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Comparing the effectiveness of TAI-CHI versus OTAGO exercise program on pain, physical functioning, and balance in elderly patients with Knee Osteoarthritis by the end of 3 weeks.

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ABSTRACT-
Background of study-Osteoarthritis is a widespread slowly developing disease which is chronic, degenerative and progressive condition affecting the synovial joints and is the second most common rheumatologic problem. The purpose of this study is to compare 2 different interventions TAI-CHI and OTAGO by examining and finding out the effectiveness on lower extremity strength, balance and pain relief in elderly patients
Aim of study- To Compare the effectiveness of TAI-CHI versus OTAGO exercises program on pain, physical functioning, and balance in elderly patients with Knee Osteoarthritis by the end of 3 weeks
Outcome measures- Visual Analogue Scale(VAS), Arthritis Impact Measurement Scales 2-SF(Aims2-SF), Berg Balance Scale (BBS)
Results- Samples were divide into 2 groups,Group A and Group B. P values for VAS,Berg balance and Aims2-sf of Group A(Tai-chi) were <0.0001 which is considered extremely significant.P values for VAS,Berg balance and Aims2-sf of Group B(Otago) were <0.0001 which is considered extremely significant.
Conclusion-The study concluded that TAI–CHI is more effective than OTAGO exercises
KEYWORDS- Tai-Chi, OTAGO, elderly, osteoarthritis, balance

I. INTRODUCTION

[1] Osteoarthritis is multifaceted and includes degeneration of articular structures, impaired muscle function and psychological traits of chronic pain.It is a degenerative condition of the cartilage that causes discomfort in the major joints, particularly the knee joint. [10] Globally OA ranks 8th in all diseases and covers around 15% proportions amongall musculoskeletal problems.Clinical symptoms and radio-diagnosis are the basis of diagnosis used for OAcharacterization. India is predicted to lead the globe in chronic illnesses till 2025 and has a greater proliferative rate of OA than any other country. There isn't much literature available on the epidemiology of OA.[9] Knee OA is an increasing problem in elderly population resulting in functional limitation, disability, reduced quality of life and substantial health care costs. Osteoarthritis is the second most common rheumatologic problem and it is the most frequent joint disease with a prevalence of 22% to 39% in India.[10] In Indian impact, nearly 80% of population shows OA among the patient who claimed for knee pain, out of which approximately 20% reported incapability in daily activities and around 11% need peculiar care. Approximately 40% population of more than 70 years shows OA, in which nearly 2% have severe knee pain and disability.[1] OA is equally present in men and women; the prevalence increases dramatically with age.Nearly, 45% of people over the age of 60 years have symptoms. While radiological evidence is found in 70% of those over 60 years. OA of the knee is a major cause of mobility impairment. From the current studies available, no specific cure for OA exists and the severity of condition varies from individual to individual. Hence, a more generic approach to current treatment methods revolves around some combination of non-pharmacological and pharmacological treatment modalities.

[1] For knee OA, physical therapy (PT) and rehabilitation are the most commonly used treatments.There is currently no proven treatment for osteoarthritis (OA) that will stop cartilage degeneration or repair damaged cartilage, except from losing weight and avoiding activities that put too much stress on the joint cartilage.Physical therapy has shown promise in improving patients' mobility and discomfort. Patients with OA of the knee have been shown to see improvements in their functional abilities when they engage in fitness walking, aerobic activity, and strength training.Primary and secondary OA are the two

groups into which it falls.Primary OAis agerelated and occursin oldage while secondary. OA may occur due to accidental injuries or a side-effect of pre occurring diseases. Maintaining a healthy diet and engaging in regular exercise are the best ways to control OA.[10] Itis also recommended toavoid sitting onthe groundor with cross-legged position. All body joints may be affected byOA but knee joints are more precious. OA in lower limbs diminish flexibility of organs and cause stiffness. [1] The specific programs that are typically run are a combination of programs such as strength training, aquatic, Tai Chi, aerobic, Otago and hydrotherapy.

[3] Chinese martial art tai chi is mostly practiced for its health advantages, which include relieving stress and tension. It is essentially a type of meditation, or what has been referred to as "meditation in motion," emphasizing total relaxation.Tai Chi, in contrast to the rigorous martial arts, emphasizes force above raw strength through its soft, leisurely, flowing movements. The movements are gentle, leisurely, and flowing, but they must be performed accurately.Tai Chi exercise, a traditional Chinese martial art, has been shown to have a positive impact on both physical and psychological function, and on the prevention of falls among the elderly.Although the most well-known Tai Chi styles are Chen, Yang, Sun, and Wu, each with a distinct set of circular movements, all styles adhere to the same fundamental ideas of the art.[2] When practicing Tai Chi exercise, concentration of the mind and relaxation of the body are emphasized (Lam, 2006). Tai Chi exercise consists of fluid, gentle and slow circular movements with a semi-squat posture that requires precise joint movements, stability, and balance.

[5] OTAGO Exercise was formulated by Prof.John Campbell and Otago medical college of New Zealand in 1997.Otago consist of 17 strength and balance exercises, walking program either at home, outpatient or community settings.It aims to prevent the fall of the elderly by guiding the elderly to carry out individual and step by step muscle strength and balance function exercise at home thereby improving static and dynamic balance in OA patients.

Ⅱ. OBJECTIVES OF THE STUDY

1. To find the effectiveness of TAI-CHI on pain,physical functioning and balance in elderly patients with Knee Osteoarthritis by the end of 3 weeks.
2. To find the effectiveness of OTAGO on pain, physical functioning and balance in elderly patients with Knee Osteoarthritis by the end of 3 weeks.
3. To compare the effectiveness of TAI-CHI and OTAGO on pain, physical functioning and balance in elderly patients with Knee Osteoarthritis by the end of three weeks.

Ⅲ. HYPOTHESIS

1. Null hypothesis (H_0) – There will be no difference in the effects of TAI-CHI exercises and OTAGO exercises in Knee Osteoarthritis on pain, physical functioning, and balance in elderly patients by the end of 3 weeks.
2. Alternative hypothesis (H_1) – There will be a difference in the effectiveness of TAI-CHI exercises than OTAGO exercises in Knee Osteoarthritis on pain, physical functioning, and balance in elderly patients by the end of 3 weeks.
3. Alternative hypothesis (H2)-There will be a difference in the effectiveness of OTAGO exercises than TAI-CHI exercises in Knee Osteoarthritis on pain, physical functioning and balance in elderly patients by the end of 3 weeks.

Ⅳ. MATERIALS AND METHODOLOGY

1. Study type –Comparative study
2. Sample size – 44
3. Sampling technique – convenient sampling
4. Study population – Men and women (55-80 years of age)
5. Study setting – In and around the city
6. Study duration – 6 months
7. Duration of intervention – 3 weeks
8. Tools - Paper, Consent form, Weight cuffs, Chair, Stopwatch
9. Inclusion Criteria-

a. [1] Age group 55-80 years of age (male and females).
b. [11] Men or women diagnosed of bilateral knee OA by orthopaedist.
c. Individuals willing to participate in the study.
d. [9] Kellgren-Lawrence grade 2 & 3 on radiographs
e. [12] VAS: Moderate pain scoring 4-7

10. Exclusion Criteria-

a. [1] Participants undergoing any regular exercise program.
b. [1] Participants with neurological deficit on lower limbs.
c. Participants with previous knee injury.
d. [1] Participants who have taken intra-articular steroid injections in the past 6 months.
e. Participants with prior TAI-CHI or OTAGO

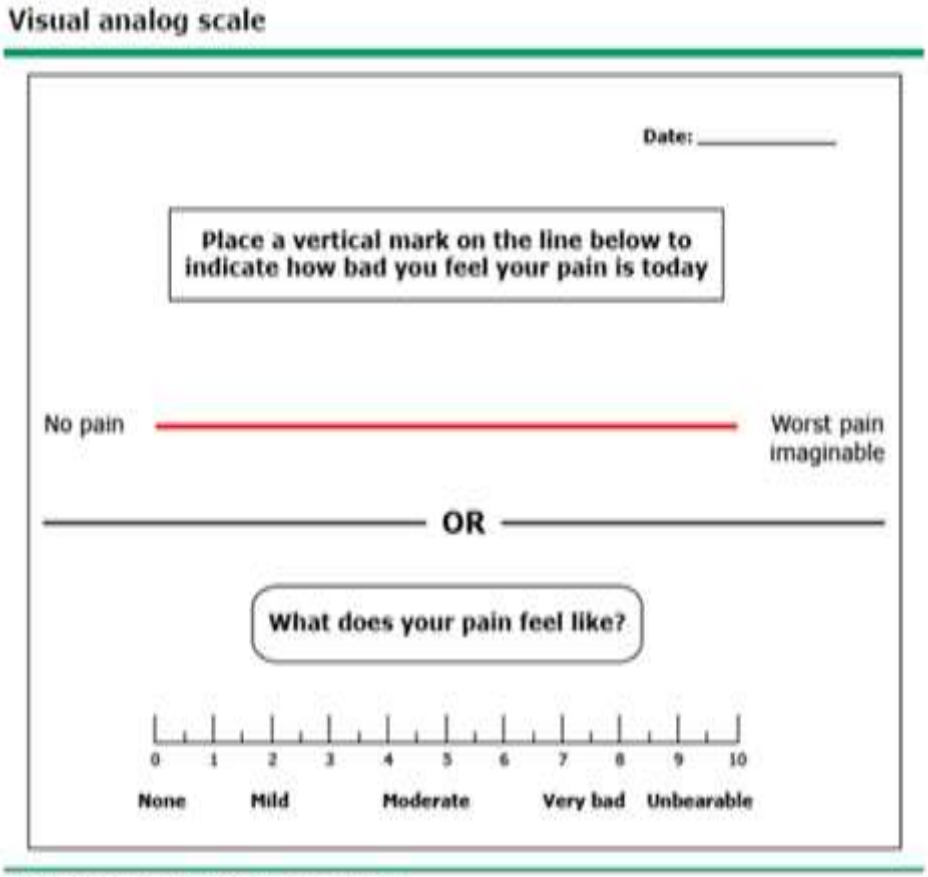
International Journal Dental and Medical Sciences Research
Volume 6, Issue 1, Jan-Feb- 2024 pp 82-93 www.ijdmsrjournal.com ISSN: 2582-6018

training.

f. [1] Participants who have undergone reconstructive surgery of knee

11. Outcome Measures-

a. Visual Analog Scale- It is a horizontal line with "no pain "at one end and"severe pain" at the other. Patient mark a point between those extremes demonstrate how much pain they are experiencing.



Visual Analog Scale (VAS) (10 cm line).
[Score = 0 to 100 mm] - measuring in millimeters from the left hand end of the line to the point that the patient marks.

Figure no 1- VAS

b. Arthritis Impact Measurement Scales 2-SF- It is a 9 scale-mobility, physical activity (walking, bending, lifting) dexterity, household activities, social activities, ADL's, pain, depression, and anxiety. AIMS2 includes arm function, social support and work. AMIS2 is 5point scale higher score indicates greater disability. The score for each section is standardized to a 0-10 scaleusing standardization formula.

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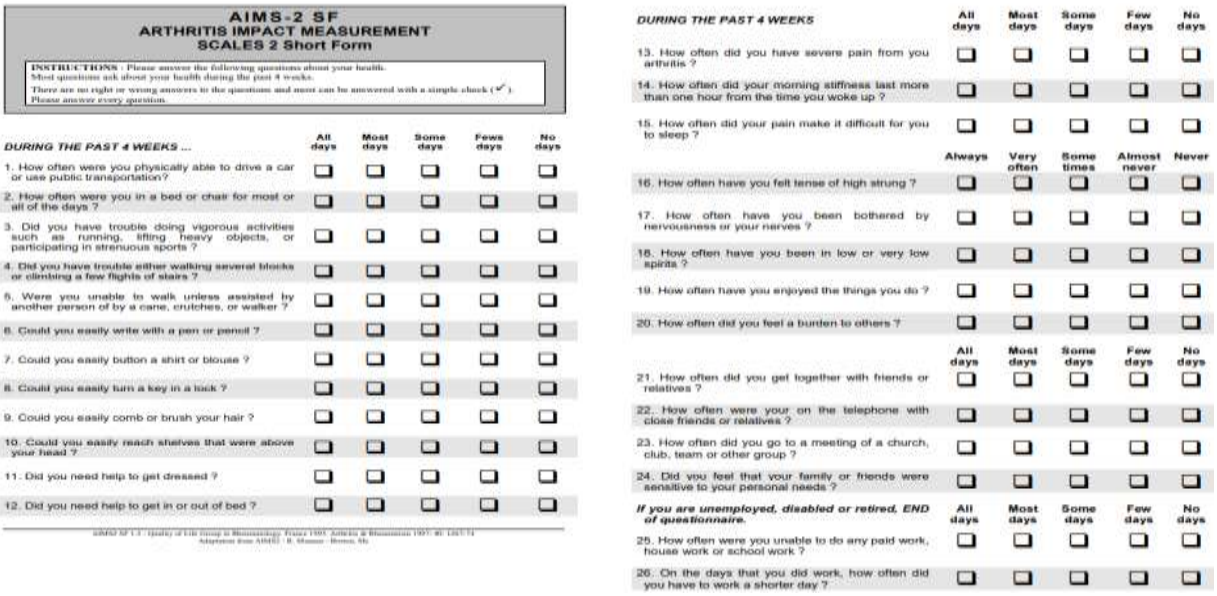


AIMS-2 SF
ARTHRITIS IMPACT MEASUREMENT SCALES 2 Short Form

INSTRUCTIONS : Please answer the following questions about your health.
Most questions ask about your health during the past 4 weeks.
There are no right or wrong answers to the questions and most can be answered with a simple check (✓).
Please answer every question.

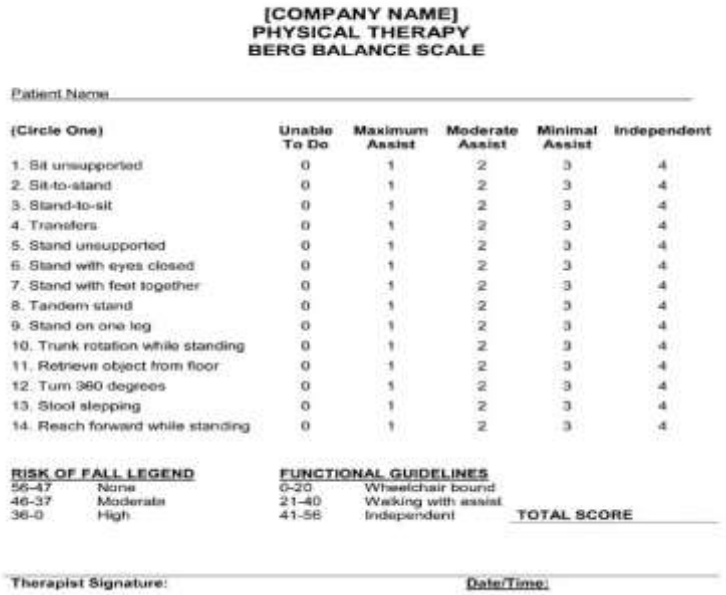
DURING THE PAST 4 WEEKS ...	All days	Most days	Some days	Few days	No days
1. How often were you physically able to drive a car or use public transportation?	☐	☐	☐	☐	☐
2. How often were you in a bed or chair for most or all of the days ?	☐	☐	☐	☐	☐
3. Did you have trouble doing vigorous activities such as running, lifting heavy objects, or participating in strenuous sports ?	☐	☐	☐	☐	☐
4. Did you have trouble either walking several blocks or climbing a few flights of stairs ?	☐	☐	☐	☐	☐
5. Were you unable to walk unless assisted by another person of by a cane, crutches, or walker ?	☐	☐	☐	☐	☐
6. Could you easily write with a pen or pencil ?	☐	☐	☐	☐	☐
7. Could you easily button a shirt or blouse ?	☐	☐	☐	☐	☐
8. Could you easily turn a key in a lock ?	☐	☐	☐	☐	☐
9. Could you easily comb or brush your hair ?	☐	☐	☐	☐	☐
10. Could you easily reach shelves that were above your head ?	☐	☐	☐	☐	☐
11. Did you need help to get dressed ?	☐	☐	☐	☐	☐
12. Did you need help to get in or out of bed ?	☐	☐	☐	☐	☐

DURING THE PAST 4 WEEKS	All days	Most days	Some days	Few days	No days
13. How often did you have severe pain from you arthritis ?	☐	☐	☐	☐	☐
14. How often did your morning stiffness last more than one hour from the time you woke up ?	☐	☐	☐	☐	☐
15. How often did your pain make it difficult for you to sleep ?	☐	☐	☐	☐	☐
	Always	**Very often**	**Some times**	**Almost never**	**Never**
16. How often have you felt tense of high strung ?	☐	☐	☐	☐	☐
17. How often have you been bothered by nervousness or your nerves ?	☐	☐	☐	☐	☐
18. How often have you been in low or very low spirits ?	☐	☐	☐	☐	☐
19. How often have you enjoyed the things you do ?	☐	☐	☐	☐	☐
20. How often did you feel a burden to others ?	☐	☐	☐	☐	☐
	All days	**Most days**	**Some days**	**Few days**	**No days**
21. How often did you get together with friends or relatives ?	☐	☐	☐	☐	☐
22. How often were your on the telephone with close friends or relatives ?	☐	☐	☐	☐	☐
23. How often did you go to a meeting of a church, club, team or other group ?	☐	☐	☐	☐	☐
24. Did you feel that your family or friends were sensitive to your personal needs ?	☐	☐	☐	☐	☐
If you are unemployed, disabled or retired, END of questionnaire.	**All days**	**Most days**	**Some days**	**Few days**	**No days**
25. How often were you unable to do any paid work, house work or school work ?	☐	☐	☐	☐	☐
26. On the days that you did work, how often did you have to work a shorter day ?	☐	☐	☐	☐	☐

Figure no 2- AIMS-2SF

c. Berg Balance Scale- 14 items scale designed to measure the balance of older adults in clinical setting.Equipment's needed are ruler, two chair (one with armrest and one without) foot step or stool, stopwatch, 15ft walkaway. Completion time is 15-20mins

Scoring: A 5-point ordinal scale, ranging from 0-4. 0 indicates the lowest level of function and 4 the highest level of function.Total score=60
Interpretation - 41-56= low fall risk
21-40= medium fall risk
0-20= high fall risk



[COMPANY NAME]
PHYSICAL THERAPY
BERG BALANCE SCALE

Patient Name

(Circle One)	Unable To Do	Maximum Assist	Moderate Assist	Minimal Assist	Independent
1. Sit unsupported	0	1	2	3	4
2. Sit-to-stand	0	1	2	3	4
3. Stand-to-sit	0	1	2	3	4
4. Transfers	0	1	2	3	4
5. Stand unsupported	0	1	2	3	4
6. Stand with eyes closed	0	1	2	3	4
7. Stand with feet together	0	1	2	3	4
8. Tandem stand	0	1	2	3	4
9. Stand on one leg	0	1	2	3	4
10. Trunk rotation while standing	0	1	2	3	4
11. Retrieve object from floor	0	1	2	3	4
12. Turn 360 degrees	0	1	2	3	4
13. Stool stepping	0	1	2	3	4
14. Reach forward while standing	0	1	2	3	4

RISK OF FALL LEGEND		FUNCTIONAL GUIDELINES	
56-47	None	0-20	Wheelchair bound
46-37	Moderate	21-40	Walking with assist
36-0	High	41-56	Independent

TOTAL SCORE

Therapist Signature: Date/Time:

Figure no 3- BBS

V. PROCEDURE- Ethical clearance was taken from the ethical committee of P.E.S. Modern College of Physiotherapy. Participants were selected on the basis of inclusion and exclusion criteria by the primary investigator and then the baseline measurements were taken. Participants

International Journal Dental and Medical Sciences Research
Volume 6, Issue 1, Jan-Feb- 2024 pp 82-93 www.ijdmsrjournal.com ISSN: 2582-6018

were explained about the study and their consent was taken. Samples were divided into two groups and were randomly allotted in these groups (odd and even)
Group A-(22 subjects) will receive TAI-CHI exercises.
Group B- (22 subjects) will receive OTAGO exercises.

Outcomes were taken prior to the session.The treatment was given on 3 days per week (alternate days). Continuing the same exercises at home for total 6 months.Outcomes was taken at the end of the session to see the progression.After completion of 6 months the data was collected and was subjected to statistical analysis

GROUP A: TAI-CHIEXERCISES	GROUP B: OTAGOEXERCISES
(a) Warm-up conventional exercise (10 min) (b) 12 forms TCEO (8 sets), (c) Cool-down stretching exercise (5 min) (d) Frequency: 3 times a week for 3 weeks (e) Duration: 45 minutes (f) Conventional Exercises- These include static and dynamic exercises. • Sitting and standing without support • Sitting and standing on different surfaces • Tandem walking • Tandem stand • Standing on one leg • Sitting to standing • Walking with and without support • Walking with obstacles • Walking on different surfaces	(a) Warm up (stretching and conventional exercises-10 min) (b) OTAGO exercises (Chair and weight cuffs-30 min) (c) Cool down (5 min) (d) Frequency: 3 times a week for 3 weeks (e) Duration: 45 minutes (f) Conventional Exercises- These include static and dynamic exercises. • Sitting and standing without support • Sitting and standing on different surfaces • Tandem walking • Tandem stand • Standing on one leg • Sitting to standing • Walking with and without support • Walking with obstacles • Walking on different surfaces

Table no 1- Exercise Prescription

TAI CHI EXERCISES

- 12 tai chi exercise movements in SUN-style were developed by Lam and colleagues to meet specific needs of arthritic patients.
- It involves slow, continuous and gentle motions with higher stance than other tai chi styles to be more suitable for patients of Osteoarthritis.
- They increase strength.
- Individuals learn to control the displacement of body while standing and increase their lower extremity strength and flexibility during the regimens of physical movement.
- The slow, continuous and rhythmic movements facilitate sensorimotorintegration andawareness of the external environment.
- The emphasis on maintaining a vertical posture enhances postural alignment and perception of orientation.
- The continuous shift of weight from one leg to another
- Facilitates anticipatory balance control, motor co-ordination and lower extremity strength.
- Lastly, the extremities' broad, dynamic, fluid, and circular movements enhance joint range of motion and flexibility.

International Journal Dental and Medical Sciences Research
Volume 6, Issue 1, Jan-Feb- 2024 pp 82-93 www.ijdmsrjournal.com ISSN: 2582-6018

Figure no 4- Tai Chi Movements by Lam

Figure no 5-Tai Chi movements

Figure no 6- Tai Chi movements

OTAGO EXERCISES

- Main features of Otago consist of 17 strength and balance exercises and a walking program.
- Strengthening-helps improve bone and muscle strength.
- Balance Retraining-helps improve balance and stability thereby preventing fall
- Walking-helps to improve physical functioning**.**
- Exercises Include
  - Knee flexion
  - Walking backward and turning around
  - Walking in straight line
  - Standing on one leg
  - Walking on heels
  - Walking on toes
  - Walking backwards on toes
  - Walking backward on toes and heels
  - Standing up from sitting position
  - Walking upstairs

International Journal Dental and Medical Sciences Research
Volume 6, Issue 1, Jan-Feb- 2024 pp 82-93 www.ijdmsrjournal.com ISSN: 2582-6018

Figure no 7- OTAGO movements

Figure no 8- OTAGO movements

KNEE STRENGTHENING EXERCISES

1.Front Knee Strengthening

- Strap the weight onto your ankle.
- Sit in a chair with your back well supported.
- Straighten the leg out. Lower the leg. Repeat 10times.
- Strap the weight onto your other ankle.
- Repeat exercise 10 times

Osteoarthritis (OA) is a disease of cartilage degradation, which results pain in major joints, especially in knee joint. Globally OA ranks eighth in all diseases and covers around 15% proportions amongall musculoskeletal problems. Clinical symptoms and radio-diagnosis are the basis of diagnosis used for Characterization. India has higherproliferative rate of OA among world and expected to be at top rank in chronic diseases till 2025. There is very limited literature present on OA epidemiology

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Figure no 9

2.Back Knee Strengthening

- Strap the weight onto your ankle.
- Stand up tall facing a table withboth hands on the table.
- Bend the knee, bringing the foot toward your bottom.
- Return to the starting position.
- Repeat 10 times.
- Strap the weight onto your other ankle.
- Repeat this exercise 10 times.

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Figure no 10

Figure no 12

BALANCE EXCERCISES

1.Knee Bends – Hold Support

- Stand up tall facing a table with both hands on the table.
- Place your feet shoulder-width apart.
- Squat down half way, bending your knees.
- The knees go over the toes.
- When you feel your heels start to lift, straighten up.
- Repeat 5-10 times.

Figure no 11

2. Knee Bends – No Support

- Stand up tall near a table and look ahead.
- Place your feet shoulder-width apart.
- Squat down half way, bending your knees.
- The knees go over the toes.
- When you feel your heels start to lift, straighten up.
- Repeat 5-10 times

WALKING

Heel Walking – Hold Support

- Stand up tall beside a table.
- Hold on and look ahead.
- Come back onto your heels, raising the front of your foot off the floor.
- Walk 10 steps on your heels.
- Lower your feet to the ground and turn around.
- Walk 10 steps on your heels.
- Repeat

Figure no 13

II. DATA ANALYSIS

Data was analysed after 3weeks of intervention and remaining 6 months of home exercises.Data was analysed according to VAS scale, AIMS-2 SF and Berg balance scale.

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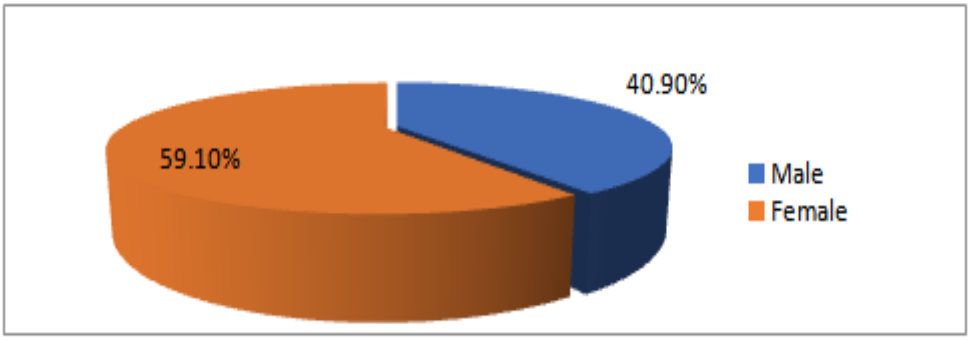
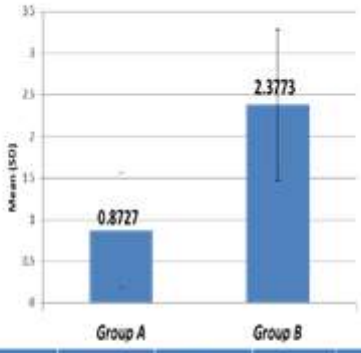
Comparison of gender and age among both the groups



Graph no1

Variables	Sub-groups	n	%
Gender	Male	9	40.9%
	Female	13	59.1%
Age (Mean ± SD)		62.36 ± 6.463	

Comparison of mean difference (Pre-Post) of visual Analog scale score among group A & B using unpaired t test



Visual analog scale score	N	Mean difference	Std. Deviation	t value	P value	Result
GROUP A	22	0.872	0.690	6.214	0.001	Highly Significant
GROUP B	22	2.377	0.901			

Graph no 2

International Journal Dental and Medical Sciences Research
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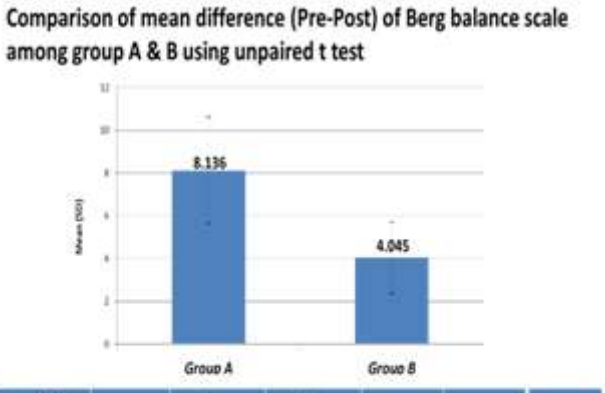
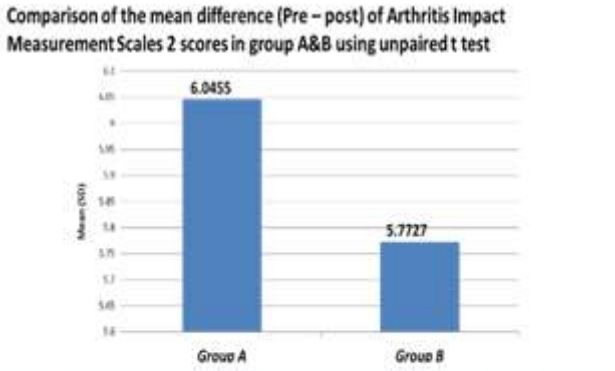


Bergs balance scale	N	Mean difference	Std. Deviation	t value	P value	Result
GROUP A	22	8.136	2.474	6.421	0.001	Highly Significant
GROUP B	22	4.045	1.675			

Graph no 3



Mean difference	Group	N	Mean difference	Std. Deviation	t value	P value	Result
Arthritis Impact Measurement Scales 2	Group A	22	6.0455	1.83815	5.562	0.001	Highly Significant
	Group B	22	5.7727	1.34277			

Graph no 4

III. RESULTS

Results for intra group analysis were obtained using paired t-test for pre and post values of Group A and Group B

Results for inter group analysis were obtained using unpaired t-test of both Group A(Tai-chi) and Group B(Otago).

Group A shows highly significant in reducing pain, balance and improving quality of life than group B.

P values for VAS,Berg balance and Aims2-sf of Group A(Tai-chi) were <0.0001 which is considered extremely significant.

P values for VAS,Berg balance and Aims2-sf of Group B(Otago) were <0.0001 which is considered extremely significant.

Tai chi exercise is more effective than OTAGO exercises.

IV. DISCUSSION

The objective of this study was to assess the effects of TAICHI and OTAGO exercises on pain,physical functioning and balance in OA knee.Study included 44 subjects in the age group of 55-80 years according to inclusion and exclusion criteria .44 subjects were divided into 2 groups Group A and Group B each group had 22 subjects. Group A had 22 subjects for TAI CHI and Group B had 22 subjects for Otago.They were given 3 weeks protocol for 3 times a week for 45 mins.When pre and post analysis were done for Group A in which Tai chi exercises along with conventional exercises was given data was analyzed using paired t-test within the group which showed statistical difference in all 3 outcome measures VAS, BBS, AIMS2-SF reported decrease in pain,improve balance and function in knee OA patients.Pre and post analysis were done for Group B in which Otago exercises along with conventional exercises was given data was analyzed using paired t-test within the group which showed statistical difference in all 3 outcome measures VAS, BBS, AIMS2-SF reported decrease in pain,improve balance and function in knee OA patients.Pre and post intergroup analysis were done using unpaired t-test for VAS, BBS, AIMS2-SF. when Pre and Post intervention values were compared,showed highly significant differences in VAS, BBS, AIMS2-SF.The data showed 3 week Tai-Chi and Otagoexercises .Tai chi lead to highly significant in improving balance ,physical functioning and reduction in pain in OA knee patients Ching-Huey Chen, Susan Fetzer2, Li-Hua Lo, Paul Lam 2008 showed significant improvements in physical functioning and improving quality of life after giving Tai chi protocol.[2]Previous studies conducted by Rhyan song et al92003 reported decrease in pain,improved balance and function in knee osteoarthritic patients after Tai chi protocol.[9] 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 center 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.Thecontinuous weight shifting from one leg to another facilitates anticipatory balance control,motor co-ordination and lower extremity strength.In osteoarthritic patients as there is degeneration of the joint results in decrease proprioception.Tai chi exercises result in enhanced proprioception of knee joint thus decreasing pain, improving function and balance. [9]The study conducted basically aimed at lower limb strength training and postural muscles. Otago showed increase in lower limb strength and balance they were improved by walking and turning around,heel to toe walking and stair climbing these factors are important causes of walking.In addition,through stairwalking,the patient practiced with fixed foot support,acceleration,balance control,contraction of lower limb and ankle dorsiflexion to move the Centre of gravity to control theafferent,efferent,and contraction of lower limb muscles.By improving parameters there can be drastic change in balance.

V. CONCLUSION-

This study concludes that TAI–CHI is more effective than OTAGOexercises and is effective in reducing pain,improve physical functioning and balance in elderly patients with Knee Osteoarthritis by the end of 3 weeks

X. CLINICAL IMPLICATION-In future,Tai chi exercises and Otago exercises both can be incorporated with physiotherapy techniques.

XI LIMITATIONS

1. Lack of interest was the leading reason for older people not engaging in physical activity during leisure time.
2. Many other components need to be selected.

XII FUTURE SCOPE

1. Large sample size can be taken
2. It can be used in osteoarthritic patients using assistive walking device
3. Further research should involve a longer training period with adequate follow up assessment to evaluate long term effects.

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