"EFFECT OF BALANCE EXERCISES ON BALANCE, PAIN AND FUNCTIONAL PERFORMANCE IN OSTEOARTHRITIS KNEE"

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Abstract

Background and Purpose:*Traditionally, rehabilitation programs improve muscle strength and proprioception which may reduce the progression of knee OA. The purpose of the study to evaluate the effect of balance exercises in improving balance, functional performances and decreasing pain in osteoarthritis knee.*

Methods*:30 patients meeting the inclusion criteria was randomly divided into groups. Subjects received one hour individualized training sessions.Group A received quads. Sets, SLR, Flexion-extension and 20 mins short wave diathermy. Exercises are performed 30 repetitions of each exercise (3 sets of 10 repetitions). Group B received strengthening exercises as well as balance exercises which includesSide stepping ,Front and backward ,crossover steps during forward ambulation,Retrowalking etc. Exercises were performed 5 days in a week for 4 weeks. Step Test, Functional Reach Test, WOMAC Questionnaire, Visual Analogue Scale were the outcome measure and their scores for all groups were taken prior and after the training.*

Results:*Pre test and post test outcome measures (VAS, WOMAC, Step test and FRT) of two independent groups were compared by repeated measures analysis of variance (RM ANOVA) using general linear models (GLM) and the significance of mean difference within and between the groups was done by Newman-Keuls post hoc test. And the results revealed that post intervention scores were highly significant (p□ 0.05) in group B and performed better than group A.*

Conclusion*: In conclusion, Study found both the balance exercises effective in improving balance, functional performance and decreasing pain in osteoarthritis knee but Group B was found to be significantly more effective than Group A.*

Keywords: *Osteoarthritis, Balance, step test, WOMAC, Functional reach test, visual analogue scale*

INTRODUCTION

Knee osteoarthritis (OA) is one of the most prevalent musculoskeletal complaints worldwide, affecting 30–40% of the population by the age of 65 yr. [1, 3]Osteoarthritis is the common form of arthritis, with an associated risk of mobility and disability. [12]The knee is the most frequently involved joint of the lower limb in OA. The prevalence of knee OA increases with age because aged cartilage is more vulnerable to physiologic load, and the resulting load across the articular surface changes mechanical, neural and surrounding muscles of the knee. [13]

In people at risk, local mechanical factors such as misalignment, muscle weakness, or alterations in the structural integrity of the joint environment (such as meniscal damage) facilitate the progression of the disease. [12]Knee pain could influence balance controlvia effects on proprioceptive input, central processing ofinformationand efferent output to activate appropriate limb and trunk muscles. [6, 30, 33] Control of balance is dependent upon sensory input from the vestibular, visual and somatosensory systems. Central processing of this information results in coordinated neuromuscular responses that ensure the centre of mass remains within the base of

support in situations when balance is disturbed. [18, 30, 32]

Hassan B, Mockett S et al in 2001, Hinman R, Bennell K et al in 2002, Jadelis K, Miller M et al in 2001 and K.L. Bennell, R.S.Hinman in 2004 have demonstrated a relationshipbetween the severity ofkneepain and balancewhereby greater knee pain is associated with poorer balance. [30, 33] The term proprioception encompasses both the sensations of the joint movement (kinesthesia) and the joint position sense (JPS). Both components of lower limb proprioception seem integral for the regulation of balance and postural control. [48]

Lack of proprioceptive sensation causes altered gait and unphysiological joint loading; slowly progressive joint degeneration may follow. [10]Improvement in muscle strength and proprioception gained from exercise may reduce the progression of knee OA. [16]Purpose of the study is to evaluate the effect of balance exercises in improving balance, functional performances and decreasing pain in osteoarthritis knee.

Four scale are used to assess the outcomes of both interventions. They are Step Test, Functional Reach Test, WOMAC Questionnaire, Visual Analogue Scale,These scales have good reliability and validity. These scales have been selected for study because

1. They are very simple to administer
2. They are quick and practical.
3. They are easy to be conducted in Indian clinical setting

METHODS –

Selection and description of participation :

Total 30 patients out of 35 patients meeting the inclusion criteria were selected.30 subjects were selected on the basis of inclusion criteria from Modern physiotherapy centre and Shanti Gopal Hospital, Ghaziabad.

To participate subjects had to meet the inclusion criteria: (i)Primary osteoarthritis on bilateral knee joint of age ≥ 50 yrs. (ii) Knee pain on most of the previous month. [Average pain ≥ 3 cm ona 10-cm Visual Analogue Scale (VAS)] (iii) Experience pain and / or difficulty when getting up from sitting or climbingstairs. (iv) Demonstrated osteophytes on X-RAY. [Grade II or greater kellgren and Lawrence grading system].
Exclusion criteria for the patients were- (i) Reported a cold or ear infection within previous month. (ii)History of dizzy spells, fainting episodes. (iii)Light headaches. (iv)Secondary osteoarthritis.(v) Past history of lower limb joint replacement. (vi) Neurologicaldisorder.

Procedure-

30 patients meeting the inclusion criteria was randomly divided into two groups (Group A and B) each consisting of 15 subjects.
Group A: Received strengthening exercises and SWD.
Group B: Received strengthening and balance exercises.
Before starting the exercises, patients were given hot pack for 20 min.

Group (A) protocol consists of strengthening exercises which includes [46]:

1) Quads Sets.
2) SLR.
3) Knee flexion, Extension.

Exercises are performed 30 repetitions of each exercise (3 sets of 10 repetitions). Patients were also given SWD for 20 min by placing malleable electrodes around the affected knee.

Group (B) protocol consists of strengthening exercises as well as balance exercises which includes [15, 32]:

1) Side stepping
2) Front and backward crossover steps during forward ambulation
3) Retrowalking
4) Multiple change in direction during walking on physiotherapist command
5) Tilt board balance training
6) Sitting down and standing up from high chair
7) Sitting down and standing up form low chair.

Exercises were performed 5 days in a week for 4 weeks.

STATISTICS

Data were summarized as Mean ± SD. Demographic continuous variable (age) of two independent groups (Group A: Control, Group B: Intervention) were compared by Student's t test while discrete data (sex) were analyzed with Fisher's exact test. The pre test and post test outcome measures (VAS, WOMAC, Step test and FRT) of two independent groups were compared by repeated measures analysis of variance (RM ANOVA) using general linear models (GLM) and the significance of mean difference within and between the groups was done by Newman-Keuls post hoc test. A two-tailed (α=2) probability $p<0.05$ was considered statistically significant. All analyses were performed on SPSS (version 15.0).

2. Age

The age of two groups were summarized in Table 8.2 and also shown graphically in Graph 8.2. The age of Group A ranged from 50-70 yrs with mean (± SD) 58.40 ± 5.82 yrs while of Group B it ranged from 50-69 yrs with mean (± SD) 58.87 ± 5.80 yrs. The mean age of Group A and Group B did not differed significantly ($p>0.05$) i.e. found to be statistically the same (58.40 ± 5.82 vs. 58.87 ± 5.80, p=0.8275). In other words, the subjects of two groups were age matched.

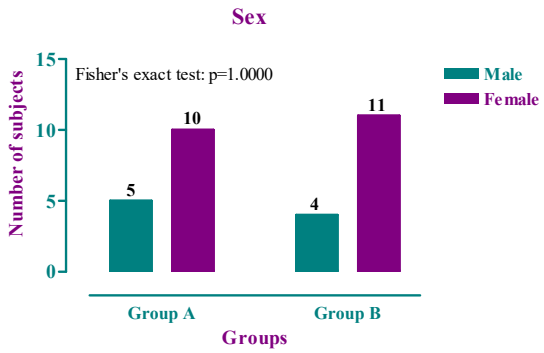
RESULT

A. Demographic characteristics-

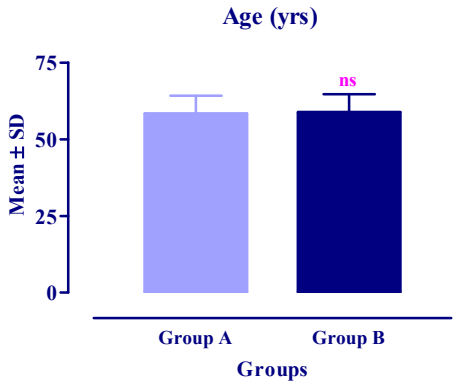
All the two groups were matched in terms of age and gender.

1. Sex-

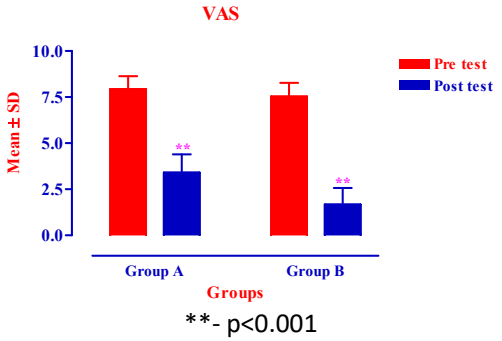
The sex proportions (M/F) of two groups (Group A: Control and Group B: Intervention) were summarized in Table 1.1 and also shown graphically in graph 1.1. In both the groups, the proportions of females were higher than males, but their proportions did not differed between the two groups i.e. found to be statistically the same (M/F: 5/10 vs. 4/11, p=1.0000). In other words, the subjects of two groups were sex matched.



Graph 1.1: Frequency distribution of sex in two groups.



Graph 8.2: Bar graph shows mean (± SD) age of two groups and also compares the age between the groups.



Graph 8.3: Bar graph shows mean (± SD) VAS scores of two groups at pre test and post test and also compares the scores between the periods (within groups).

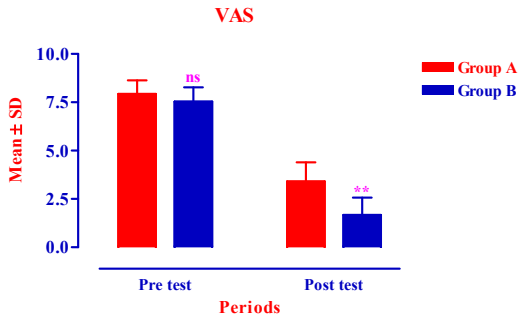
Similarly, comparing (Table 8.4 and Graph 8.4) the mean VAS scores between the groups (Group A vs. Group B), the VAS scores did not differed between the two groups at pre test (7.93 ± 0.70 vs. 7.53 ± 0.74, p=0.1982) while differed significantly at post test (3.40 ± 0.99 vs. 1.67 ± 0.90, p=0.0001). In other words, VAS scores were comparable at baseline (pre test) and at post test (at the end of 4 wk or after 4 wks of treatment), the VAS decreased significantly more in Group B than group A.

ns- p>0.05

Outcome measures

1. VAS

Comparing (Table 8.3 and Graph 8.3) the mean VAS scores within the groups (i.e. between periods or pre test vs. post test), the VAS scores decreased significantly (p<0.001) in Group A (7.93 ± 0.70 vs. 3.40 ± 0.99, p=0.0001) and Group B (7.53 ± 0.74 vs. 1.67 ± 0.90, p=0.0001) at post test as compared to pre test.

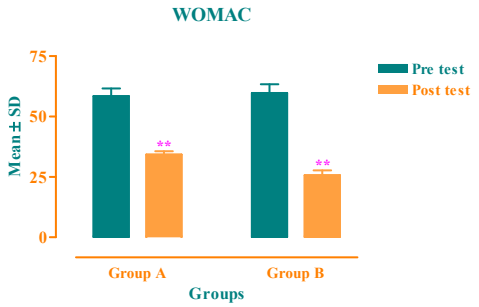


ns- p>0.05
**- p<0.001

Graph 8.4: Bar graph shows mean (± SD) VAS scores of two groups at pre test and post test and also compares the scores between the groups (within periods).

3. WOMAC

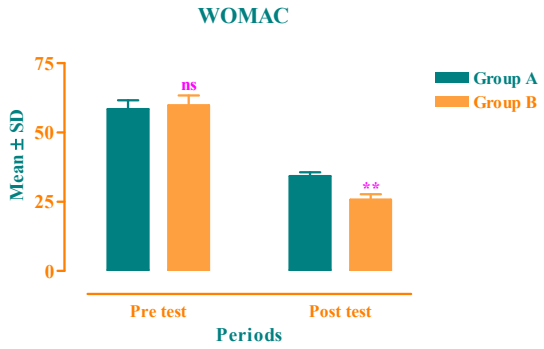
Comparing (Table 8.5 and Graph 8.5) the mean WOMAC scores within the groups, the WOMAC scores decreased significantly (p<0.001) in Group A (58.40 ± 3.14 vs. 34.20 ± 1.42, p=0.0001) and Group B (59.67 ± 3.60 vs. 25.67 ± 2.02, p=0.0002) at post test as compared to pre test.



**- p<0.001

Graph 8.5: Bar graph shows mean (± SD) WOMAC scores of two groups at pre test and post test and also compares the scores between the periods (within groups).

Similarly, comparing (Table 8.6 and Graph 8.6) the mean WOMAC scores between the groups, the WOMAC scores did not differed between the two groups at pre test (58.40 ± 3.14 vs. 59.67 ± 3.60, p=0.2028) while differed significantly at post test (34.20 ± 1.42 vs. 25.67 ± 2.02, p=0.0001). In other words, WOMAC scores were comparable at baseline (pre test) and at post test (at the end of 4 wk or after 4 wks of treatment), the WOMAC decreased significantly more in Group B than group A.



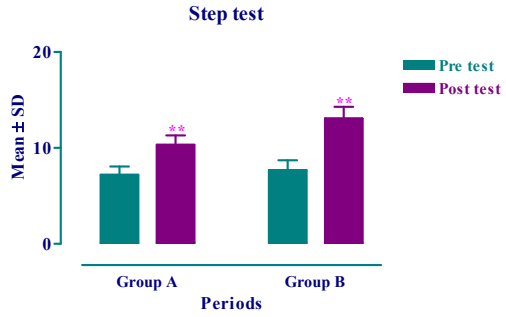
ns- p>0.05

**- p<0.001

Graph 8.6: Bar graph shows mean (± SD) WOMAC scores of two groups at pre test and post test and also compares the scores between the groups (within periods).

3. Step test

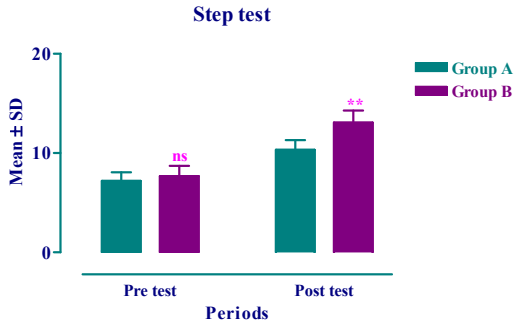
Comparing (Table 8.7 and Graph 8.7) the mean step test scores within the groups, the step test scores increased significantly (p<0.001) in Group A (7.20 ± 0.86 vs. 10.33 ± 0.98, p=0.0001) and Group B (7.67 ± 1.05 vs. 13.07 ± 1.22, p=0.0001) at post test as compared to pre test.



**- p<0.001

Graph 8.7:Bar graph shows mean (± SD) step test scores of two groups at pre test and post test and also compares the scores between the periods (within groups).

Similarly, comparing (Table 8.8 and Graph 8.8) the mean step test scores between the groups, the step test scores did not differed between the two groups at pre test (7.20 ± 0.86 vs. 7.67 ± 1.05, p=0.2226) while differed significantly at post test (10.33 ± 0.98 vs. 13.07 ± 1.22, p=0.0001). In other words, step test scores were comparable at baseline (pre test) and at post test (at the end of 4 wk or after 4 wks of treatment), the step test increased significantly more in Group B than group A.



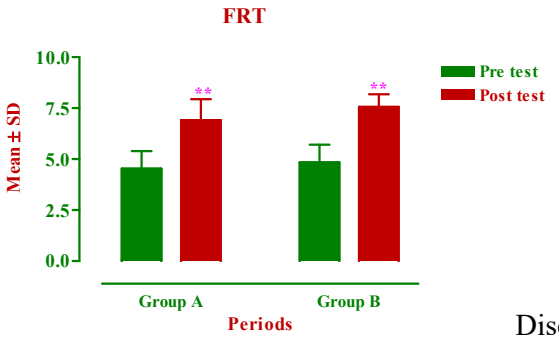
ns- p>0.05

**- p<0.001

Graph 8.8: Bar graph shows mean (± SD) step test scores of two groups at pre test and post test and also compares the scores between the groups (within periods).

4. FRT

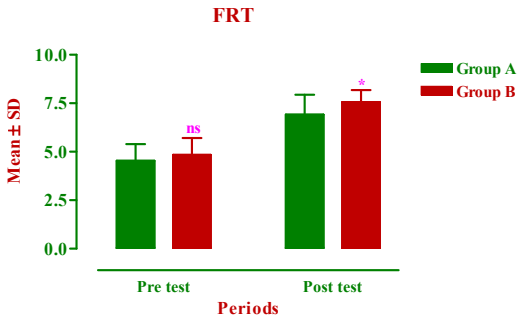
Comparing (Table 8.9 and Graph 8.9) the mean FRT scores within the groups, the FRT scores increased significantly (p<0.001) in Group A (4.53 ± 0.86 vs. 6.91 ± 1.03, p=0.0001) and Group B (4.84 ± 0.87 vs. 7.56 ± 0.62, p=0.0001) at post test as compared to pre test.



**- p<0.001

Graph 8.9: Bar graph shows mean (± SD) FRT scores of two groups at pre test and post test and also compares the scores between the periods (within groups).

Similarly, comparing (Table 8.10 and Graph 8.10) the mean FRT scores between the groups, the FRT scores did not differed between the two groups at pre test (4.53 ± 0.86 vs. 4.84 ± 0.87, p=0.3257) while differed significantly at post test (6.91 ± 1.03 vs. 7.56 ± 0.62, p=0.0411). In other words, FRT scores were comparable at baseline (pre test) and at post test (at the end of 4 wk or after 4 wks of treatment), the FRT increased significantly more in Group B than group A.



ns- p>0.05

*- p<0.05

Graph 8.10: Bar graph shows mean (± SD) FRT scores of two groups at pre test and post test and also compares the scores between the groups (within periods).

Discussion

This study consisted of two groups- group A (control) and group B (Experimental). The subjects of group A were given Strengthening exercises and SWD and group B were given Strengthening exercises as well as balance exercises. The main findings were that both the group

shown significant improvement in VAS, WOMAC, Step test and FRT.

DemirhanDiracoglu, Resa Aydin et al in 2005 studied the effect of kinesthesia and balance exercises in knee osteoarthritis. They measure change in functional status, isokinetic muscle strength and proprioceptive sense accuracy. Significant changes were detected in the kinesthesia group. They conclude that addition of kinesthesia and balance exercises that help neuromuscular restoration to standard strengthening exercises provides dynamic muscle strength increase with significant recoveries in the functional status of the patients. [15]

There is also improvement in group A (control) that may be because of previous study by Kristen Jadelis, Michael E. Miller et al in 2001 concluded that strength also appears to play a significant role in maintaining balance in an older, osteoarthritic population. They showed that quadriceps weakness in older adults with knee OA plays an important role in physical function.[33]
R. S. Hinamn, K.L. Bennell et al in 2002 showed that deficits in lower limb proprioception and muscle strength are associated with knee OA and thus may be postulated as a cause of impaired balance. Pain associated with the osteoarthritis knee may paly a role in balance impairments.[50]

Volga BayrackiTunay et al, given strengthening exercises and proprioceptive training in order to improve proprioceptive sense which is part of balance during functional activities. They show improvement in pain and proprioception.[59]
Strengthening exercises were given because of previous study that shows the importance of these exercises in knee OA. Robert Topp et al, exercises can reduce pain and increase the perceived and actual functional abilities of OA patients.[53]

Hu and Woollacott suggested that general exercise programs are less effective than programs that target a specific system (e.g. visual, vestibular, somatosensory) that functions to maintain balance.Ufuksekir et al concludes that short term proprioceptive/ balance training improves balance and proprioception in older OA patients.[59]
VAS is used in this study for pain assessment. VAS is regarded as a valid and reliable tool for pain measurement. [49]

WOMAC questionnaire is commonly used in evaluating physical function and is often used in knee osteoarthritis. Evcik et al evaluated the functional capacity and pain by using VAS and WOMAC in patients with knee OA. There is moderate relationship between the WOMAC scores and pain levels. [59]

Step test is used for balance assessment and it is a easy to use and well known reliability and validity. Step test is a functional and dynamic test of standing balance.[6]

Future research

Future research could be done by comparing various balance exercise in different grades of osteoarthritis. Assessment of static balance in knee OA are also need consideration in future studies.

Relevance to clinical practices

This study shows that patient with knee OA shows improvement in balance and functional performance and decrease pain by performing strengthening and balance exercises as compare to those who are performing only strengthening exercises. Thus, balance exercises should be incorporated along with strengthening exercises in Knee OA patients to improve balance, functional performance and decreasing pain.

Conclusion

Study found both the balance exercises effective in improving balance, functional performance and decreasing pain in osteoarthritis knee but **Group B** was found to be significantly more effective than **Group A**. The VAS, WOMAC, step test and FRT improved 1.36, 1.38, 1.62 and 1.07 times more respectively in patients those who received the Group B than those who received the Group A.

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