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Effect of tai chi exercise along with conventional on pain, balance and funtion in patients with knee osteoarthritis at the end of 4 weeks: A randomized control trial

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Abstract
Purpose: The study was conducted to check the therapeutic effect of tai chi exercise along with conventional exercises on pain, balance and function in patients with Knee osteoarthritis.
Introduction: Osteoarthritis is a degenerative joint disease most commonly seen in elderly population. Pain, physical disability, reduced quality of life, presence of osteophytes on radiographic images of joints in later stages are some of the manifestations affecting the people having knee osteoarthritis. [1][3] Tai chi exercise is one of the preferred exercise therapy for arthritic patients as it inherits features of isometric muscle contraction, correction of body posture and relaxation.[1]
Objective: The study objectives were to evaluate the effect of tai chi exercise along with conventional exercises on pain, balance and function in patients with Knee osteoarthritis at the end of 4 weeks.
Methods: 30 subjects within the age group 60-80 were selected on the basis of the inclusion and exclusion criteria. After taking their written consents they were divided into two groups. Group "A" received Tai chi exercise + conventional exercises, 6 sessions a week. Group "B" received conventional exercises, 6 sessions a week. Pre and Post intervention readings were taken using the outcome measures VAS (for pain), WOMAC(for function) and Berg balance scale (for balance).
Results: The study showed that the experimental group (Group A) had significantly better results than the control group (Group B) with p values <0.0001 for pain, balance and function.
Concluson: The study concludes that adding Tai chi exercises along with conventional exercises has significant effects on reducing pain and improving balance and function.

Keywords: tai chi exercise, knee osteoarthritis, pain, balance, function

1. Introduction
Osteoarthritis (oa) is a degenerative joint disease most commonly seen in elderly population. Erosion of the articular cartilage, osteophyte formation seen radiographically and synovial inflammation are some of the characteristics of OA [3]. The prevalence of Knee OA ranges between 22%-39% in India while in Maharashtra it is about 10.2%. [6]. It causes thinning of the cartilage of knee joint and thus making the surfaces of the joint rougher. As the joint becomes rough the knee doesn't move as smoothly as it should which causes pain and difficulty in knee movements. Age, obesity, low bone mineral density, joint trauma, instability immobilization, diabetes mellitus are some of the risk factors associated with OA. Natural aging strength loss because of decline in muscle mass can limit the daily activities and mobility which increases the chances of falling. Decrease in proprioception and imbalance are possible causes due to loss of mechanoreceptors [3]. As the mechanoreceptors play a role in promoting stability by providing sensory feedback. The breakdown of this stabilizing and protective mechanism can also contribute to arthritic joint.
Tai chi exercise is one of the preferred exercise therapy for arthritic patients as it inherits features of isometric muscle contraction, correction of body posture and relaxation combined with stretching [1]. Lam and colleagues developed a 12 tai chi exercise movements which meets the specific needs of arthritic patients. It involves slow, continuous and gentle motions with higher stance than other tai chi styles. These movements also increases strength and aerobic capacity. The mechanism responsible for specific gains in postural stability includes control over the displacement of body mass over one's base of support, postural orientation, range of motion (ankle, knee, hip) and also abdominal and lower-extremity function which are the characteristics of Tai chi exercise.

2. Materials and Methods
Materials-
- Towel roll
- Measurements ;VAS, WOMAC, Berg Balance Scale
- Book
- Pen

Methodology
- Study design: Randomized Control Trial
- Study setting: Societies, clinics in and around Pune.
- Study population: Age group 60-80.
- Sample size: 30
- Sampling method: Simple random sampling.

- Treatment duration: 4 weeks.

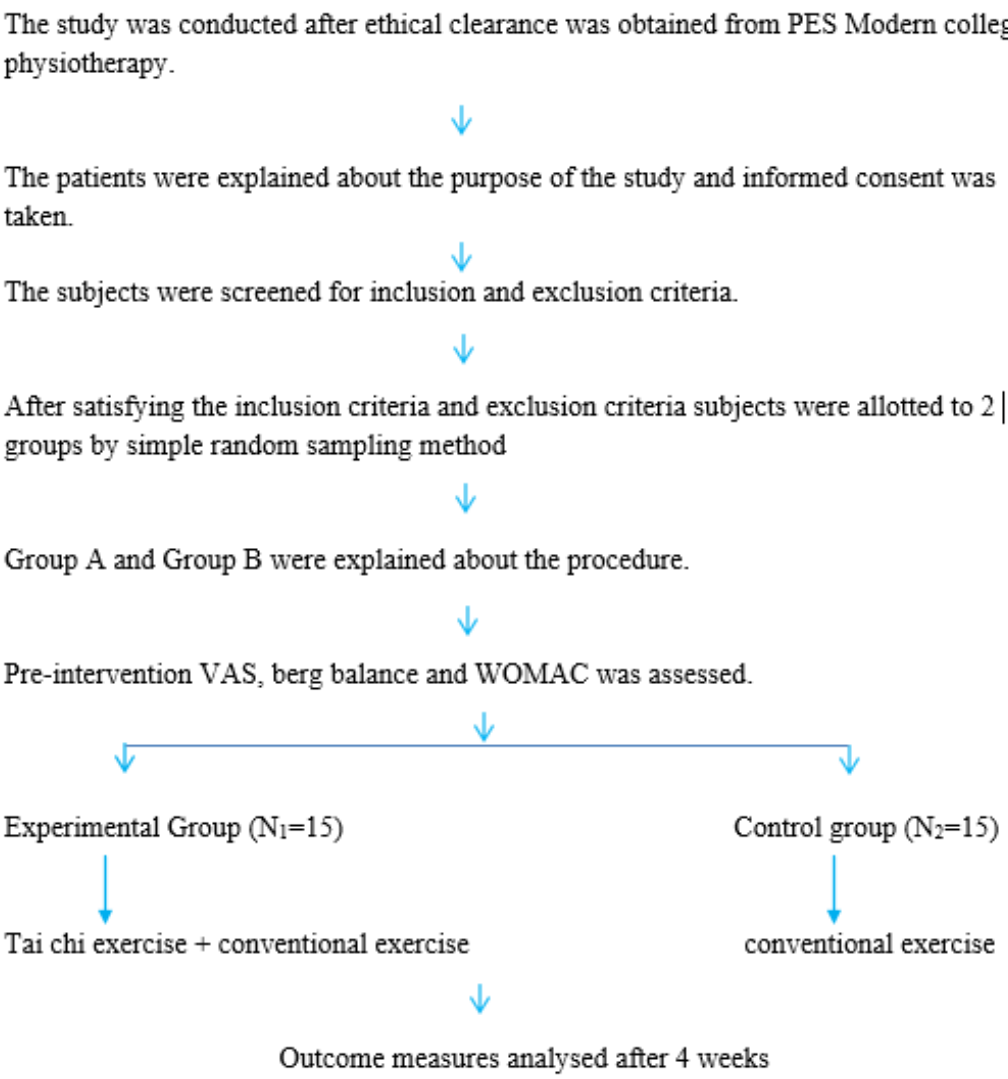

Fig 1

2.1 Inclusion and Exclusion criteria

2.1.1 Inclusion criteri

- Age: 60-80 years.
- No participation in any regular exercise program during previous year.
- VAS: moderate pain scoring (4-7).
- Berg balance berg: moderate impairment scoring (20-41).

2.1.2 Exclusion criteria

- Neurological conditions; Dementia, Parkinson's disease, stroke, vestibular dysfunctions.
- Recent lower limb and spine fractures.
- Presence of peripheral vascular disease.
- Lower limb discrepancy.
- Any lower limb surgeries within last 1 month.
- Who are unable to walk without walking aids.

2.2 Outcome measures

2.2.1 Visual Analog Scale

VAS is used to measure the intensity of pain. It is represented with a 10cm lie. Initial point being "0" and last point being "10". 0 indicate "No pain" and 10 indicate "Worst possible pain".

2.2.2 Berg Balance Scale

The berg balance scale consists of 14 different physical tasks that stimulate activities common in everyday life. Each task is graded on a scale of 0-4, yielding total score ranging from 0 to 56, with high scores indicating better balance.

2.2.3 Womac Scale

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a set of standardized questionnaires. It consists of 5 items for Pain, 2 for Stiffness and 17 for Functional limitation. The difficulties faced by the patient has to be graded on a scale of 5.

1. None (no difficulty)
2. Slight (slight difficult)
3. Moderate (moderately difficult)
4. Very (very difficult)
5. Extremely (extremely difficult)

The score for pain ranges from 0-20. The score for stiffness ranges from 0-8. The score for function ranges from 0-68. The minimum score for WOMAC Scale is "0" and the maximum score is "96"

2.3 Procedure

Subjects were selected for the study depending upon the inclusion and exclusion criteria. 30 subjects that fulfilled the criteria were selected. Written consent was taken from the subjects. Pre intervention scores of VAS, WOMAC and berg balance scale were noted. Subjects were properly explained about the intervention (exercise) and the exercises were done under the supervision of the therapist. Subjects were divided into two groups by simple random sampling method. Each group carried out the intervention 6 times a week.

2.3.1 Group A (Experimental group)-

- **Tai chi exercise**: [1, 2] The Sun-style tai chi exercise program for arthritic patients developed by Lam and colleagues consists of warm-up exercise, 12 main movements and cool-down exercise. In this study the warm-up and cool-down exercises involved stretching and relaxing the head, neck, upper and lower body and they will be repeated 3–5 times, alternating sides where appropriate. The patients were asked to perform each exercise slowly and walk or move at their own pace while simultaneously breathing in and out. The patients performed each movement from a standing position with the knees bent at varying degrees of flexion, but those who felt pain or discomfort were allowed to perform it at higher stance and to adapt the movements gradually as they became more comfortable. Patients were expected to stand upright but to be relaxed during the tai chi exercise and adapt each movement according to their individual capabilities.

Number of sessions per week: 6 sessions per week.
Treatment duration: 4 weeks.

- **Conventional exercises-**[3]
- **Isometric exercises (muscle setting) -** Patients were asked to sit in long sitting position with hands at side, with a role of towel placed below affected knee. Then patients were asked to press the towel down and hold it till count of ten and then relax and repeat again for 10 repetitions followed by other side knee. 10 repetitions per session one session per day under supervision.
- **Isotonic exercises** starting with 10 repetitions.
- **Balance training -** Patients were instructed to stand in 6 different conditions for static exercises;

1. On a firm surface, eyes open, head neutral.
2. On a firm surface, eyes closed, head neutral.
3. On a firm surface, eyes open, head tilted back.
4. On a firm surface, eyes close, head tilted back.
5. On a foam surface, eyes open, head neutral.
6. On a foam surface, eyes closed, head neutral.

- Progressing to dynamic exercises; Walking on a foam mat.

Stair up & down on staircase or stepper.

2.3.2 Group B (Control Group)

- **Conventional exercises**
- **Isometric exercises (muscle setting):** Patients were asked to sit in long sitting position with hands at side, with a role of towel placed below affected knee. Then patients were asked to press the towel down and hold it till count of ten and then relax and repeat again for 10 repetitions followed by other side knee. 10 repetitions per session one session per day under supervision.
- **Isotonic exercises:** starting with 10 repetitions.
- **Balance training:** Patients were instructed to stand in 6 different conditions for static exercises;

1. On a firm surface, eyes open, head neutral.
2. On a firm surface, eyes closed, head neutral.
3. On a firm surface, eyes open, head tilted back.
4. On a firm surface, eyes close, head tilted back.
5. On a foam surface, eyes open, head neutral.
6. On a foam surface, eyes closed, head neutral.

- Progressing to dynamic exercises; Walking on a foam mat.

Stair up & down on staircase or stepper.

2.4 Data and Statistical analysis

- Improvement in pain, balance and function was analysed using Visual Analogue Scale, Berg Balance and WOMAC scoring.
- The data was entered in Excel spread sheet, tabulated and subjected to Statistical Analysis.
- Data entered was analysed with the help of Primer of biostatistics, Graph pad instats, checking effect of Tai chi exercise on pain, balance and function in patients with osteoarthritis.
- Data analysis was done for Group A and Group B using outcome measures Visual Analogue scale (VAS), berg balance and WOMAC.
- Pre and Post data analysis for VAS, berg balance and WOMAC was done by paired t-test for both Group A and Group B.
- Group A and Group B inter group analysis was done using unpaired t-test.

2.4.1 Age wise distribution

Table 1: Age Wise Distribution

Age wise distribution	No.
60-65	5
65-70	12
70-75	9
75-80	4

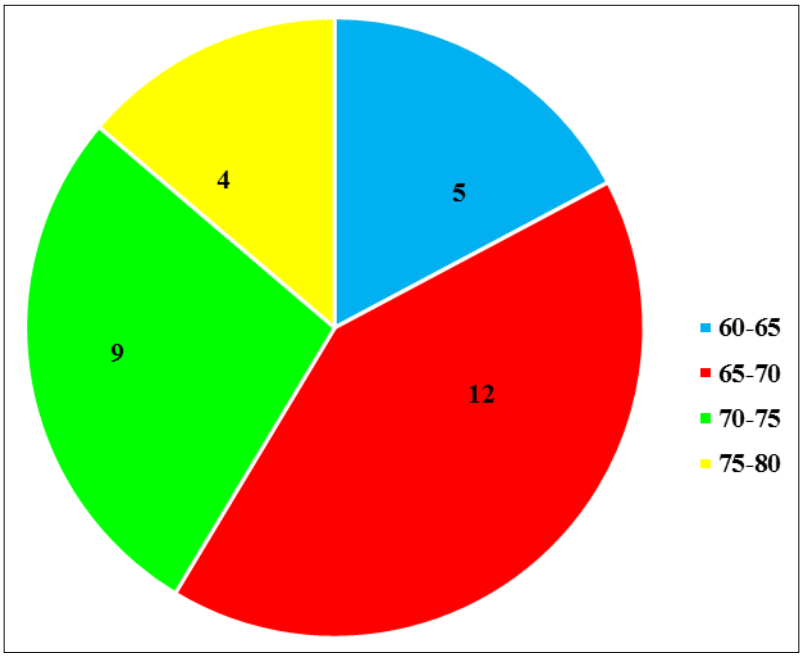

Fig 1: Age Wise Distribution

2.4.2 Gender wise distribution

Table 2: Gender Wise Distribution

Gender wise distribution	No.
Males	10
Females	20

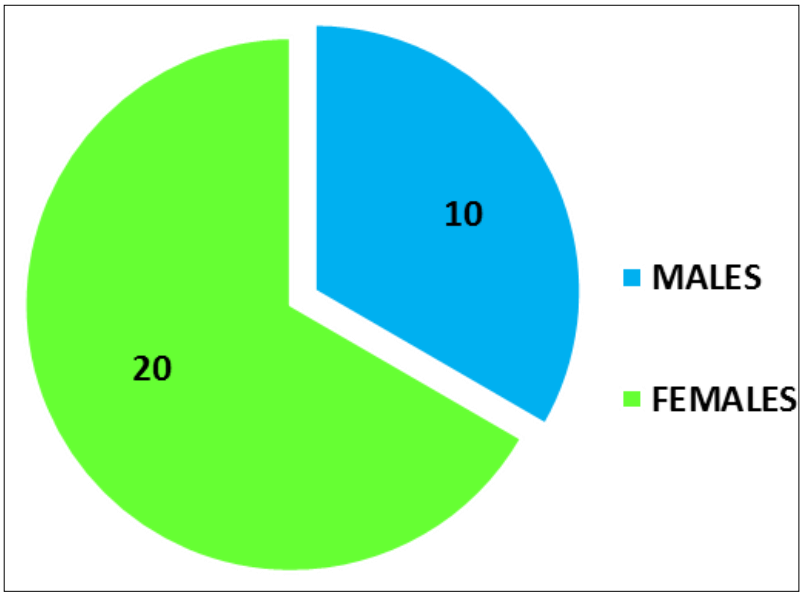

Table 2: Intra Group Analysis

2.4.3 Intra group VAS, Berg balance and WOMAC scale analysis

Table 3: Intra Group Analysis

Outcome measures/group	Pre intervention mean±sd	Post intervention mean±sd	T-value	P-value
VAS(A)	6.26 ± 0.89	3.86 ± 1.24	10.08	<0.0001
VAS(B)	6.03 ± 0.84	5.03 ± 1.21	4.14	0.001
BERG BALANCE(A)	42.8 ± 5.75	50.47 ± 4.81	-11.63	<0.0001
BERG BALANCE(B)	42.4 ± 3.23	46.2 ± 3.69	-9.99	<0.0001
WOMAC(A)	57.8 ± 9.04	45.6 ± 9.18	3.67	0.001
WOMAC(B)	53.93 ± 10.37	46.2 ± 9.92	2.09	0.046

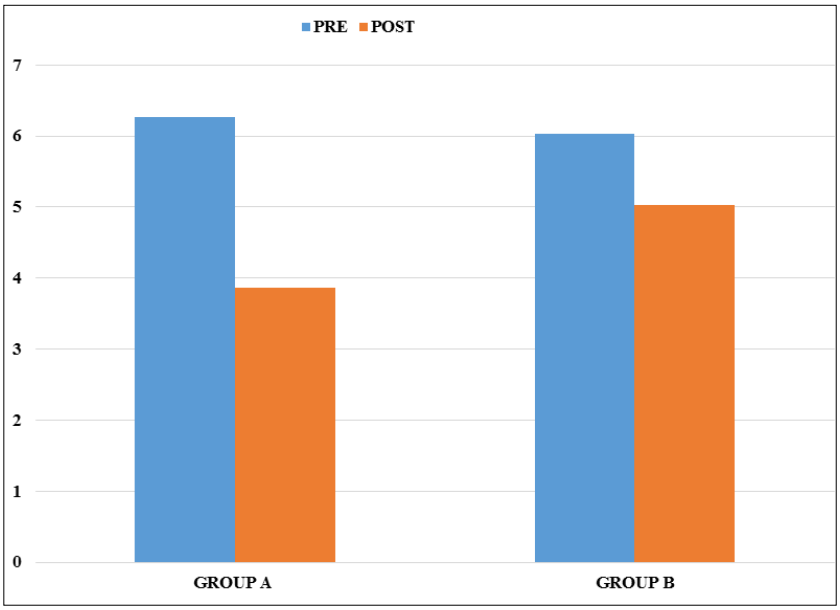

Fig 3: Pre and Post vas analysis

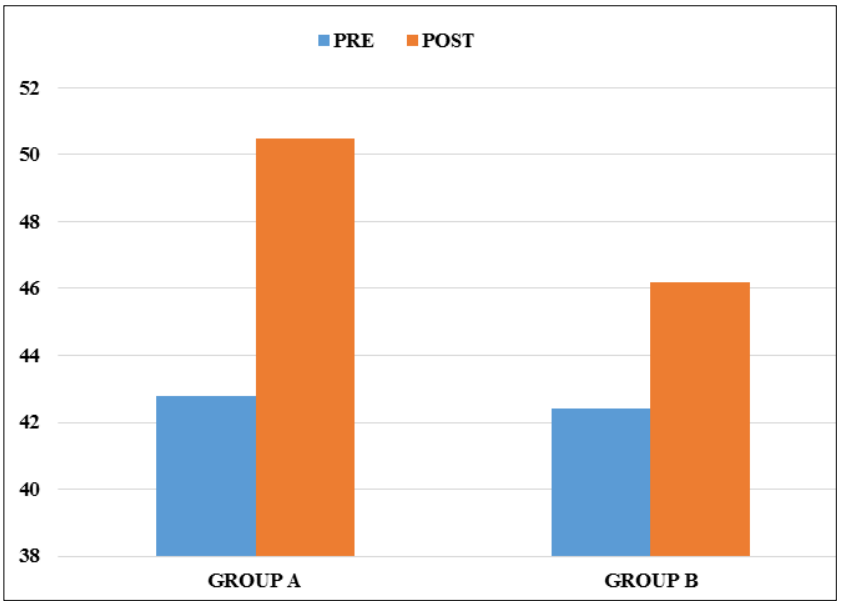

Fig 4: Pre And Post Berg Balance Scale Analysis

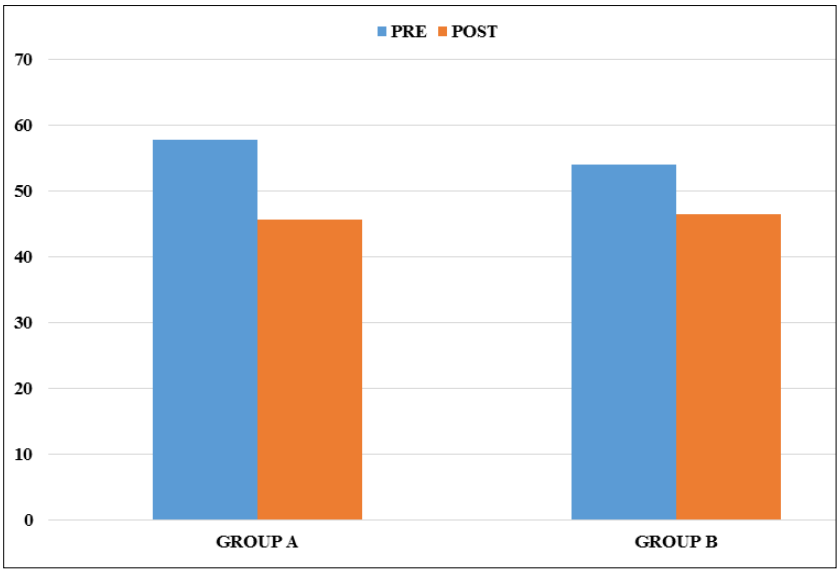

Fig 5: Pre and Post Womac Analysis

2.4.4 Inter Group Vas, Berg Balance and Womac Analysis

Table 4: Inter Group Analysis

Outcome measure/ group	Post mean/sd	P-value
VAS(A)	3.86 ± 1.24	0.01
VAS(B)	5.03 ± 1.21	
Berg balance(A)	50.47 ± 4.81	0.01
Berg balance(B)	46.2 ± 3.69	
Womac(a)	45.6 ± 9.18	0.82
Womac(B)	46.2 ± 9.92	

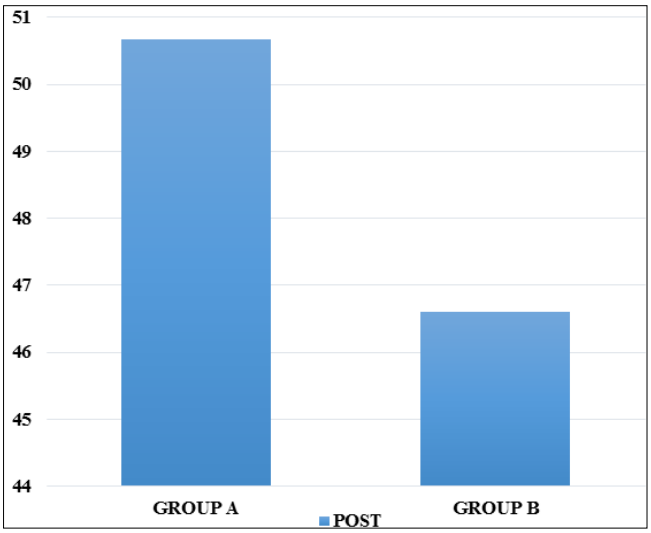

Fig 6: Post Vas Analysis

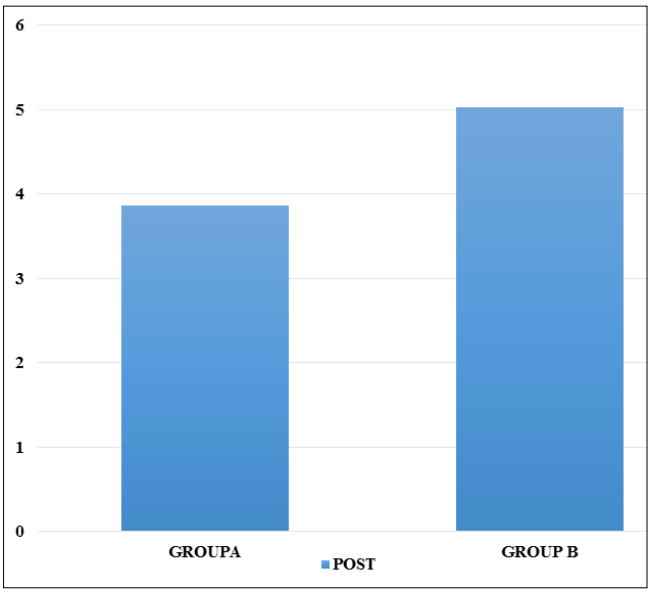

Fig 7: Post Berg Balance Scale Analysis

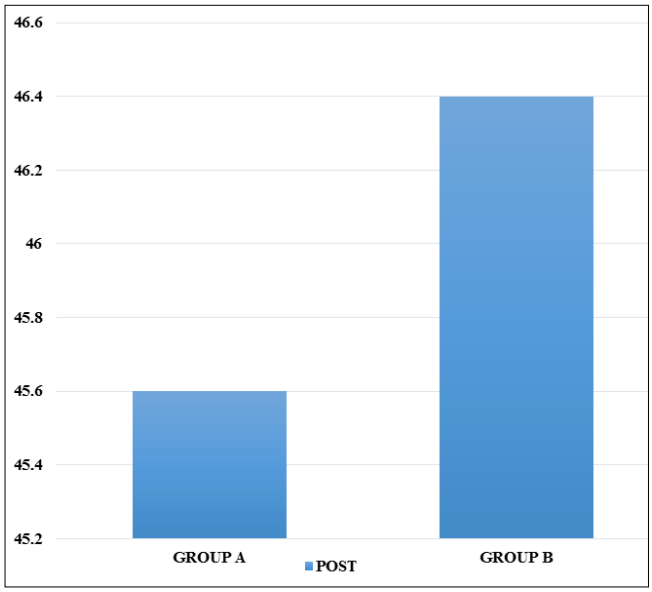

Fig 8: Post Womac Analysis

2.5 Ethical issue

Entire process of this research project was done by following the guidelines of Maharashtra University of Health Science. Synopsis proposal including procedure and methodology was approved by the Ethical committee of PES modern college of Physiotherapy at institution level. The safety of the participant was ensured by the researcher and strict confidentiality was maintained regarding patient information, their condition and the treatment.

2.6 Informed consent

The researcher obtained informed written consent from all the participants those were the part of the study. All the participants were explained about the study and the nature of the assessment and treatment. They were given the liberty to quit being part of the study at any time if they wish to without having to give any reason for doing so.

3. Results

30 SUBJECTS participated in the study. Both male and female within the age group of 60-80 years were included in the study. Out of 30 subjects 20 were females (67%) while10 were male (33%). Group comparisons were made on changed scores which revealed that the experimental group showed significantly less pain, improved balance and funtion. Results for intra group analysis was obtained using paired t-test for pre and post P values for VAS, Berg balance and WOMAC were <0.05 of both Group A and Group B. Graphs 3, 4 and 5 shows comparison between pre and post values of VAS, Berg balance and WOMAC respectively. Results for inter group analysis were obtained

Using unpaired t-test of both Group A (experimental) and Group B (control). Graph 6 shows comparison between post values of VAS for Group A and B. The values for Group A and B are 3.86 ± 1.24 and 5.03 ± 1.21 respectively. This indicates that there was considerable decrease in the pain in Group A than Group B. Graph 7 shows comparison between post values of Berg balance scale score for Group A and B. The values for Group A is 50.47 ± 4.81 and for Group B is 46.2 ± 3.69, which indicates that Group A has significant increase in balance than Group B. Graph 8 shows comparison between post values of WOMAC for Group A and B, the values are 45.6 ± 9.18 and 46.2 ± 9.92 which indicates improved function in Group A than Group B. Post intervention P values for VAS and Berg balance of Group A were <0.05 which is considered significant whereas P value for WOMAC was>0.05 which was found not to be significant. According to the statistical analysis of the data, the experimental group exercises(Tai chi exercise + convention exercise) was proved to be more effective than the control group exercises(only conventional exercises).

4. Discussion

Osteoarthritis is a degenerative joint disease, occurring primarily in older person, characterized by erosion of the articular cartilage, hypertrophy of bone at the margins i.e. osteophytes subchondral sclerosis and a range of biochemical and morphologic alteration of the synovial membrane and joint capsule. It is one of the leading causes of disability among elderly men and woman. Knee osteoarthritis is prevalent musculoskeletal condition affecting the people causing pain, physical disability and reduced quality of life.This study was done to see the effect of tai chi exercise along with conventional exercises on pain, balance and function in patients with knee osteoarthritis. Study included 30 subjects in the age group of 60-80 years. Mean age of Group A and Group B were 70.07 ± 5.17 and 67.87 ± 5.31 respectively. Female patients were more than male patients. Group were divided into half by simple random sampling method. Group A was given tai chi exercises along with conventional exercises and Group B was given only conventional exercises. The duration of the study was four weeks and exercises were given 6 days/week.

When pre and post analysis were done for Group A for which Tai chi exercises along with conventional exercises was given, data was analysed using paired t-test within the group for pain, balance and function which showed statistical difference in all three outcome measures that is VAS, berg balance and WOMAC.RHAYUN SONG *et al* (2003) reported decrease in pain, improved balance and function in knee osteoarthritic patients. The basic Tai chi exercise is a series of forward and backward movements that leads the body to constantly exchange loading and unloading of the two legs with a low centre of gravity, the dynamic weight transition between double-stance and single-stance postures, interchange of roles between stabilizers and movers which enhances proprioception of the knee joint. The continuous weight shifting from one leg to the other facilitates anticipatory balance control, motor co-ordination and lower extremity strength. In osteoarthritic patients as there is degeneration of the joint results in decreased proprioception. Tai chi exercises results in enhanced proprioception of knee joint thus decreasing pain, improving balance and function. When pre and post analysis were done for Group B for which only conventional exercises were given, data was analysed using paired t-test within the group for pain, balance and function which showed statistical significant in all three outcome measures that is VAS, berg balance and WOMAC. Conventional exercises included isometrics (muscle setting) exercises, isotonic exercises and balance training. Muscle setting isometric exercises involve low intensity isometric contractions performed against little or no resistance. They promote relaxation and circulation thus reducing pain.[8] Intergroup analysis was done using unpaired t-test for VAS, berg balance and WOMAC. When pre and post intervention values were compared, showed significant difference in values of VAS, berg balance and WOMAC. Group A who were given Tai chi exercises with conventional exercises showed much difference in reducing pain, improving balance and function than group B who received only conventional exercises.

4.1 Limitations

The sample size was less. Any differences in sexes were not considered in the study.

4.2 Future scope of study

Large sample size can be taken.

It can be used in osteoarthritic patients using assistive walking device.

Further research should involve a longer training period with adequate follow up assessment to evaluate long term effects.

5. Conclusion

This study concludes that Tai chi exercises along with conventional exercises has significant effect in reducing pain, improving balance and function.

6. Acknowledgment

The authors are thankful to each and everyone for their support during the period of the study.

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