Original Research Article

Comparative study of the effectiveness between balancing exercises and strengthening exercises with common use of TENS to improve functional ability in Osteoarthritis involving knee joint

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Abstract

Background and purpose: People with knee Osteoarthritis (OA) sometimes report episodes of knee instability that limit their activities of daily living. Proprioception and balance are important aspects of osteoarthritis treatment because of their strong correlation with function in the knee. The purpose of this study is to evaluate the effects of balancing exercises and strengthening exercises to improve functional ability in knee osteoarthritis patients and also it may be helpful to identify the use of best treatment protocol for OA knee.

Material and methods: Thirty OA knee patients randomly allocated into two groups and received either balancing exercises (Group A) or strengthening exercises (Group B). Both the groups received

TENS and taken treatment for 4 days a week for 4 weeks. The outcome measures were VAS and WOMAC. VAS was used to measure intensity of knee pain and WOMAC was used for assessment of perceived pain, stiffness and functional ability.

Results: After 4 weeks of treatment, significant reduction in the WOMAC score and VAS was found in both the Groups. The result showing statistical improvement is more in Group A than Group B.

Conclusion: The results of the study shows that balancing exercise is more effective than strengthening exercise to improve the functional ability of OA involving knee joint. The improvement in Group A is more than Group B and having statistically highly significant.

Key words

Knee Osteoarthritis, Balance, Proprioception, Functional ability, TENS, Exercise therapy.

Introduction

Physical disability is a major public health problem in elderly subjects. Problems with locomotion are the most common disorders [1]. Osteoarthritis of the knee joint is affected – in one fourth people aged over 55 years have knee pain [2]. Osteoarthritis is the second most common rheumatological problem and is most frequent joint disease with prevalence of 22% to 39% in India [3].

Osteoarthritis is a chronic degenerative disorder of multifactorial etiology characterized by loss of articular cartilage, hypertrophy of bone at the margins, subchondral sclerosis, range of biochemical and morphological alterations of the synovial membrane and joint capsule [4-9]. As a result of the degenerative changes, the disease may also be accompanied by abnormalities in the excitability of the nerve endings located around the joint tissues and abnormalities of motor activity. Local vascular changes accompanied by a state of ischemia of subcondral and juxta-condral bone and hyperplasia of intraosseous arteries may also form part of the pathomorphology of osteoarthritis. Alone, or in combination may produce signs and symptoms of pain, inflammation, swelling, spasm, instability, limited range of motion, deformity, proprioceptive abnormality, decrease strength, endurance and aerobic power, which is the problem of most concern to patients [10-12].

Osteoarthritis of the knee is characterized by disability in daily functioning, primarily in activities related to mobility, e.g. walking, stair climbing and transfers (such as rising from a chair, rising from bed, getting into and out of a car). Traditionally, reduced functional ability in knee osteoarthritis patients has been attributed to degeneration of cartilage and bone. Dougados, et al. showed an increased risk of functional deterioration associated with progressive cartilage degeneration. As osteoarthritis progresses, pain may become more persistent and may also occur at rest and at night. In the chronic stage of disease, knee pain arises in response to a complex interaction between internal and external factors leading to enhanced sensitization of the peripheral and central nervous system. Pain has been found to the major cause for reducing functional ability in knee osteoarthritis patients. Joint pain is increased by joint use and relieved by rest [13, 15]. However, sometimes as inflammatory component can be significant in osteoarthritis. Many patients will also complain of pain and stiffness on rising in the morning and after periods of immobility. As the degeneration progresses, any active or passive movement may also be painful [14]. In the later stages of osteoarthritis, where hyaline cartilage has been damaged, patients may complain of a sensation of crunching or crackling on joint movement, this may be detected on palpation or auscultation as crepitus. In advance cases due to cartilage lose; the joint may demonstrate anteroposterior and lateral instability [15].

Repeated heavy stress on joints as a result of occupation may increase the prevalence of osteoarthritis. The etiology of osteoarthritis is unknown, but various factors may contribute including age, obesity, sex, degrees of physical activity, hypermobility syndromes, abnormal subchondral bone or bone mass, muscular disorders or genetic factors [16].

Physical therapists provide a variety of intervention such as manual therapy techniques, balance, coordination and functional retraining techniques, knee taping techniques etc [17]. Recently, some study reported that a significant number of individuals with knee osteoarthritis complain of knee instability that is severe enough to affect their ability to perform activities of daily living [18]. Knee instability is a prevalent problem in individuals with knee osteoarthritis that contributes to disability above and beyond what can be expected from the presence of other impairments [19-21].

In addition to exercises that improve lower extremity strength, range of motion and cardiovascular endurance it is now being recommended that exercise therapy programs also include techniques to improve balance and coordination, and provide patients with an opportunity to practice various skills that they will likely encounter during normal daily activities [17].

As joint degeneration progresses, the tension of soft tissue is altered and an unequal distribution of joint loads causes the articular surface to break down. Pain, effusion and joint laxity diminish proprioceptive awareness and in the lower extremity this may lead to deficits in balance. Without conscious awareness of joint motion and position in the knee, the placement of the lower extremity during ambulation is affected. Balance impairments are associated with an increased risk of falls and poorer mobility measures in knee osteoarthritis patients [22, 23].

Proprioception and balance are important aspects of osteoarthritis treatment because of their strong correlation with function in the knee. Balance is often used to assess functional joint stability. It is influenced by the same sensory information that mediates joint proprioception and is partially dependent on the inherent ability to integrate joint position sense with neuromuscular control [22].

Hurley and Scott examined a protocol that used simple balance board exercises and practice of transfer techniques in conjunction with standard exercise therapy in patients with knee osteoarthritis, compared with a control group demonstrated improvements in strength, muscle activation, joint position sense, and both physical performance and self- report measures of function [24].

Muscle strength in knee osteoarthritis patients has been shown to be an important determinant of functional ability. The periarticular knee muscles are an integrated component of the knee joint and provide knee joint movement. The muscles absorb forces and loads generated during walking and contribute to the control of body position and movement. Sufficient muscle strength is necessary for adequate functional ability. Muscle weakness has been found to increase the risk of reduced functional ability in knee osteoarthritis patients [13].

Transcutaneous electrical nerve stimulation is a common treatment modality for musculoskeletal pain and has been demonstrated to be effective for managing osteoarthritis knee pain. Study showed that TENS produced a significantly longer pain relief period than placebo stimulation [25].

Conventional Transcutaneous electrical nerve stimulation produces analgesia predominantly by a segmental mechanism whereby activity generated in Aβ fibers inhibits ongoing activity in second order nociceptive neurons in the dorsal horn of spinal cord. The neuronal circuitry for

conventional Transcutaneous electrical nerve stimulation analgesia is located in the spinal cord and is likely that a combination of pre and post synaptic inhibition takes place [26].

The aim of my study is to identify the effectiveness of balancing exercises versus strengthening exercises with common use of Transcutaneous electrical nerve stimulation to improve the functional ability of osteoarthritis knee patients. The improvements were observed pre and post treatment for both groups by using visual analogue scale to measure knee pain intensity and the WOMAC (Western Ontario and McMaster Universities) index to assess patients with osteoarthritis of the knee using 24 parameters.

A substantial number of individuals with knee OA report episodes of knee instability during activities of daily living and which is a limiting factor in their ability to perform functional tasks. Knee instability is a multi-factorial problem that may be the result of factors such as increased capsuloligamentous laxity, structural damage to the knee and altered lower extremity muscular strength and neuromuscular control.

Proprioception plays a vital role in maintenance of joint stability of the knee via the sensorimotor system. In OA, degenerative changes can affect the function of sensory receptors and mechanoreceptors. As a result, appreciation of limb position as well as function may be compromised.

When sensorimotor dysfunction exists an abrupt jarring of the leg at heel strike will occur, initiating or perpetuating arthritic damage. Traditional exercise programs for people with knee OA have focused primarily on addressing limitations in lower extremity muscle strength, joint mobility and aerobic capacity. The addition of balance training techniques to exercise therapy programs can develop motor skills adequate to protect the knee from potentially harmful loads during functional activities. This study mainly is to intend the effectiveness of balancing exercises over strengthening exercises to improve the functional ability of OA knee patients.

Material and methods

For the study 30 subjects were selected. Patients were selected in the study on the basis of inclusion criteria. The patients were fully informed about the treatment procedure and written consent was taken. The patients were divided into two groups in a randomized manner and each group consisted of 15 patients. The Ethical approval was taken from Ethical Approval Committee of the Burdwan Medical College and Hospital.

Inclusion criteria

- Knee pain in or around the joint for most days in the previous month.
- At least three of the following six clinical features-
    - Age – 50 years to 65years.
    - Stiffness less than 30 min.
    - Crepitus.
    - Bony tenderness
    - Bony enlargement.
    - No palpable Warmth.
- Moderate to severe degenerative changes of knee joint with following radiological features:-
    - Reduction of medial joint space.
    - Subchondral sclerosis.
    - Subarticular cyst formation.
    - Marginal osteophytes.
    - Minimal lateral subluxation.

Exclusion criteria

- Presence of R.A, Polyarthritis or systemic inflammatory arthropathies.
- History of total knee arthroplasty or major knee trauma injury.
- Corticosteroid injection to the quadriceps or patellar tendon in the last month.
- History of neurological and psychological disorder.
- Unresolved balance disorder.

- Hip or ankle instability, excessive weakness, surgery or major trauma injury.
- High risk health status- e. g. uncontrolled hypertension, diabetes, heart disease, anginal type pain, nocturnal dyspnea, shortness of breath, trachycardia etc.
- Musculoskeletal problem like fractures, tendonitis or bursitis or any significant symptoms affecting the whole lower limb or back that would severe enough to interfere with the exercise program.

Study design

This was a randomized comparative study.

The following were necessary materials for the study. (**Photo – 1**)

Photo – 1: Equipments and materials used for the study.

- Treatment couch
- TENS unit
- Four surface carbon –rubber electrodes with leads.
- Velcro straps.
- Electrode gel
- Cotton
- Kidney tray
- Sufficient pillows and bed sheets
- Pen
- White papers with clip board
- Chair
- Rocker board
- Mat
- Stool
- Scale
- Soap and water
- Chalk
- Measuring tape.

Assessment tools

Western Ontario and McMaster Universities Osteoarthritis Index; VA- 3 (WOMAC)

The Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index was used as a self –report measure of function. The WOMAC is a disease specific measure of pain, stiffness and physical function for individuals with knee OA, which includes 5 items related to pain, 2 related to stiffness and 17 related to physical function. Each item is scored on a five- point Likert scale. Reliability and Validity of WOMAC has been established with higher scores representing greater limitations in functions.

Visual Analogue Scale (VAS)

The Visual Analogue Scale was used to measure the intensity of subjective pain sensation. The VAS consisted of 10 cm horizontal line, anchored with ‘no pain’ at the left end (i.e. threshold intensity) and ‘pain as bad as it could be’ at the right (i.e. maximally tolerable intensity). The subjects were requested to put mark on the scale at the point which approximates to the relative intensity of his / her pain experienced. It is taken at the initial of treatment i.e. day1 and at the end of 4 week. The subjects were not permitted to see the previous scores. Scores were established by measuring from the zero point to the distance mark in cm.

Data collection procedure

All the subjects who fulfilled inclusion criteria were selected and they were randomly assigned in two groups. The patients were fully informed about the treatment procedure and written consent is taken. Before starting the treatment in

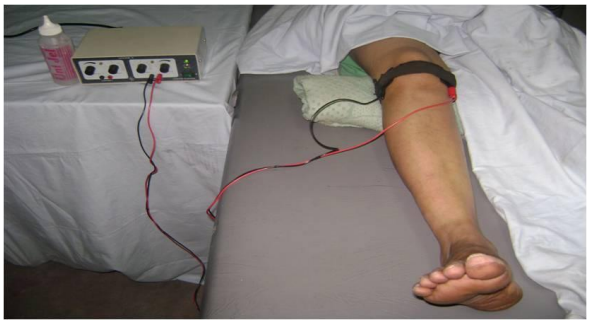
day one detail assessment according to assessment format was taken and assessment of the parameters like VAS and WOMAC were taken and recorded for both the groups as pre treatment data. The Ethical approval was taken from Ethical approval Committee of Burdwan Medical College and Hospital.

Interventions

Group A and Group B both group received TENS treatment. (**Photo – 2**)

TENS was given to the patient in supine lying position on the couch, both knees supported by a roll of towel at approximately 15° from full knee extension, which is a relaxed position for the knee joint. The treatment area is exposed by maintaining privacy of patient. The area to be treated is cleaned with wet cotton swab to reduce skin resistance. The two channeled carbon rubber electrodes were placed at the both sites of the knee (over the site of pain) and then the treatment was administered for 40 min. Patients were asked to report any kind of discomfort within knee during treatment. The parameter of TENS is used high frequency (100 Hz), low intensity, and continuous pattern for 4 days per week for 4 weeks.

Photo – 2: Application of TENS.



Group - A

In addition to the TENS, Group A receives a set of balancing exercises in each setting.

The exercise programs were as follows.

a. **One leg balances**: It involved standing on affected foot with relaxed, upright posture and the other leg raised to the back (flexed at 90°). This position was hold for 30 seconds, followed by rest for 10 seconds. It was repeated three times with each leg.
b. **Blind advanced one leg balances**: It was same like one leg balance, except that the patient was asked to keep his / her eyes completely closed while performing the exercise.
c. **Cross body leg swings:** Leaning slightly forward with hands on a wall for support and whole body weight on affected leg, other leg was swing in front of the body, pointing toes upwards as foot reaches its farthest point of movement. Then the same leg was swing backward as far as comfortably possible. This was repeated for 15 times. After 10 sec rest 15 similar repetition was done with another leg.
d. **Tandem walking**: Walking, placing the heel of one foot directly in front of the toe of the opposite foot (tandem walking) along a three meter line marked on the floor. (**Photo – 3**)

Photo – 3: Patient performing tandem walking.

e. **Rocker board exercise**: At first the rocker board was placed on mat near a wall. Then asked the patient stand on it

and just trying to maintain the balance. Then asked to slowly rock it back and forth by hinging at the ankles and try to avoid bending at the waist. Then rocking was done with the feet facing either corner or towards the narrow end. Balance training should be last for 5 to 30 min per day. (**Photo – 4**)

Photo – 4: Exercise on rocker board.

Group - B

Group B received additional TENS with strengthening exercises. After receiving TENS the strengthening exercises are performed by the patients. The exercise programs were as follows.

a. **Quadriceps-setting exercise**: Patient lying in a firm bed in supine position with the knee extended (or flexed a few degrees with a towel placed below the knee). Then the patient asked to push the knee back and tighten the thigh muscle, causing the patella to glide proximally, and then hold for a count of 10. It was repeated 10 times with each leg. (**Photo – 5**)

b. **Straight leg raise**: Patient lying in a firm bed in supine position and kneecap pointing to the ceiling. Then ask him to tighten the thigh muscle in one leg and then slowly lift that leg about 45 degrees of hip flexion while keeping the knee extended. Then after 10 sec holding the leg in that position ask the patient to slowly lower the leg down to the bed. It was repeated 10 times with each leg. (**Photo – 6**)

c. **Hamstring-setting exercise:** Patient position is long sitting with the knee in extension or slight flexion over a towel roll. The patient ask to isometrically contract the knee flexors just enough to feel tension developing in the muscle group by gently pushing the heel into the treatment table and holding the contraction for 10 sec. Then the patient relaxes and repeats the exercise 10 times with each leg.

d. **Quadriceps strengthening exercise:** Patient sits in a chair in comfortable position. Then straighten the leg and hold for 5 to 10 sec. and then slowly lower back the leg. It is repeated 5 to 10 times with each leg throughout the full existing range of motion. Later resistance was added, it began at 0.5 Kg and progressed by 0.5 Kg increments if the patient dose not experience pain. (**Photo – 7**)

e. **Mini-Squat**: Patient asked to stand holding the back of the chair for balance. He or she stand with feet shoulder – width apart, then slowly bend the knees and then straighten them. At that time he or she instructed to keep the heels on the floor throughout the exercise. It was repeated 10 times.

Photo – 5: Patient doing quadriceps setting exercise.

Photo – 6: Patient performing straight leg raising exercise.

Results and Discussion

For this study, 36 subjects were screened out of which 30 subjects were selected. Those subjects were randomly assigned in two groups i.e. Group A and Group B. Each group contained 15 subjects.

Photo – 7: Patient doing quadriceps strengthening exercise.

The WOMAC and VAS scores were recorded to the subjects on first day prior to the treatment and at the end of the 4th week.

Mean and SD were calculated for the first day prior to the treatment and after the treatment at the end of the 4th week to see the average improvement in WOMAC and VAS in the two groups separately.

Table – 1: Group - A (At first day and end of 4th week of treatment) WOMAC Score.

Sl. No.	Day: 1	End of 4th week
1	52	25
2	70	27
3	40	14
4	62	30
5	45	18
6	38	16
7	32	10
8	54	22
9	30	12
10	44	16
11	53	27
12	28	10
13	47	21
14	26	11
15	39	15
MEAN	44	18.26666667
SD	12.68294693	6.68117469
OBSERVATION	15	15
d.f.	14	
P- value	7.16728×10^{-10}	

Paired t-test:

Null Hypothesis- There is no significant change in WOMAC scores at the end of 4th week.

Alternative Hypothesis- There is significant reduction in WOMAC scores at the end of 4th week.

Interpretations:

Since P value is almost zero so the null hypothesis is rejected or alternative hypothesis is accepted i.e. significant reduction in WOMAC

scores at the end of 4th week. It shows to be statistically highly significant.

Table – 2: Group - B (At first day and end of 4th week of treatment) WOMAC Score.

Sl. No.	Day: 1	End of 4th week
1	17	10
2	61	35
3	61	41
4	39	28
5	66	42
6	38	25
7	33	23
8	60	45
9	32	27
10	61	39
11	72	46
12	68	44
13	38	29
14	52	36
15	40	30
MEAN	49.2	33.33333333
SD	16.32789025	10.01902951
OBSERVATION	15	15
d.f. for	14	
P- value	7.04812×10^{-07}	

Paired t-test:

Null Hypothesis- There is no significant change in WOMAC scores at the end of 4th week.

Alternative Hypothesis- There is significant reduction in WOMAC scores at the end of 4th week.

Interpretations:
Since P value is almost zero so the null hypothesis is rejected or alternative hypothesis is accepted i.e. significant reduction in WOMAC scores at the end of 4th week. It shows to be statistically highly significant.

Table – 3: Group - A (At first day and end of 4th week of treatment) VAS Score.

Sl. No.	Day: 1	End of 4th week
1	5	1
2	6	2
3	5	1
4	6	2
5	5	1
6	7	2
7	4	0
8	6	2
9	7	1
10	8	2
11	6	1
12	4	0
13	7	3
14	5	2
15	4	1
MEAN	5.666666667	1.4
SD	1.2344268	0.828078671
OBSERVATION	15	15
d.f.	14	
P- value	2.67061×10^{-11}	

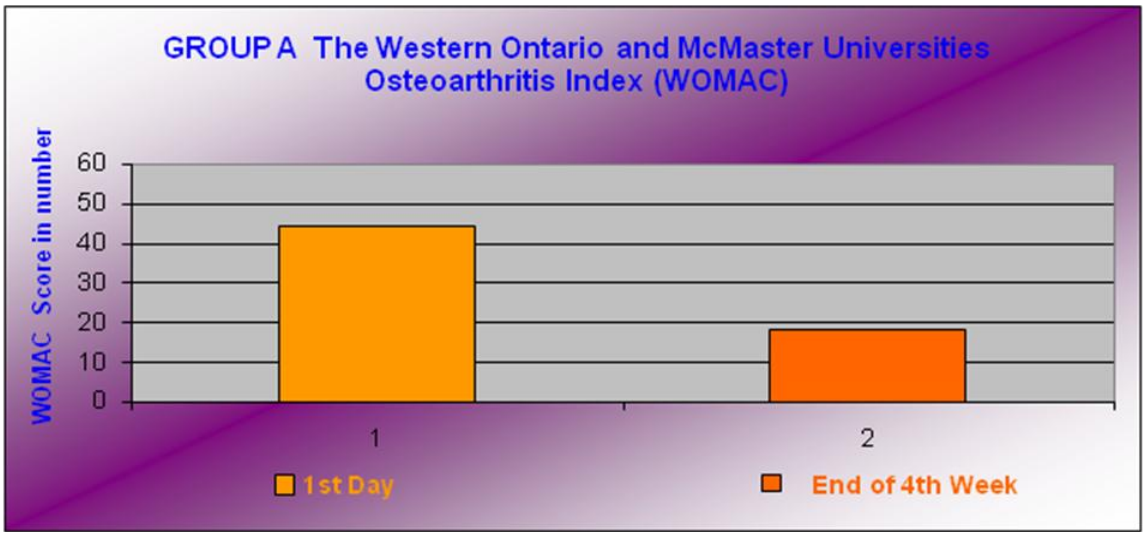
Paired t-test:-

Null Hypothesis- There is no significant change in VAS scores at the end of 4th week.

Alternative Hypothesis- There is significant reduction in VAS scores at the end of 4th week.

Interpretations:
Since P value is almost zero so the null hypothesis is rejected or alternative hypothesis is accepted i.e. significant reduction in VAS scores at the end of 4th week. It shows to be statistically highly significant.

Graph – 1: Comparison of WOMAC score from day 1st to end of 4th week in Group – A.
This graph is showing the WOMAC score reduction from pretreatment of day 1 to post treatment of 4th week.



Graph – 2: Comparison of WOMAC score from day 1st to end of 4th week in Group – B.
This graph is showing the WOMAC score reduction from pretreatment of day 1 to post treatment of 4th week.

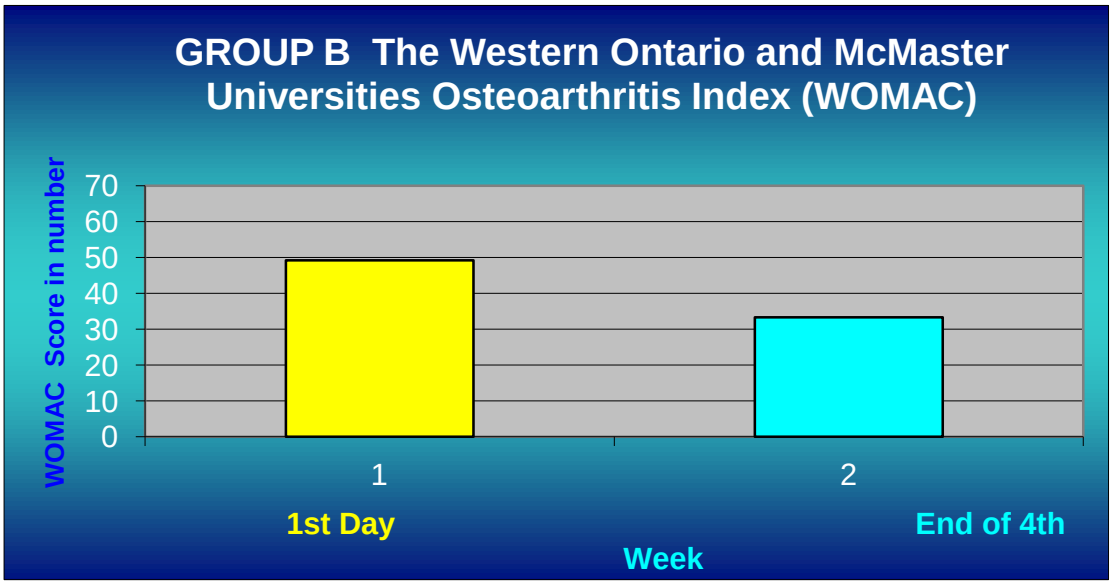


Table – 4: Group B (At first day and end of 4th week of treatment) VAS Score.

Sl. No.	Day: 1	End of 4th week
1	4	1
2	8	6
3	7	2
4	8	5
5	7	3
6	7	4
7	6	3
8	7	4
9	5	2
10	5	3
11	8	4
12	6	2
13	4	0
14	5	3
15	6	2
MEAN	6.2	2.933333333
SD	1.373213125	1.533747356
OBSERVATION	15	15
d.f.	14	
P- value	9.41745×10^{-10}	

Paired t-test:-

Null Hypothesis- There is no significant change in VAS scores at the end of 4th week.

Alternative Hypothesis- There is significant reduction in VAS scores at the end of 4th week.

Interpretations:
Since P value is almost zero so the null hypothesis is rejected or alternative hypothesis is accepted i.e. significant reduction in VAS scores at the end of 4th week. It shows to be statistically highly significant.

Table – 5: WOMAC score in both groups (Group A and Group B) at end of 4th week of treatment.

Sl. No.	Day: 1	End of 4th week
1	25	10
2	27	35
3	14	41
4	30	28
5	18	42
6	16	25
7	10	23
8	22	45
9	12	27
10	16	39
11	27	46
12	10	44
13	21	29
14	11	36
15	15	30
MEAN	18.26666667	33.33333333
SD	6.68117469	10.01902951
OBSERVATION	15	15
d.f.	28	
P- value	4.22974×10^{-05}	

Independent t-test (Fisher's t test):
Null Hypothesis – WOMAC score is equal in two Groups.

Alternative Hypothesis- WOMAC score in Group A is less than Group B.

Interpretations:
Since P-value is almost zero so the null hypothesis is rejected and alternative hypothesis is accepted. So balancing exercises +TENS is more effective than strengthening exercises + TENS. This table represents the comparison of WOMAC scores between the Groups and showing both the result having statistical significant improvement but in Group A the mean value (18.2) is less than in Group B (33.3). Therefore the result shows that improvement in

Group A is more than Group B and having the statistically highly significant.

Table – 6: VAS score in both groups (Group - A and Group - B) at end of 4th week of treatment.

Sl. No.	Day: 1	End of 4th week
1	1	1
2	2	6
3	1	2
4	2	5
5	1	3
6	2	4
7	0	3
8	2	4
9	1	2
10	2	3
11	1	4
12	0	2
13	3	0
14	2	3
15	1	2
MEAN	1.4	2.933333333
SD	0.828078671	1.533747356
OBSERVATION	15	15
d.f.	28	
P- value	0.002005591	

Independent t-test (Fisher's t test):

Null Hypothesis – Mean VAS score is equal in two Groups.

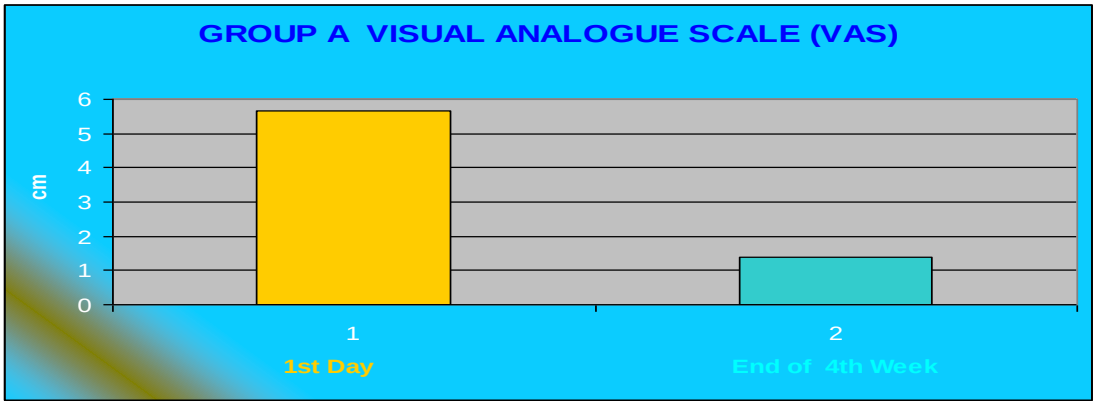
Alternative Hypothesis- Mean VAS score in Group A is less than Group B.

Interpretations:
Since P-value is almost zero so the null hypothesis is rejected and alternative hypothesis is accepted. So balancing exercises +TENS is more effective than strengthening exercises + TENS. This table represents the comparison of VAS scores between the Groups and showing both the result having statistical significant improvement but in Group A the mean value (1.4) is less than in Group B (2.9). Therefore the result shows that improvement in Group A is more than Group B and having the statistically highly significant.

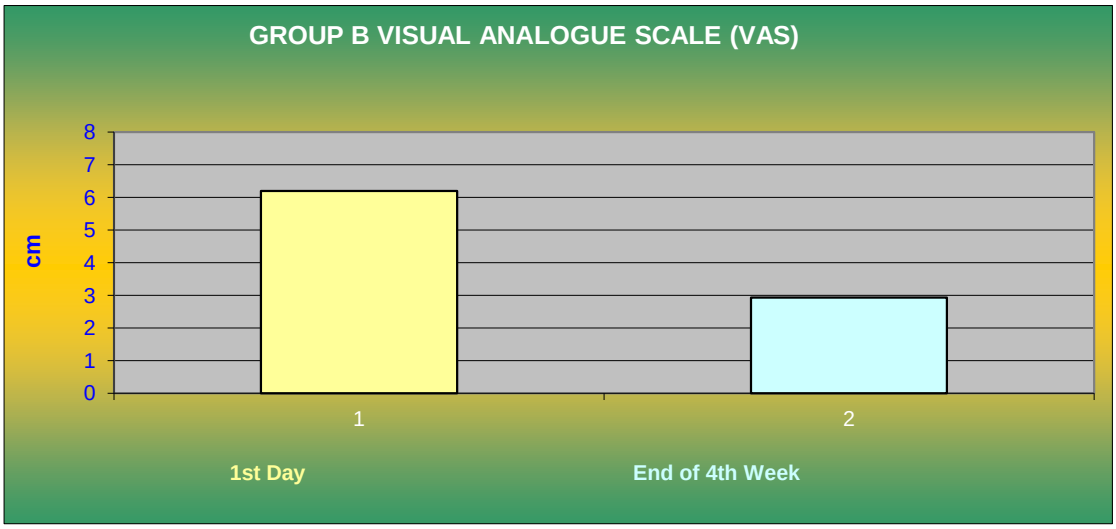
Standard deviations were taken into account to see the variation from their means. Mean differences were calculated to see the variation within the group from day 1 and of the 4th week between the Group A and Group B.

The observed differences were tested with the paired't' test (d.f. 14) for within the group and Fisher's't' test (independent 't' test) for between the groups with 28 d.f. and p-values are noted against each result.

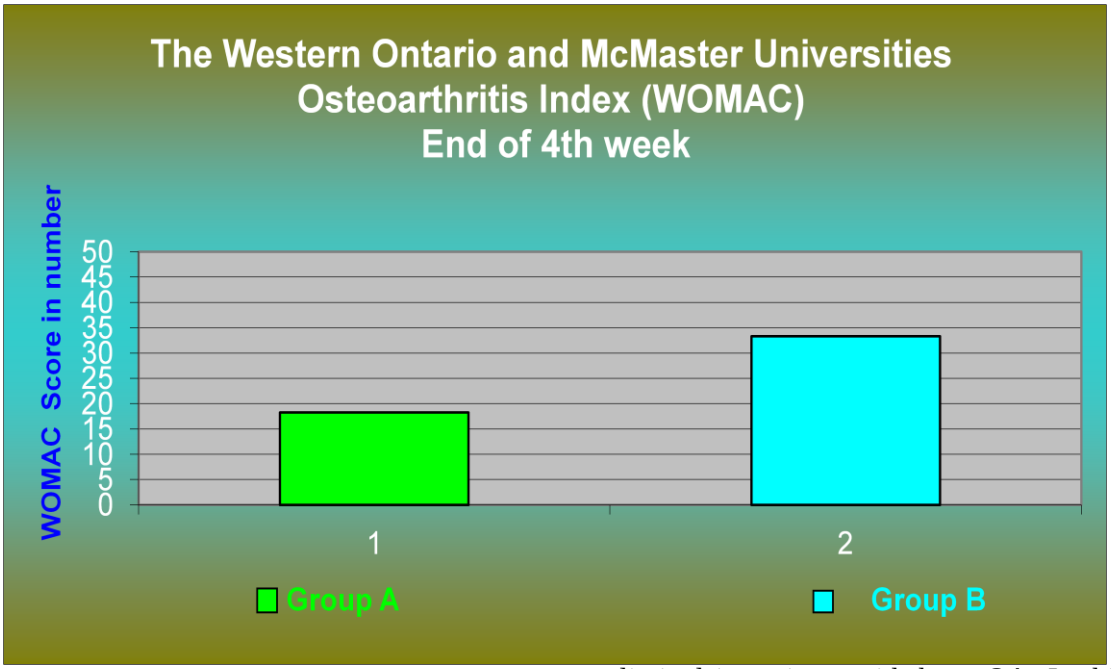
Graph – 3: Comparison of VAS score from day 1st to end of 4th week in Group – A.
This graph is showing the VAS score reduction from pretreatment of day 1 to post treatment of 4th week.



Graph – 4: Comparison of VAS from day 1st to end of 4th week in Group – B.
This graph is showing the VAS score reduction from pretreatment of day 1 to post treatment of 4th week.



Graph – 5: Comparison of WOMAC score between the Group A and Group B at the end of 4th week of treatment.
This graph is showing the comparison between the average means of WOMAC score for the two groups at the end of 4th week of treatment and represents that there is more improvement in Group - A than Group - B.



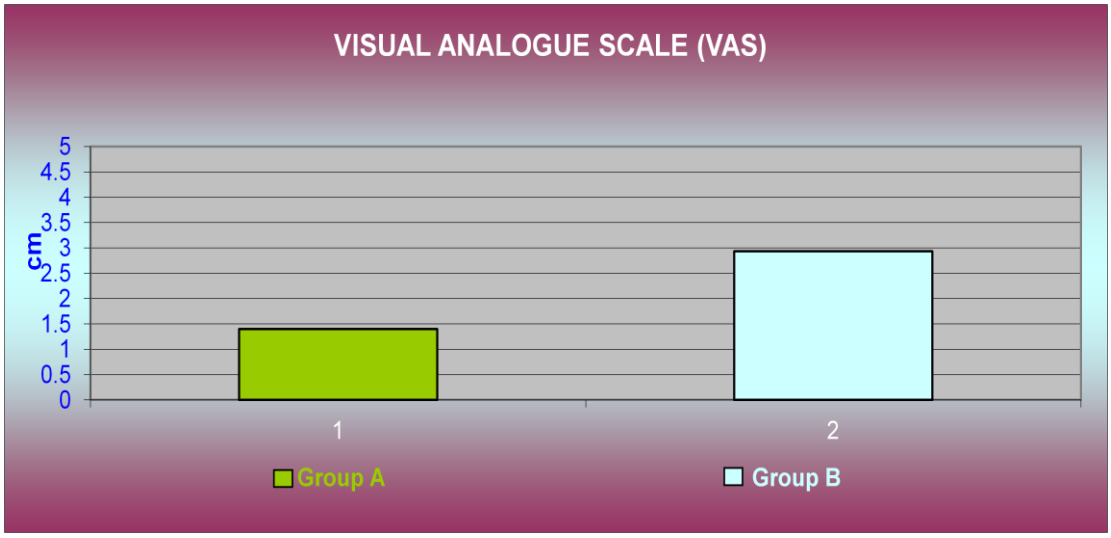
Conclusion

The result of this study shows that balancing exercises were superior to strengthening exercises. Balance is limited partially due to strength reductions so functional performance is limited in patients with knee OA. In this study WOMAC Index was used to assess overall knee function since its validity and reliability is established. The intra group comparison of both the group showed highly significant difference in WOMAC score and VAS score. It was noted that

WOMAC Index was highly reduced in patients treated with balancing exercise (Group A). This could be due to pain relief, improve in the strength of weak muscles, correct mechanical loading and thus increased quality of movement and improved proprioception. The balancing exercise program gave the patient additional exposure to these activities may allowed them to develop adequate motor skills for dealing with potentially destabilizing forces on the knee that may be encountered during recreational activities and activities of daily living.

Graph – 6: Comparison of VAS score between the Group - A and Group - B at the end of 4th week of treatment.

This graph is showing the comparison between the average means of VAS score for the two groups at the end of 4th week of treatment and represents that there is more improvement in Group - A than Group - B.



In the study reported by M.V Hurley, et al.; 1998 the most important improvements were observed in quadriceps strength and proprioceptive acuity and increased functional ability in patients with knee OA. In the study they investigated the effects of a rehabilitation program, which included proprioceptive and balance exercises 2 days a week for 5 weeks about 30 min [24]. Kelly P Westlake, et al.; 2007 have investigated that effects of sensory –specific balance training on proprioceptive reintegration for 3 times per week for 8 week period. This study provides evidence that sensory –specific exercise improves balance and proprioception in OA patients [27]. Ufuk Sekir, et al.; 2005 investigated the effects of a multistation proprioceptive exercise program on functional capacity, perceived knee pain and sensorimotor function. The OA patients in the study performed proprioceptive and balance exercises and recorded large improvements [28]. Rogind, et al., 1998 have investigated the effects of a physical training program, employed twice a week for three months on general fitness, lower extremity muscle strength, agility and balance and co-ordination of knee OA pts. The result shows significant improvement in muscle strength [29].

Statistical results suggest that scores of WOMAC in Group A that is pretreatment (44 ± 12.68) and post treatment after the end of 4 weeks (18.26 ± 6.68) and in Group B that is pretreatment (49.2 ± 16.32) and after the end of 4 weeks (33.33 ± 10.01) has significantly differences in both the groups after the end of 4 weeks. However there is statistically significant difference between both the groups (P value =4.22974 x 10^{-05}). Therefore the result shows that improvement in Group A is more than Group B and having the statistically highly significant.

VAS in Group A that is pretreatment (5.66 ± 1.23) and after the end of 4 weeks (1.4 ± 0.82) and that in Group B is pretreatment (6.2 ± 1.37) and after the end of 4 weeks (2.93 ± 1.53) has significantly differences in both the groups after the end of 4 weeks. However there is statistically significant difference between both the groups (P value = 0.002005591). Therefore the result shows that improvement in Group A is more than Group B and having the statistically highly significant.

A more probable explanation for these results is an increase during the training intervention in the attention allocated to propriceptive cues (explicit learning), which eventually led to a less attentionally demanding recovery of postural stability (implicit learning). As the accuracy of peripheral input declines with degenerative changes the attentional resources become more focused on the control of posture. Thus the introduction of a sufficiently challenging secondary task or postural condition often results in reduced task performance or instability.

Osiri M, et al., 2000 were used different modes of transcutaneous electrical nerve stimulation setting in osteoarthritis knee pain relief. The result shows that high frequency and strong burst mode TENS used in pain relief of knee osteoarthritis [30].

Although this study was done with lesser amount of sample as well as the study duration was less, if the study duration, sample size would be more then effect of balancing exercises and strengthening exercises would been explained in a detailed and better manner.

The results of the study shows that balancing exercise is more effective than strengthening exercise to improve the functional ability of OA knee patients. The improvement in Group A is more than Group B and having statistically highly significant. Balancing exercise can be used as a preventive or non- operative intervention to enhance proprioceptive function, reverse the degenerative joint disease related strength loss and achieve joint stability. The positive effects of balancing exercise interventions are widely accepted for keeping the OA knee patients active and preventing falls.

Limitations

- The sample size on the study was small, larger samples was not taken.
- Duration of this study was short.
- Severity of the underlying pathological process was not matched for all the patients and simultaneous use of analgesics was not prohibited.
- There is no Indian version of WOMAC score.

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