

# A Study on Efficacy of Pilates & Pilates & Mckenzie Exercises in Postural Low Back Pain- A Rehabilitative Protocol

**\*Niti Rajpal, \*\*Manish Arora, \*\*\*Vivek Chauhan**

\*Student, Masters in Physiotherapy (Sports) final year, Sardar Bhagwan Singh Institute, Dehradun, \*\* HOD, Sardar Bhagwan Singh Institute, Dehradun

\*\*\* Lecturer, MMIPR, Ambala

## Introduction

Back is a mechanical structure that supports the individual throughout the life. Back pain is a huge public health issue affecting most of us at some times in our lives and causing enormous suffering. It continues to be a major cause of functional disability which almost affects between 60-80% of the population.

Although most of these low back pain episodes subside in 2-3 months, recurrence is common, shown to be as high as 85%. Studies indicates 2-3% of patients with LBP may proceed to suffer chronic disabling pain. Approximately 50% of all working people suffer back pain symptoms for atleast some of the time during any given year. Approximately 30% of people have had a back problem in the past 5 years that has been severe enough for them to seek professional help.

In a study conducted in rural north India, it was observed 23.09% patients reporting to out-patients clinic during 1 year had back pain. In this group, 67% had psychological issues, 57% were in blue collars jobs (heavy manual workers) 26% had to change/leave their profession and 38% did not enjoy their present jobs.

According to Nachemson, "low back pain occurs with about the same frequency in people with sedentary occupations as in those doing heavy labour, although the latter have the incidence of absence from work because they are unable to work with their complaint".<sup>8</sup>

Postural low back can be because of prolonged standing & sitting, poor posture, poor

biomechanics, abnormal sleeping posture or sedentary lifestyle. Back pain particularly low back pain, is often caused by strained back muscles and ligaments as a result of improper lifting techniques or as a result of lifting an overly heavy loads, or as a result of sudden or awkward movement<sup>4</sup>.

According to Michelle Schwahn, PT, in a healthy spine there is activation of deep core muscles in stabilization of the trunk before the body moves. This interaction between the deep core muscles and the nervous system plays a role in the proprioceptive feedback sent to the brain as we perform activities and undergo our normal activities.<sup>6</sup>

Number of strategies have been documented for treating low back pain as traction, hot/cold packs, short wave diathermy, interferential therapy, massage, TENS, ultrasound and stretching exercises etc. which provides improvement in pain and activity levels.<sup>14</sup> There is also strong evidence that general exercise programs results in reduced disability, reduced absenteeism and faster return to work. Classic trunk exercises involves both flexion & extension exercises activates abdominals & paraspinal muscles, increases inter-segmental stability (multifidus, transverse abdominis<sup>13</sup>. Transversus abdominis acts as a girdle to flatten the abdominal wall and compress the abdominal viscera and stabilize linea alba. Its weakness leads to bulging of anterior abdominal wall, thereby causing hyperlordosis. Multifidus is also an important back extensor involved in providing stiffness for the lumbar spine.

Spinal stability is further increased with trunk flexor-extensor muscle co-activation which increases intra-abdominal pressure & produces abdominal spring force.<sup>5</sup>

## Reprint requests: Niti Rajpal

Student, Masters in Physiotherapy (Sports) final year, S.B.S. PG Institute, Balwala Dehradun 248 161 (Uttaranchal)  
Mob: 09927436020

The recent treatment regime for low back pain includes McKenzie exercises, Pilates regime, Williams flexion exercises, Cyriax, Pilates, Maitland mobilization & other manipulative therapies which promotes early activity & return to work.

Low back pain is common affliction whose specific cause and precise treatment are still a baffling to the medical profession. In the present study, the comparison between Pilates & McKenzie exercises is done to find out their effect on postural low back pain.

Pilates focuses on strengthening of core muscles of the back which affects the posture and provides support to the spine. It also improves strength and flexibility which helps to alleviate back pain. Pilates emphasizes on proper breathing and body awareness in addition to core conditioning.<sup>9</sup>

McKenzie defines postural syndrome as a mechanical deformation of postural origin causing pain of a strictly intermittent nature, which appears when the soft tissues surrounding the lumbar segments are placed under prolonged stress. McKenzie explains 3 syndromes - postural, dysfunction & derangement. The treatment for postural syndrome includes postural correction and re-education.<sup>10</sup>

Physiotherapists are pioneering investigations into the proposed mechanisms contributing to chronic and recurrent low back pain by evaluating the effects of specific exercise programme. Through highly skilled clinical practice and well designed research, physiotherapists are able to provide evidence for physiotherapy as a safe, low cost management approach.

Thus, this study is aimed to expand the work done by the studies conducted in western countries to identify the rehabilitation for low back pain in India and an effort to ensure best professional practice based on research evidence from scientific literature.

### **Operational Definitions**

#### **Pilates**

It is an exercise program that works on strengthening the core muscles which affect

posture and provide support and strength for the spine. It teaches body awareness, good posture & easy, graceful movement. Pilates improves flexibility, agility, & economy of motion.<sup>9</sup>

#### **McKenzie**

McKenzie defines postural syndrome as a mechanical deformation of postural origin causing pain of a strictly intermittent nature, which appears when the soft tissues surrounding the lumbar segments are placed under prolonged stress. This occurs when a person performs activities which keep the lumbar spine in a relatively static position (as in vacuuming, gardening) or when they maintain end positions for any length of time (as in prolonged sitting).<sup>10</sup>

#### **Back performance scale score**

It is a condition-specific performance measure of activity limitation for patients with back pain. It consist of the Sock test, Pick up test, Roll-up test, Fingertip to Floor test & Lift test. All the tests are scored on 4-point ordinary scales according to observed physical performance. The BPS is the sum of scores from all five tests and ranges from 0 (no activity limitation) to 15 (major activity limitation).<sup>19, 20</sup>

#### **Sphygmomanometer**

This was used to teach the correct activation of the Transversus abdominis muscle from the baseline pressure of 40mg of Hg (that is the pressure in the cell that fills the space behind the bag giving the patient an awareness only of it's presence), the correct drawing – in action causes a slight flattening of the lumbar spine, which registers as a pressure increase of approximately 10 mm of Hg. This pressure sensor provides both a measure and feedback system for the patient.<sup>16</sup>

#### **Digital inclinometer**

This inclinometer is a device used to measure angles from the horizontal reference<sup>17</sup>. The equipment used in the study is a hand held digital inclinometer from Chattanooga group, Inc. with ISO 9001 certification. The inclinometer was fixed on a wooden base for the purpose of measuring standing pelvic tilt angle.

### Numeric pain scale

A 10 cm long non-sequential numeric rating scale with the range of scores from 0 (no pain) to 10 (worst pain) used for subjective evaluation of pain.

No pain \_\_\_\_\_ worst pain  
0 1 2 3 4 5 6 7 8 9 10

### Review of Literature

1. Keegan (1953) claimed that increased lumbar lordosis can increase the risk of chronic low back pain on the basis of study conducted towards the correlation between the lumbar lordosis and back ache.
2. Delarue. NC (1957) stated in "Poor posture: a social, industrial and medical problem" proposed that lumbar spine is associated with minimal normal anterior pelvic inclination and this results in increasing shortening and contracture of paraspinal muscles within the concavity of the lumbar curve. *Canad.M.A.J.* Aug 1957; 77: 252-256.
3. Rosa. NG (1984) stated in "Back exercise" that postural muscles show a tendency to get hypertrophied and tight and are readily activated to most movement patterns. They include hamstrings, iliopsoas and trunk extensors. *J HongKong Physiotherapy Association.* 1984; 6: 21-25.
4. Day. JW et al (1984) stated in "Effects of pelvic tilt on standing posture" that anterior pelvic tilt causes an increase in the depth of the lumbar curve. *Phys Ther.* 1984 Apr; 64(4): 510-16.
5. Gajdosik. R et al (1985) in their study "Pelvic tilt: Intratester reliability of measuring the standing position and range of motion" concluded that mean standing pelvic tilt angle is 8.4 degree which was found in a group of 20 healthy male subjects. *Phys Ther.* 1985 Feb; 65 (2): 169-74.
6. S. Donzelli et al (1985) concluded that Pilates method is used as an alternative approach for the treatment of non specific low back pain.
7. Fredrickson B E et al (1986) stated in "The McKenzie Treatment of Low back Pain: a correlation of Significant Factors in Determining Prognosis" that McKenzie system had definite prognostic value. Annual meeting of International Society for the Study of the Lumbar Spine, USA, 1986.
8. Walker. ML et al (1987) stated in "Relationship between lumbar lordosis, pelvic tilt and abdominal muscle performance" that to test the reliability of the pelvic inclination measurement Intraclass coefficients (ICC) were calculated and the ICC value for repeated measures (i.e. reliability) of pelvic tilt was 0.84. *Phys Ther.* 1987 Apr; 67(4): 512-16.
9. Walker. ML et al (1987) stated in "Relationship between lumbar lordosis, pelvic tilt and abdominal muscle performance" that pelvic inclination was measured using an inclinometer to determine the angle formed with the horizontal line drawn between the anterior superior iliac spine (ASIS) and posterior superior iliac spine (PSIS). To measure the pelvic tilt, the first examiner places the arms of the inclinometer on the marked ASIS and PSIS, and the second examiner read and record the angle of inclination. *Phys Ther.* 1987 Apr; 67(4): 512-16.
10. Belanger A. Y. et al (1991) stated in "The McKenzie Approach: How Many Clinical Trials support Its Effectiveness?" that there is effectiveness of the McKenzie approach. *Physical Therapy, London, UK.*
11. Adams N (1993) stated in "Psychophysiological and Neurochemical Substrates of Chronic Low Back Pain and Modulation by treatment" that chronic low back pain patients had decreased pain scale readings, increased lumbar range of motion, reduced EMG activity, and elevated levels of substance P following a 6 week treatment programme of McKenzie extension procedures. *Physiotherapy* 79:2; 86 , 1993.
12. Kay MA, Helewa A (1994) stated in "The effects of Maitland and McKenzie

- techniques in the musculoskeletal management of low back pain: A pilot study" that the McKenzie group improved by 18 units on a pain visual analogue scale, the Maitland group deteriorated by 16 units. *PhysTher.*74.5.S: 59; 1994.
13. Goldby L (1995) stated in "A randomised controlled trial comparing the McKenzie method of mechanical diagnosis and therapy with a non-prescriptive exercise regime in the conservative treatment of chronic low back pain" that there were improvements in both groups, significant differences in McKenzie group in pain, and function. Proceedings 4th McKenzie Institute International Conference, England, September 1995.
  14. Fowler B et al (1995) stated in "The therapeutic efficacy of McKenzie concept in the management of low back pain" that 27 patients treated with McKenzie had 74% made rapid recovery. Proceedings 12th International Congress World Confederation Physical Therapists, June, 1995, USA.
  15. Gillan MG et al (1998) stated in "The natural history of trunk list, its associated disability and the influence of McKenzie management" that there was a significantly greater reduction of list in the McKenzie group.
  16. "Philadelphia panel evidence-based clinical practice guidelines on selected rehabilitation interventions for low back pain". (2001) concluded that for sub-acute and chronic back pain there is good evidence to include certain specific exercises, including the McKenzie method. *Physical Therapy* 81; 1641-1674, 2001.
  17. Petersen et al (2002) stated in "The effect of McKenzie therapy as compared with that of intensive strengthening training for the treatment of patients with subacute or chronic low back pain" that McKenzie therapy was more effective than the strengthening training. *ARCT.Spine*27.1702-1709.
  18. Ludmila et al (2003) stated in "Effects of Physioball and Conventional Floor Exercises on Early Phase Adaptations in Back and Abdominal Core Stability and Balance in Women" that early adaptations in a short-term core exercise program using the physioball resulted in greater gains in torso balance and EMG neuronal activity in previously untrained women when compared to performing exercises on the floor. *The Journal of Strength and Conditioning Research*: pp. 721-725.
  19. EM Skikic et al (2003) stated in "The effects of McKenzie exercises for patients with low back pain" that McKenzie exercises are beneficial treatment for increasing flexibility of spine and improving pain with better results of back pain. *Bosn J Basic Med Sci.* 2003 Nov; 3(4): 70-5.
  20. Neil A. Segal MD (2004) stated in "The effect of Pilates training on flexibility & body composition: an observational study" that Pilates results in improved flexibility. *Archives of Physical Medicine and Rehabilitation*. Volume 85, Issue 12, December 2004, Pages 1977-1981.
  21. Jri.P.Arokoski et al (2004) stated in "Activation of lumbar para-spinal and abdominal muscle during therapeutic exercises in low back pain patients" that patients with chronic low back pain when treated with active rehabilitation had no effect on abdominal muscles & back muscles activation. *Archives of physical medicine and rehabilitation*; 85: 823-832.
  22. Joseph E Musculino (2004) stated in "Pilates & powerhouse-II" that Pilates is focused mainly towards the stabilizing contraction of the muscles of powerhouse. *Journal of Bodywork and Movement Therapies*. Volume 8, Issue 2, April 2004: 122-130.
  23. Helen A Clare et al (2004) stated in "A systematic review of efficacy of McKenzie therapy for spinal pain" that patients with low back pain treated with McKenzie therapy resulted in a greater decrease in pain and disability in the short term than do other standard therapies. *Australian Journal of Physiotherapy* 50: 209-216.

24. Gregory J Lehman et al (2005) stated in "Trunk muscle activity during bridging exercises on and off a swissball" that swiss ball is capable of influencing trunk muscle activity in the rectus abdominis and external oblique musculature during prone bridge exercises. *Chiropractic & Osteopathy* 2005, 13: 14doi: 10.1186/1746-1340-13-14.
25. Lee Herrington et al(2005) stated in" The influence of Pilates training on the ability to contract the transversus abdominis muscle in asymptomatic individual" that Pilates trained subjects could contract transversus abdominis & maintain better lumbo-pevic control. *Journal of Bodywork and Movement Therapies*. Volume 9, Issue 1, January 2005: 52-57.
26. Jill V Quinn et al (2005) stated in "The influence of Pilates- based mat exercises on chronic low back pain" that Pilates is an effective method for reducing muscle activity in para-spinal muscles in those who experience chronic low back pain. *Journal of American college of sports medicine*, 2005, Vol.37.
27. Valerie Gladwell et al (2006) stated in" Does a program of Pilates improve chronic non-specific low back pain?" that Pilates is effective in treating non-specific low back pain and it improves general health, pain level, flexibility and proprioception in individuals with chronic low back pain. *J Sport Rehabil*. 2006,15: 338-350.
28. Slade SC et al (2006) stated in "Trunk strengthening exercises for chronic low back pain: a systematic review" that trunk strengthening compared with aerobic or McKenzie exercises showed no benefit on strengthening. *J Manipulative Physio Ther*. 2006 Feb; 29(2): 163-73.
29. S. Donzelli et al (2006) stated in "Two different techniques n the rehabilitation treatment of low back pain: a randomized controlled trial" that Pilates technique is more effective than back school method in the treatment of low back pain. *Eura Medico Phys* 2006; 42: 205-210.
30. Rochend Rydeard et al (2006) stated in "Pilates based approach on subjects with non-specific low back pain" that Pilates reported significant decrease in low back pain and disability. *Journal of Orthopaedic and Sports Physical Therapy*; 36(7): 472-484.
31. Marshall PW et al (2006) stated in "Evaluation of functional and neuromuscular changes after exercise rehabilitation for back pain using swiss ball: a pilot study" that swiss ball can be used in the rehabilitation context for patients with low back pain. *Journal of manipulative physiological therapy* 2006: 550-560.
32. J Klaber Moffett et al (2006) stated in "The randomized trial of two physiotherapy interventions for primary care neck and back pain patients: McKenzie vs brief physiotherapy pain management" that McKenzie was more effective than the other physiotherapy pain management. *Rheumatology* 2006 45(12): 1514-1521.
33. Brian M Busanich et al (2006) stated in "Does McKenzie therapy improves outcomes for back pain?" that McKenzie therapy results in decrease in pain & disability for low back pain patients compared with other standard treatments, such as NSAIDS, back massage with back care advice, strength training with therapist supervision and spinal mobilization. *Aust J Physiother*. 2004; 50: 209-216.
34. Betul Sekendiz et al (2006) stated in "The effect of Pilates exercise on trunk strength, endurance & flexibility in sedentary adult females" that there was a positive effect of Pilates mat exercises on abdominal and lower back muscular strength, abdominal muscular endurance and posterior trunk flexibility in sedentary adult females. *Journal of body work and movement therapies*, (2006): 318-326.

## **Research Design and Methodology**

### **Nature of study**

It is an experimental study intended to see the efficacy of Pilates & McKenzie exercises on postural low back pain.

## Research setting

Study was performed in the out-patient department of Sardar Bhagwan Singh Post Graduate Institute of Biomedical Sciences and Research, Balawala, Dehradun.

## Ethical approval and consent

After selecting the sample, the methodology and procedure were explained and a written consent was obtained from all subjects prior to the study.

## Population of the study

Population of 40 female subjects of age group 20-30 years were assessed and selected.

## Sample size

A sample of 40 subjects who fulfill the selection criteria, were included in the study, out of which 32 subjects completed the 30 days protocol. 17 subjects were from Pilates Group and the rest of 15 subjects were studied in McKenzie Group.

## Method of assigning samples

40 subjects were selected on the basis of assessment and who met the inclusion criteria. The subjects were then randomly allocated into both groups, Pilates Group (n=20) and McKenzie Group (n=20).

## Inclusion criteria

- \* Patients with postural low back pain for 3 months.
- \* Female subjects between the age group 20-30 years.
- \* Subjects with the standing pelvic tilt angle of 9° or more.
- \* Subjects with reduced abdominal muscle strength.

## Exclusion criteria

- \* Subjects having sciatica or any neurological deficit.
- \* Subjects having soft tissue injuries.
- \* Subjects with spinal fractures.
- \* Subjects with disc prolapse.
- \* Back pain due to structural deformity, infection, tumour.

## Variables

Dependent variable

- \* Back performance scale score.
- \* Core muscle strength (Sphygmomanometer).
- \* Digital inclinometer.
- \* Numerical pain scale. Independent variable
- \* Pilates regime.
- \* McKenzie exercises.

## Instrumentation

- Digital inclinometer
- Sphygmomanometer
- Plinth
- Mat
- Swiss ball

## Protocol

After satisfying the inclusion and exclusion criteria and receiving their informed consent, each subject was randomly assigned to both groups.

Pilates Group (n=17) (10 reps, 10 seconds hold x 30 days)

McKenzie Group (3 reps, 15 - 20 daily  
B (n=15)x 30 days)

## Procedure

During the initial session, assessment of core muscle strength and posture was done. Recordings were done on the 0 day before the treatment, 15<sup>th</sup> day and 30<sup>th</sup> day after the treatment protocol.

Demographic data was collected from each subject included age, gender, occupation etc. Subjective assessment was done to rule out for the presence of any symptoms like history of trauma, muscle weakness, radiating pain, surgical or any medical illness.

## Measurements

### Core muscle strength

Core muscle strength was measured using sphygmomanometer. The subject were made to lie in crook lying on a firm surface and were taught the contraction of Transversus abdominis by holding the breath during

exhalation and moving the belly upwards and inwards and holds for 10 seconds. The flicker was felt infero-medial to the ASIS. Once the subject mastered this procedure, the sphygmomanometer cuff was placed beneath the back at the level of umbilicus. The cuff was inflated upto 40mm of Hg & the point at which the subject feels the cuff is noted down. The subject then contracts the muscle by holding the breath during exhalation. If the deflection rises for more than 10mm of Hg, this indicates that the core muscle strength is normal for that individual and if less than 10mm of Hg, the core muscle strength is weak.<sup>16</sup>

### **Back performance scale score**

The patient was asked to perform the following tests:-Sock test, Pick up test, Roll-up test, Fingertip to Floor test & Lift test. Each test was performed three times and the mean value was recorded. And later on the sum of scores was done and recorded.<sup>19, 20</sup>

### **Standing pelvic tilt angle**

It was measured using the digital inclinometer and a base to determine the angle formed by the horizontal plane and a line drawn between the ASIS and PSIS.

Each measurement was taken 3 times, allowing the subject 1 minute rest in between and the mean value was used as a data for the main analysis.

The subjects were instructed to stand barefooted on a sheet of paper with feet shoulder wide apart and weight evenly distributed. A tracing was made of the subject's feet so that all measurements were made with the subject in the same standing position. Now the ASISs were exposed, palpated and marked with a black dot over the apices. With the similar procedure, dots were marked over the centre of the PSISs. Once the dots were marked, the arms of the inclinometer base were placed on the already marked ASIS and PSIS on each side separately by placing on the ilium and recording was done directly from the inclinometer.<sup>11,12</sup>

### **Numeric pain scale**

A 10 cm long line was drawn on a paper with 1(no pain) to 10 (worst pain) markings on it and the subject was instructed to mark a point at

which he feels the pain. The readings were recorded on the day 0, day 15<sup>th</sup> and 30<sup>th</sup> day.

### **Interventions**

After recording pretreatment values for the dependent variable, the treatment was assigned according to group allocation. 30 subjects completed the set protocol, 17 subjects in Pilates group and 15 in McKenzie group.

### **Pilates Group**

In this the group (n=17) the subjects were given Pilates exercises for one month. The exercises were done for 10 times with 10 seconds hold in between daily.<sup>21, 22, 23</sup>

### **This includes:-**

- \* The subjects were made to lie in crook lying with hip and knee flexed. In this position, the lumbar spine is neither arched up nor flattened against the floor, but is aligned normally with a small gap between the floor and the back. The subjects were asked to breathe in deeply and relax all the stomach muscles. While breathing out, the subject draws the lower abdomen inwards as if the umbilicus goes backwards and upwards. The contraction was held for 10 seconds and then relaxed. This exercise was done for 10 times daily for 10 days.
- \* The subjects were made to lie in quadrupod / 4-point kneeling position and were allowed to do the same contractions for 10 times daily for next 10 days.
- \* The subjects were made to sit on an exercise ball with both hands over the pelvis and were made to perform the same contractions and along with that, were made to extend their leg simultaneously. This exercise was performed for 10 times daily for the next 10 days<sup>23</sup>.

### **McKenzie Group**

In this group, the subjects were taught postural correction and re-education. This includes:-

### **Correction of the sitting posture**

The subjects were explained that as a person sits, his spine sooner or later takes a relaxed posture and the lumbar spine moves into a fully flexed position that places stress over the various

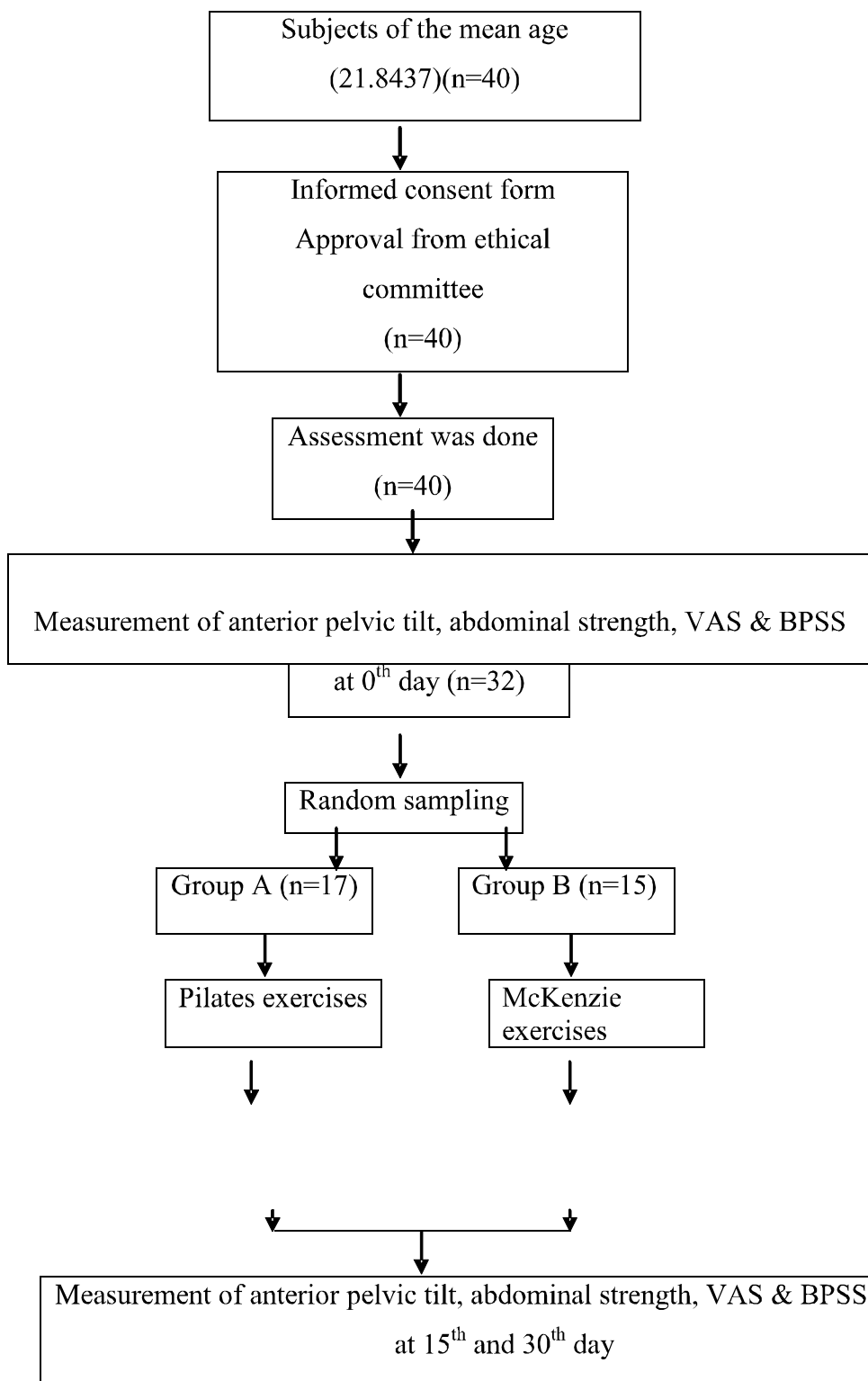
ligamentous structures. This position is painful if maintained for longer period.

The subjects were taught how to obtain and maintain the sitting posture for longer periods.

1. To obtain the correct sitting posture- This includes 'slouch-overcorrect' procedure.

The subjects were made to sit slouched on a backless chair or stool, allowing the lumbar

### Protocol





spine to rest on the ligaments in the fully flexed position and permit head and chin to protrude. Then, slowly moved into the erect sitting posture with the lordosis at its maximum and the head held directly over the spine with the chin pulled up. This sequence was repeated for 3 times daily, 15-20 times at each session.

Once they had mastered this procedure, they were advised to follow this procedure whenever they feel pain and maintain the position.

2. To maintain the correct sitting position- The subjects were taught about maintaining the lumbar lordosis by 2 ways-
  - Actively by conscious control of the lordosis, when sitting on a chair without back rest.
  - Passively by using the lumbar support, when sitting on a seat with a back rest. The lumbar roll was used to hold the lumbar spine in a good position while prolonged sitting. The roll was placed at or just above the belt line (area of L3 and L4 vertebrae).

This procedure was repeated for 3 times daily, 15-20 times at each session.

### **Correction of standing posture**

The subjects were made to stand and moving the lower part of the spine backwards by tightening the abdominal muscles and tilting the pelvis posteriorly, while at the same time moving the upper spine forwards and raising the chest.

This procedure was repeated for 3 times daily, 15-20 times at each session.

### **Outcome measures**

For both the groups the assessment of standing pelvic tilt angle, Core muscle strength, VAS, Back performance scale score was done initially before starting the treatment .i.e. 0 day, 15<sup>th</sup> day and 30<sup>th</sup> day. The final measurement was taken following the 30<sup>th</sup> day treatment protocol.

### **Reliability**

#### **Standard pelvic tilt angle**

1. The palpation of ASIS and PSIS was given by Derek Field (1997) in "Anatomy: palpation and surface markings".<sup>11</sup>
2. The procedure of markings of bony

landmarks and measurement of standing pelvic tilt angle by pelvic inclinometer was used by-

- Freburger. JK & Riddle. DL (1999) in their study "Measurement of sacro-iliac joint dysfunction: a multitester intertester reliability study".<sup>12</sup>
- Walker. ML et al (1987) in their study "Relationship between lumbar lordosis, pelvic tilt and abdominal muscle performance".<sup>18</sup>

### **Core strength**

1. The measurement of core strength by using sphygmomanometer was given by Lance T Twomey & James R Taylor (1994) in "Physical Therapy of low back".<sup>16</sup>

### **Back performance scale score**

1. This outcome scale was given by Mirjam Myklebust et al (2004) in "Back performance scale scores in people without back pain: Normative data".<sup>19</sup>
2. The reliability of back performance scale score was given by Magnussen L, Strand LI, Lygren H (2004) in "Reliability and validity of the back performance scale: Observing activity limitation in patients with back pain".<sup>20</sup>

### **Visual analogue scale (VAS)**

1. The validity of scale was given by Price D, McGrath P, Rafii A, Buckingham B (1983) in "The validation of visual analogue scales as ratio scale measures for chronic and experimental pain".<sup>30</sup>
2. The quantitative measure of pain was given by Zusman M (1986) in "The absolute visual analogue scale (AVAS) as a measure of pain intensity".<sup>31</sup>

### **Instrumental reliability**

#### **Reliability of digital inclinometer**

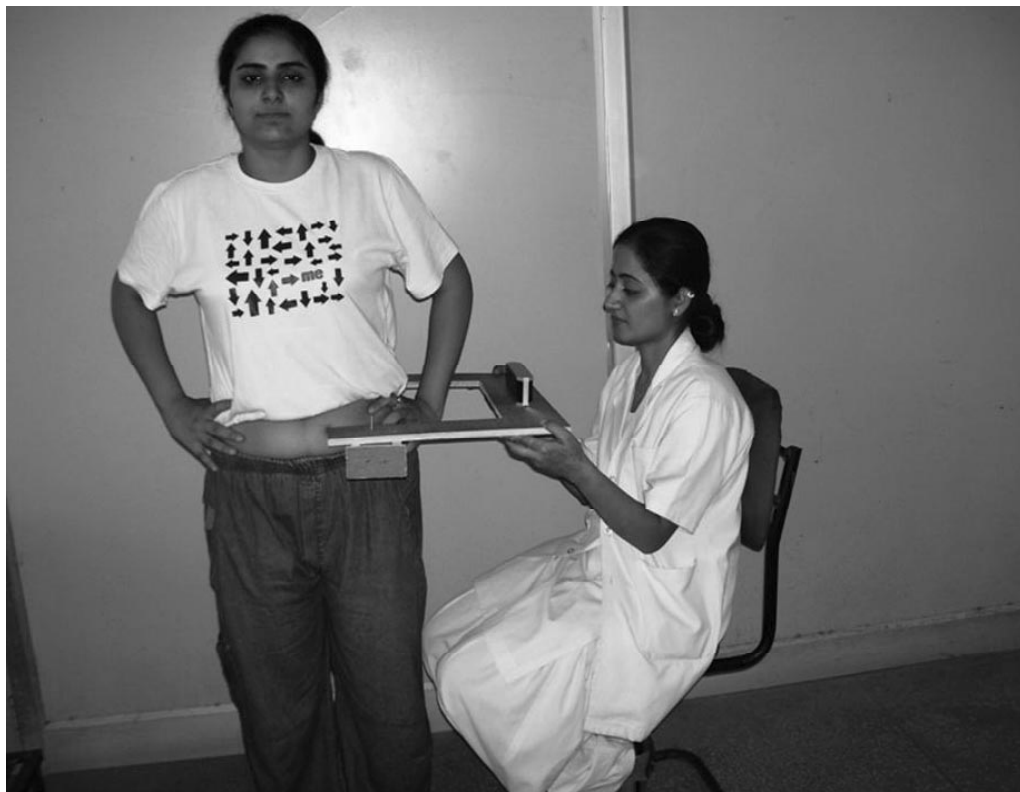
The standard pelvic tilt was calculated by using hand held digital inclinometer from Chattanooga group, Inc. with ISO 9001 certification.

#### **Reliability of sphygmomanometer**

Prolix sphygmomanometer, IS: 3390, CM/L-8262373.



Measurement of core strength



Measurement of standing pelvic tilt angle



Pilates exercise on a swiss ball- starting position



Pilates exercise on a swiss ball- alternate leg raise



Pilates exercise in quadrupod position

### Data Analysis

The data were analyzed using statistical tests, which were performed using SPSS 10.0 software package.

- Paired t-test was used to analyse the dependent variable .i.e. standing pelvic tilt angle, core strength, back performance scale score and VAS for within the group A and B.
- Unpaired t-test was used for analyzing the dependent variable .i.e. standing pelvic tilt angle, core strength, back performance scale score and VAS for between the group A and B. A 0.05 level of significance was used for all comparisons.

### Results

Group A included 17 subjects with the mean age of 22.05 and Group B included 15 subjects with the mean age of 21.6.

#### Standing pelvic tilt angle (SPTA)

#### Between the groups

The analysis between Pilates group and McKenzie group were done using unpaired t-test for 0 day, 15<sup>th</sup> day and 30<sup>th</sup> day. The result showed no significant differences between the groups. (p>0.05).

**Table-1**

Comparison of mean standing pelvic tilt angle at 0 day, 15<sup>th</sup> day and 30<sup>th</sup> day between Pilates group and McKenzie group.

GROUP	N	0-15 day	15-30 day	0- 30 day
PILATES	17	0.882± 0.485	0.823± 0.727	1.822± 0.927
MCKENZIE	15	0.666± 0.617	0.933± 0.883	1.600± 0.736
t-value		1.106	0.385	0.944
Significance	NS	0.278	0.703	0.352

S= Significant ( $P \leq 0.05$ )  
 NS= Not significant ( $P \geq 0.05$ )

The result showed no significant differences between the groups. ( $p \geq 0.05$ )

**Core strength**  
**Between the groups**

The analysis between Pilates group and

McKenzie group was done using unpaired t-test for 0 day, 15<sup>th</sup> day and 30<sup>th</sup> day. The result showed significant differences in Pilates group as compared to McKenzie group ( $p < 0.05$ )

**Table-2**

Comparison of mean core strength at 0 day, 15<sup>th</sup> day and 30<sup>th</sup> day between Pilates group and McKenzie group.

GROUP	N	0-15 day	15-30 day	0-30 day
PILATES	17	3.529±1.662	3.705±1.686	7.294± 2.257
MCKENZIE	15	0.333±0.487	0.533±0.516	0.866±0.743
t-value		7.165	6.989	10.519
Significance	S	0.000	0.000	0.000

S=Significant ( $P \leq 0.05$ )  
 NS=Not significant ( $P \geq 0.05$ )

The result showed significant differences in Pilates group as compared to McKenzie group ( $p \leq 0.05$ ).

**Back performance scale score**  
**Between the groups**

The analysis between Pilates group and

McKenzie group was done using unpaired t-test for 0 day, 15<sup>th</sup> day and 30<sup>th</sup> day. The result showed no significant differences between the groups. ( $p > 0.05$ )

**Table-3**

Comparison of mean back performance scale score at 0 day, 15<sup>th</sup> day and 30<sup>th</sup> day between group A and group B.

GROUP	N	0-15 day	15-30 day	0-30 day
PILATES	17	0.882± 0.600	0.941± 0.658	1.941± 0.555
MCKENZIE	15	0.866± 0.639	0.666± 0.487	1.533± 0.639
t-value		0.072	1.324	1.930
Significance	NS	0.943	0.195	0.063

S= Significant ( $P \leq 0.05$ )  
 NS= Not significant ( $P \geq 0.05$ )

The result showed no significant differences between the groups. ( $p \leq 0.05$ )

**VAS**  
**Between the groups**

The analysis between Pilates group and McKenzie group was done using unpaired t-

test for 0 day, 15<sup>th</sup> day and 30<sup>th</sup> day. The result showed significant differences in Pilates group as compared to McKenzie group ( $p \leq 0.05$ )

**Table-4**

Comparison of mean VAS at 0 day, 15<sup>th</sup> day and 30<sup>th</sup> day between Pilates group and McKenzie group.

GROUP	N	0- 15 day	15-30 day	0-30 day
PILATES	17	1.352± 0.606	2.000± 0.707	3.352± 0.931
MCKENZIE	15	0.533±0.516	1.466± 0.990	2.000± 1.000
t-value		4.087	1.769	3.962
Significance	S	0.000	0.087	0.000

S=Significant ( $P \leq 0.05$ )a

NS=Not significant ( $P \geq 0.05$ )

The result showed significant differences in Pilates group as compared to McKenzie group ( $p \leq 0.05$ ).

**Standing pelvic tilt angle (SPTA)**

**Within the group**

Group A: The analysis within Pilates group

was done using paired t-test for 0 vs 15<sup>th</sup> day, 15<sup>th</sup> vs 30<sup>th</sup> day and 0 vs 30<sup>th</sup> day. The results revealed no significant improvement over time within Pilates group. 'p' value was found not significant ( $p \geq 0.05$ ).

**Table-5**

Comparison of the mean standing pelvic tilt angle at 0-15 day, 15-30 day and 0-30 day within the Pilates group.

SESSIONS	N	Mean± SD	t- value	SIGNIFICANCE
O-15 DAY	17	0.882± 0.485	0.251	0.805
15-30 DAY	17	0.823± 0.727		
15-30 DAY	17	0.823± 0.727	4.123	0.001
0-30 DAY	17	1.882± 0.927		
0-30 DAY	17	1.882± 0.927	7.856	0.000
0-15 DAY	17	0.882± 0.485		

S= Significant ( $P \leq 0.05$ )

NS= Not significant ( $P \geq 0.05$ )

The results revealed no significant improvement over time within Pilates group.

Group B: The analysis within McKenzie group was done using paired t-test for 0 vs 15<sup>th</sup> day, 15<sup>th</sup> vs 30<sup>th</sup> day and 0 vs 30<sup>th</sup> day. The results

revealed little significant improvement over time within McKenzie group. 'p' value was found not significant ( $p \geq 0.05$ ).

**Table- 6**

Comparison of the mean standing pelvic tilt angle at 0-15 day, 15-30 day and 0-30 day within the McKenzie group.

SESSIONS	N	Mean± SD	t-value	SIGNIFICANCE
O – 15 DAY	15	0.666± 0.617	0.774	0.452
15-30 DAY	15	0.933± 0.883		
15-30 DAY	15	0.933± 0.883	4.183	0.001
0-30 DAY	15	1.60± 0.736		
0-30 DAY	15	1.60± 0.736	4.090	0.001
0-15 DAY	15	0.666± 0.617		

S=Significant ( $P \leq 0.05$ )

NS=Not significant ( $P \geq 0.05$ )

The results revealed little significant improvement over time within McKenzie group.

### Core strength

#### Within the group

Group A: The analysis within Pilates group was done using paired t-test for 0 vs 15<sup>th</sup> day, 15<sup>th</sup> vs 30<sup>th</sup> day and 0 vs 30<sup>th</sup> day. More effect

was seen between 15<sup>th</sup> – 30<sup>th</sup> day as compared to 0- 15<sup>th</sup> day, therefore improved strength was seen in 0-30<sup>th</sup> day. The results revealed significant improvement over time within Pilates group. 'p' value was found to be significant ( $p \leq 0.05$ ).

#### Table- 7

Comparison of the core strength at 0-15 day, 15-30 day and 0-30 day within the Pilates group.

SESSIONS	N	Mean± SD	t-value	SIGNIFICANCE
O – 15 DAY	15	0.666± 0.617	0.774	0.452
15-30 DAY	15	0.933± 0.883		
15-30 DAY	15	0.933± 0.883	4.183	0.001
0-30 DAY	15	1.60± 0.736		
0-30 DAY	15	1.60± 0.736	4.090	0.001
0-15 DAY	15	0.666± 0.617		

S=Significant ( $P \leq 0.05$ )

NS=Not significant ( $P \geq 0.05$ )

The results revealed significant improvement over time within Pilates group. 'p' value was found to be significant ( $p \leq 0.05$ ).

Group B: The analysis within McKenzie group was done using paired t-test for 0 vs 15<sup>th</sup> day, 15<sup>th</sup> vs 30<sup>th</sup> day and 0 vs 30<sup>th</sup> day. The results

revealed no significant improvement over time within McKenzie group. 'p' value was found not significant ( $p \geq 0.05$ ).

#### Table- 8

Comparison of the core strength at 0-15 day, 15-30 day and 0-30 day within the McKenzie group.

SESSIONS	N	Mean± SD	t- value	SIGNIFICANCE
O – 15 DAY	15	0.333± 0.487	1.146	0.271
15-30 DAY	15	0.533± 0.516		
15-30 DAY	15	0.533± 0.516	2.646	0.019
0-30 DAY	15	0.866± 0.743		
0-30 DAY	15	0.866± 0.743	4.000	0.001
0-15 DAY	15	0.333± 0.487		

S=Significant ( $P \leq 0.05$ )

NS=Not significant ( $P \geq 0.05$ )

The results revealed no significant improvement over time within McKenzie group. 'p' value was found not significant ( $p \geq 0.05$ ).

#### Back performance scale score

##### Within the group

Group A: The analysis within Pilates group

was done using paired t-test for 0 vs 15<sup>th</sup> day, 15<sup>th</sup> vs 30<sup>th</sup> day and 0 vs 30<sup>th</sup> day. The results revealed no significant improvement over time within Pilates group. 'p' value was found not significant ( $p \geq 0.05$ ).

**Table- 9**

Comparison of the back performance scale score at 0-15 day, 15-30 day and 0-30 day within the Pilates group.

SESSIONS	N	Mean± SD	T value	SIGNIFICANCE
O – 15 DAY	17	0.882± 0.600	0.212	0.835
15-30 DAY	17	0.941± 0.658		
15-30 DAY	17	0.941± 0.658	5.215	0.000
0-30 DAY	17	1.941± 0.555		
0-30 DAY	17	1.941± 0.555	6.628	0.000
0-15 DAY	17	0.882± 0.600		

S=Significant ( $P \leq 0.05$ )

NS=Not significant ( $P \geq 0.05$ )

The results revealed no significant improvement over time within Pilates group. 'p' value was found not significant ( $p \geq 0.05$ ).

Group B: The analysis within McKenzie group was done using paired t-test for 0 vs 15<sup>th</sup> day,

15<sup>th</sup> vs 30<sup>th</sup> day and 0 vs 30<sup>th</sup> day. The results revealed no significant improvement over time within McKenzie group. 'p' value was found not significant ( $p \geq 0.05$ ).

**Table-10**

Comparison of the back performance scale score at 0-15 day, 15-30 day and 0-30 day within the McKenzie group.



SESSIONS	N	Mean± SD	T value	SIGNIFICANCE
O – 15 DAY	15	0.866± 0.639	0.823	0.424
15-30 DAY	15	0.666± 0.487		
15-30 DAY	15	0.666± 0.487	5.245	0.000
0-30 DAY	15	1.533± 0.639		
0-30 DAY	15	0.666± 0.487	5.292	0.000
0-15 DAY	15	0.866± 0.639		

S=Significant ( $P \leq 0.05$ )

NS=Not significant ( $P \geq 0.05$ )

The results revealed no significant improvement over time within McKenzie group. 'p' value was found not significant ( $p \geq 0.05$ ).

### VAS

#### Within the group

Group A: The analysis within Pilates group was done using paired t-test for 0 vs 15<sup>th</sup> day,

15<sup>th</sup> vs 30<sup>th</sup> day and 0 vs 30<sup>th</sup> day. More improvement was seen in 0-15 day as compared to 15-30 day, therefore more improvement was seen on 0-30 day. The results revealed significant improvement over time within Pilates group. 'p' value was found to be significant ( $p \leq 0.05$ ).

**Table-11**

Comparison of the VAS at 0-15 day, 15-30 day and 0- 30 day within the Pilates group.

SESSIONS	N	Mean± SD	T value	SIGNIFICANCE
O – 15 DAY	17	1.352± 0.606	2.864	0.011
15-30 DAY	17	2.000± 0.707		
15-30 DAY	17	2.000± 0.707	9.200	0.000
0-30 DAY	17	3.352± 0.931		
0-30 DAY	17	3.352± 0.931	11.662	0.000
0-15 DAY	17	1.352± 0.606		

S= Significant ( $P \leq 0.05$ )

NS= Not significant( $P \geq 0.05$ )

The results revealed significant improvement over time within Pilates group. 'p' value was found to be significant ( $p \leq 0.05$ ).

Group B: The analysis within McKenzie group was done using paired t-test for 0 vs 15<sup>th</sup> day,

15<sup>th</sup> vs 30<sup>th</sup> day and 0 vs 30<sup>th</sup> day. The results revealed no significant improvement over time within McKenzie group. 'p' value was found not significant ( $p \geq 0.05$ ).

**Table-12**

Comparison of the VAS at 0-15 day, 15-30 day and 0- 30 day within the McKenzie group.

SESSIONS	N	Mean± SD	T value	SIGNIFICANCE
O – 15 DAY	15	0.533± 0.516	2.956	0.010
15-30 DAY	15	1.466± 0.990		
15-30 DAY	15	1.466± 0.990	4.000	0.001
0-30 DAY	15	2.000± 1.000		
0-30 DAY	15	0.533± 0.516	5.735	0.000
0-15 DAY	15	2.000± 1.000		

S=Significant ( $P \leq 0.05$ )

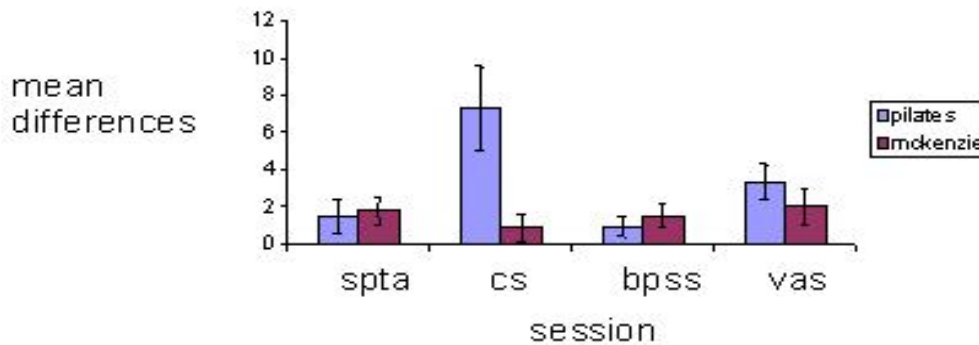
NS=Not significant ( $P \geq 0.05$ )

The results revealed no significant improvement over time within McKenzie group.

'p' value was found not significant ( $p \geq 0.05$ ).

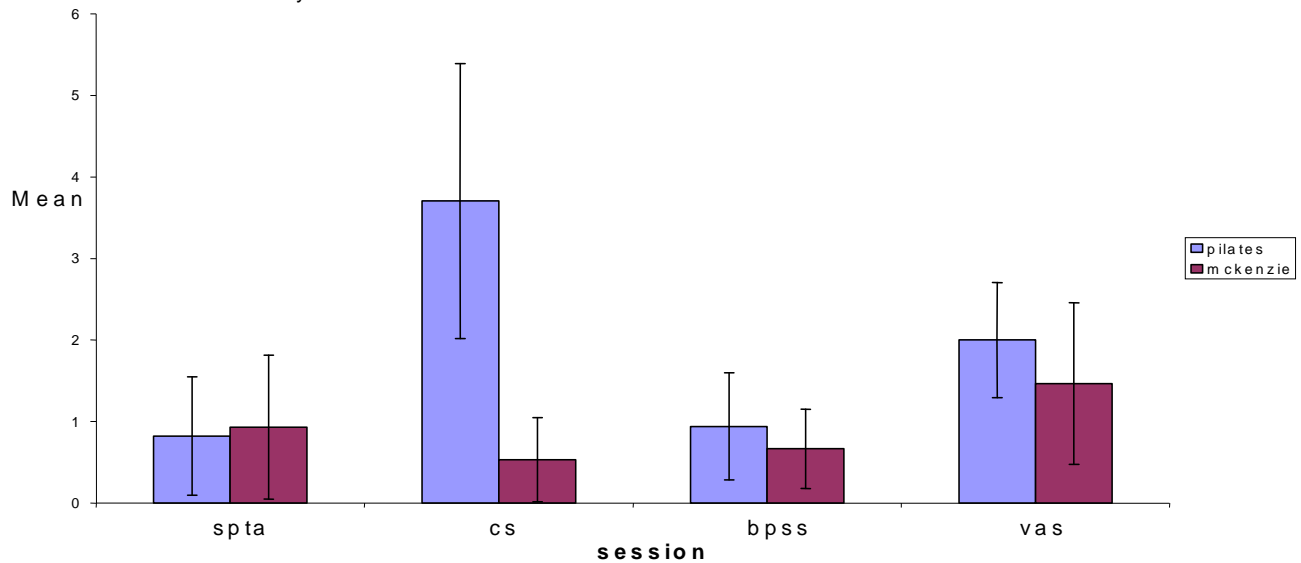
The analysis therefore revealed that Pilates regime influenced core strength and VAS as compared to standing pelvic tilt angle and BPSS during the study period.

comparison of mean differences of variables between pilates and mckenzie in 0-30 days



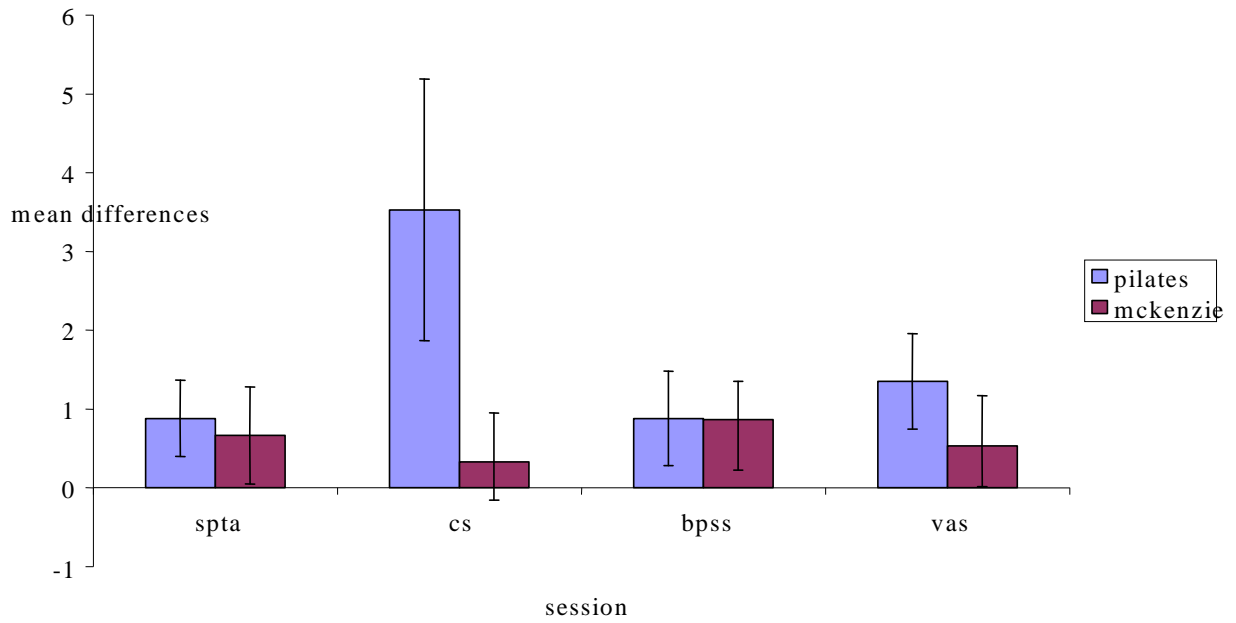
**Graph 1- Mean (SD) of variables between Pilates and Mckenzie in 0-30 days**

comparison of mean differences of variables between pilates and mckenzie in 15-30 days



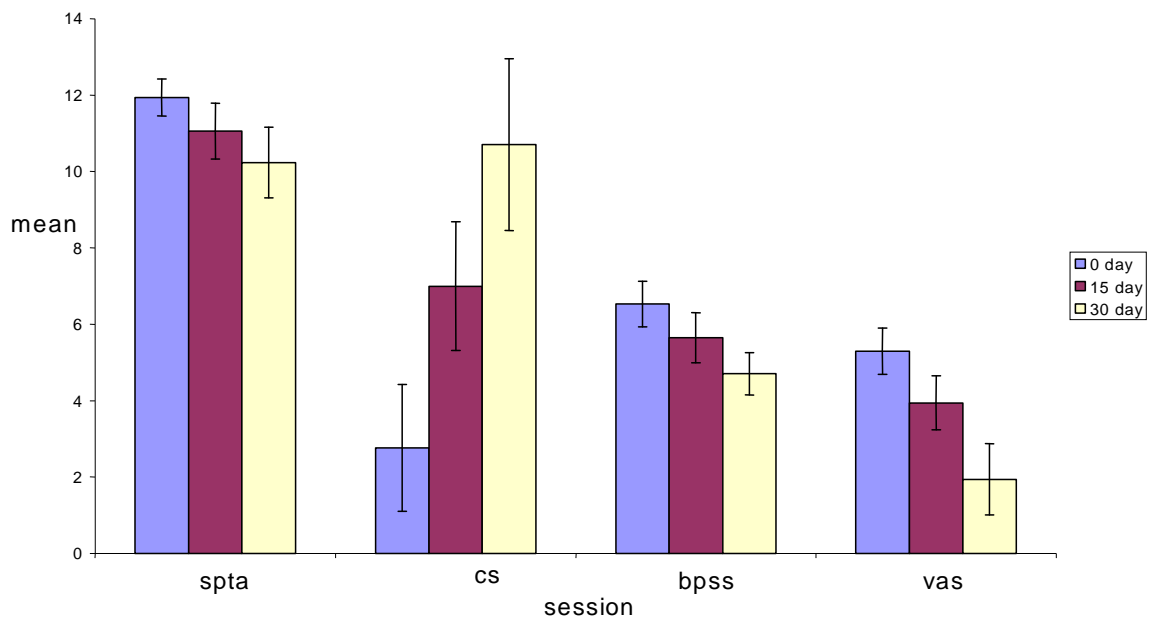
**Graph 2- Mean (SD) of variables between Pilates and Mckenzie in 15-30 days**

comparison of mean differences of variables between pilates and mckenzie in 0-15 days

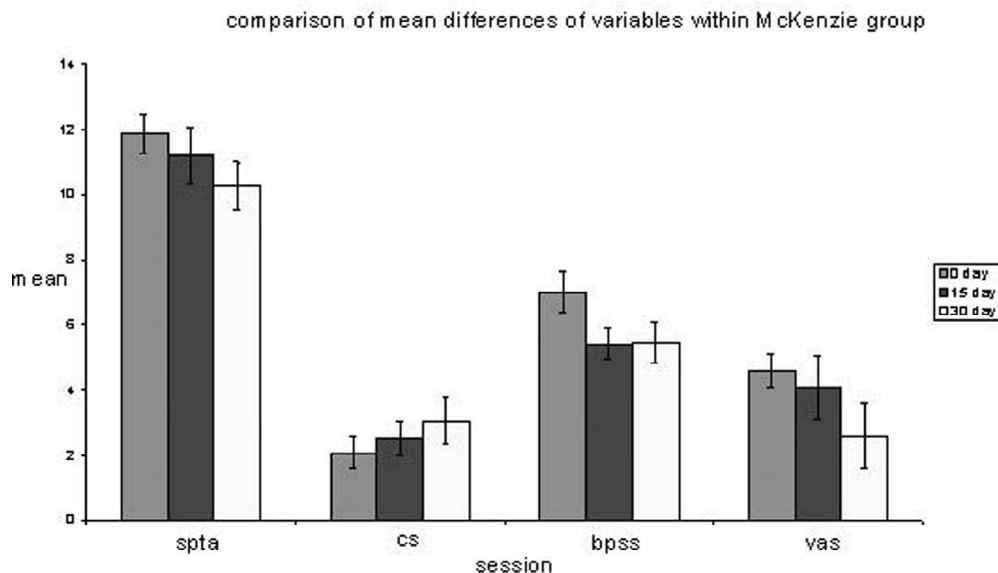


**Graph 3- Mean (SD) of variables between Pilates and McKenzie in 0-15 days**

comparison of mean differences of variables within pilates group



**Graph 4- Mean (SD) of variables within Pilates group**



**Graph 5- Mean (SD) of variables within McKenzie group**

**Discussion**

This was a prospective study which compares the effect of Pilates and McKenzie exercises in rehabilitation of postural low back pain. After the analysis of the data, it was found that there was a significant improvement in the values of Core strength and VAS in the Pilates (group-A) as compared to the McKenzie (group-B).

**Standing pelvic tilt angle**

The result of analysis of SPTA did not show any significant improvement between the groups A and B. In Pilates (group A) the analysis showed no significant improvement in 0- 15 days session (0.805), but in 15- 30 days session significant improvement was seen (0.001), therefore significant improvement was seen in 0- 30 days session (0.000). In McKenzie (group B) the analysis showed no significant improvement in 0-15 day session (0.452), but in 15- 30 days session significant improvement was seen (0.001), therefore significant improvement was seen in 0-30 days session (0.001).

So, the result revealed that there were significant improvement in both the groups A and B but no significant improvement within the groups.

Joseph E. Muscolino stated that Pilates exercises have their effect on pelvic posture, on

lengthening of spine and on the tone of abdomino-pelvic cavity<sup>40</sup>.

Nelson et al stated that motion promotes healing in the musculo-skeletal system and that lack of motion leads to stiffness, cartilage degeneration, and muscle atrophy. The healing benefits of motion for LBP may be accomplished by stretching shortened tissues such as muscles, tendons, and ligaments, increasing blood flow to the lumbar extensors, mobilizing stiff joints and mechanically affecting disc pathology. Therefore, reduces hyperlordosis and thus reduces anterior pelvic tilt.<sup>41, 42</sup>

The other technique to reduce anterior pelvic tilt can be myofascial release. This includes involvement of neuromotor and central nervous system. When a muscle on one side of a joint contracts, the muscles on the opposite side should be inhibited for passive lengthening. This leads to change in the tone of the muscle by the process known as reciprocal inhibition. When myofascial release technique is applied over the shortened muscles, the antagonist muscles are released from a long, weakened and inefficient position.<sup>45</sup>

**Core strength**

The result of analysis of core strength showed significant improvement between the groups A

and B (0.000). In Pilates (group A) the analysis showed no significant improvement in 0- 15 days session (0.775), but in 15- 30 days session significant improvement was seen (0.000), therefore improvement was seen in 0- 30 days session (0.000). In McKenzie (group B) the analysis showed no significant improvement in 0-15 day session (0.271), but in 15- 30 days session significant improvement was seen (0.019), therefore, significant improvement was seen in 0-30 days session (0.001).

So, the results revealed that there was slight improvement in both the groups but significant improvement was seen in group A as compared to group B.

This result of increase in core strength being more effective can be supported by the proposed mechanisms. The possible mechanism underlying in improvement of core strength and back pain is that Pilates encompasses core stabilization exercises that are not only static but also involves dynamic functional strengthening movements.<sup>24, 25, 26</sup>

In the early phase, there is recruitment of deep stabilizers (i.e. transversus abdominis, internal and external abdominal obliques, and multifidi muscles). The stabilizers consist largely of type I fibers and contracts at a submaximal level, which is less than 30% to 40% of a maximal voluntary contraction. This submaximal contraction happens simultaneously while disassociating the extremities or segments above or below the lesion. As the extremity disassociates from the trunk and the pelvis remains in neutral, the deep stabilizers work efficiently to maintain the control. This efficient use of the deep stabilizers controls pain and improves strength.<sup>27, 28, 29.</sup>

Cosio-Lima LM et al found that 5 weeks of Swiss ball core stability and balance exercises increased torso balance and EMG activity compared to conventional floor exercises in women<sup>32</sup>. Other studies have established that only some of the core muscles (i.e. the rectus abdominis) are activated to a greater extent during stability ball exercises.<sup>33</sup>

Several studies have shown that while stability ball exercises may improve core stability they are not necessarily any superior to conventional exercises.<sup>34, 35, 36</sup>

The strengthening of functional muscle groups (core muscles) leads to a more sophisticated neuromuscular system and improved lumbar spine support.<sup>37</sup>

The lumbar multifidus provides segmental stabilization to the spine, which is imperative in patients with lumbar spine instability. Researches shows that people with previous episodes of low back pain have delayed activation of the transversus abdominis and lumbar multifidus. So, by strengthening of the core muscles, the incidence of back pain can be reduced.<sup>38</sup>

Core muscle strengthening is the form of exercise that concentrates on the abdominal and lower back muscles. The advantage of this form of exercise is that it can reduce lower back pain and reduce back injury by allowing proper alignment of the spinal column.<sup>38</sup>

#### **Back performance scale score**

The result of analysis of BPSS showed no significant improvement between the groups A and B (0.943). In Pilates (group A), the analysis showed no significant improvement in 0- 15 days session (0.835), but in 15- 30 days session significant improvement was seen (0.000), therefore significant improvement was seen in 0- 30 days session (0.000). In McKenzie (group B) the analysis showed no significant improvement in 0-15 day session (0.424), but in 15- 30 days session slight significant improvement was seen (0.000), therefore significant improvement was seen in 0-30 days session (0.000).

So, the results revealed that there was significant improvement in both the groups but no significant improvement within the groups.

Cyrino et al. stated that suitable levels of muscular strength and flexibility are crucial for good musculo-skeletal performance, contributing for the preservation of healthy muscles and articulations during life, and that the decline of the flexibility levels gradually makes the performance of different daily tasks difficult, leading many times to early loss of autonomy.<sup>43</sup>

Jago R. et al stated that Pilates involves muscular exercises of low contraction impact,

intensely strengthening the abdominal muscles and therefore improves flexibility. <sup>44</sup>

### **VAS**

The result of analysis of VAS showed significant improvement between the groups A and B (0.000). In Pilates (group A) the analysis showed slight improvement in 0- 15 days session (0.011), in 15- 30 days session significant improvement was seen (0.000), therefore improvement was seen in 0- 30 days session (0.000). In McKenzie (group B) the analysis showed slight improvement in 0-15 day session (0.010), in 15- 30 days session significant improvement was seen (0.001), therefore significant improvement was seen in 0-30 days session (0.001).

So, the results revealed that there was significant improvement in both the groups but more improvement was seen in group A as compared to group B.

This result of improved VAS being more effective can be supported by various mechanisms.

Stability of the spine is provided by the integrated functioning of the active, passive and control subsystems (Panjabi, 1992). O'Sullivan et al. (1997) investigated the effect of 10 weeks of this training program on pain, disability scores and spinal range of motion. A group A completed a 10-week program beginning with contraction of the TrA and LM muscles, and progressing with increased contraction time and the application of a low load on the muscles by means of adding leverage through the limbs. A group B also underwent 10-weeks of physical activity which was directed by each patient's medical practitioner and consisted of general weekly exercises including swimming, walking and gym exercise. After training, the intervention group demonstrated a greater reduction in pain intensity, pain descriptor scores, Oswestry functional disability levels and improved hip flexion and extension ROM when compared to the control group. These differences were maintained at the 3, 6 and 30-month follow-up times. Decreased pain scores and increased ROM in patients with stability dysfunction are valid outcome measures of treatment efficacy and in the context of the

study by O'Sullivan et al (1997), are interpreted as improvements in LPS (Liebenson, 1998). While these measures may assess overall treatment efficacy, they do not provide a direct measurement of the effect on LPS itself.

### **Limitation of study**

- Larger sample size could have brought in more clarity in observed trends.
- A difficulty in the palpation of the bony landmarks could have caused some bias.
- Heterogenous group could have made the study more clear.
- A difficulty in exact contraction of transversus abdominis muscle.
- VAS being a subjective evaluation, is not a reliable method to quantify pain, McGill questionnaire could have been used.
- Test of homogeneity was applied in the initial values of all variables and the result was found that SPTA and BPSS were not significant & VAS and core strength were significant.

### **Implication of study**

Low back pain is common affliction whose specific cause and precise treatment are still baffling to the medical professionals. Inability to pinpoint the proper structure at fault can result in array of problems. Thus, this study is an effort to ensure the proper rehabilitation of the postural low back pain.

### **Scope of future study**

- The study can be carried out in larger population.
- The study can be carried out for male population also.
- As the assessment was carried out only for postural low back pain, the future study could be done for the rehabilitation of other types of back pain also.
- The study can be carried out with the help of pressure biofeedback unit.

### **Conclusion**

32 subjects with reduced core strength, increased anterior pelvic tilt, increased VAS and increased back performance scale score were investigated to compare the effects of Pilates and

McKenzie exercises in rehabilitation of postural low back pain over a period of 30 days. The result showed significant improvement in core strength and VAS in both the groups as compared to SPTA and BPSS.

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