suggests that improvement of kinesiophobia is possible with appropriate treatment in this population. In the present study the experimental group showed significant improvement after the three phase treatment of graded motor imagery. Hence the study concludes that graded motor imagery should be used for kinesiophobia, pain and function in institutionalized older people with knee osteoarthritis.

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