

Effectiveness of Gluteus Maximus Activation in Correcting Pelvic Tilt for People with Mechanical Low Back Pain

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Abstract

Background: Low back pain (LBP) is one of the most common conditions in industrialized modern societies. Low back pain is usually nonspecific or mechanical. People with LBP have previously been found to have poor endurance and delayed Gluteus Maximus muscle firing. Anterior pelvic tilt was also believed to cause pelvic girdle discomfort and generalized LBP.

Purpose: To evaluate the effectiveness of Gluteus Maximus Activation in correcting anterior pelvic tilt, reducing pain and improving the Functional Outcome among Mechanical Low back pain subjects.

Materials and Methods: About 250 participants were selected from Thiraviam Orthopaedic Hospital by using Kinovea software based on inclusion and exclusion criteria. They were divided into 2 groups, Experimental Group (n=125), Control Group (n=125). Both groups were given stretching exercises then Experimental group was given Gluteus Maximus activation exercise with IFT and Control group was given spinal stabilization exercise with IFT. Interventions were given 5 times a week for 6 weeks. Study period : October 2022 to July 2023.

Results: Pre-test and post-test values were analyzed and the result suggests that GM Activation Group has significant improvement when compared with Spinal stabilization Group with $P < 0.0001$.

Conclusion: According to this study, Gluteus Maximus activation exercises are more effective in correcting anterior pelvic tilt and reducing pain and improving functional outcome among Mechanical Low back pain subjects.

Key words: Mechanical Low Back Pain, Pelvic Tilt, Kinovea software, Roland Morris Disability Questionnaire, Spinal stabilization, Gluteus Maximus Activation.

Introduction

Currently, one of the most prevalent disorders in industrialized, modern society is Low back pain.¹ Mechanical or nonspecific LBP is more common.² An important global public health issue is non-specific LBP. According to reports 23% of people

will experience chronic LBP, leaving 11-12% of the population incapacitated.³

Anterior pelvic tilt was believed to be the cause of generalized LBP.⁴ Excessive anterior tilting of pelvic is not an isolated disorder.⁵ It was discovered that those with chronic LBP experience multifidus

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atrophy. Erector spinae, external oblique, rectus abdominis, and quadratus lumborum are important global muscles.⁶ Because many people spend a lot of time sitting down, GM frequently becomes weak.⁷ People with LBP have previously been found to have poor endurance and delayed GM muscle firing.⁶ Interferential current therapy is used for treating musculoskeletal pain.⁸ In order to evaluate pain, people frequently utilize the Numeric Pain Rating Scale.⁹ NPRS an 11-point scale, 0 represents no pain and 10 represents maximum discomfort.¹⁰ Kinovea is used to study human motion using goniometry. Angles were measured utilizing Kinovea.¹¹ In order to evaluate physical disability brought on by LBP, Roland Morris Disability Questionnaire was developed for primary care research.¹²

Aim

Aim of this study is to evaluate the effectiveness of Gluteus Maximus activation exercises in correcting anterior pelvic tilt, reducing pain and improving Functional Outcome among Mechanical Low back pain subjects.

Materials and Method

1. Step Stool
2. Dumbbell
3. Dowel Bar
4. IFT Apparatus
5. Pad Electrode, Gel
6. Micropore
7. Cotton

It was an experimental study conducted on 250 subjects with mechanical LBP, aged between 20-40 years. The subjects were taken from Orthopaedic Hospital. Convenient sampling with a random allocation method was used in the study.

Study period: October 2022 to July 2023.

Inclusion Criteria

8. Subjects of both genders
9. Age group: 20 – 40 years
10. NPRS score more than 5
11. Subjects with Mechanical LBP along with Anterior pelvic tilt.

Exclusion Criteria

1. Radiculopathy
2. Disc derangement
3. Pacemaker , Metal implants , Cancer
4. Spinal stenosis
5. Skin ulcer, infection
6. With hereditary disorders
7. Neoplasm
8. TB spine, referred pain
9. History of recent fracture of lower limb
10. History of recent surgery of spine and lower limb

Outcome Measure

Assessment was done before and after 6 weeks of study.

1. Kinovea Software¹¹
2. Numerical Pain Rating Scale¹⁰
3. Roland Morris Disability Questionnaire¹²

Procedure

About 250 participants with anterior pelvic tilt were screened by using Kinovea software based on inclusion and exclusion criteria. Written informed consent was collected and procedures were explained before commencement of the study. These 250 participants were allocated into 2 groups, GM Activation group (n = 125) and Spinal Stabilization group (n = 125). Both groups were given with Stretching exercise for 10 minutes, then Experimental group was given with Gluteus Maximus activation exercises and Control Group was given with Spinal stabilization exercises for 30 minutes. At the end of the session both groups were given IFT for 20 minutes. Intervention was given 5 times a week for a total duration of 6 weeks.

Kinovea Software, NPRS score and Roland Morris Disability Questionnaire were used to measure pelvic tilt, pain intensity and functional result. Pre-test results were evaluated prior to the start of the treatment, and they were reassessed 6 weeks later to determine post-test results.

Pelvic Tilt Measurement

ASIS and PSIS were palpated and marked then photo in lateral view was taken, using Kinovea

software, marks were connected with a straight line then a horizontal line was drawn through ASIS, the angle formed between the 2 lines was the degree of pelvic tilt. Normal range 0-23 degrees. Angles more than 23 were considered as anterior pelvic tilt, and were screened for this study.

IFT Protocol

IFT in 4 pole classic mode of carrier frequency of 4kHz, Base 90, Sweep 50 and Beat frequency 90-130 for 20 minutes duration was given to both the groups after each session. Intervention was given 5 times a week for a duration of 6 weeks.

Stretching Exercise

1. Double knee to chest
2. Single knee to chest
3. Hamstring muscle stretching
4. Piriformis muscle stretching
5. Tensor Fascia Lata stretching
6. Abdominal muscle stretching
7. Cat-Camel stretching
8. Quadratus Lumborum stretching
9. Quadriceps muscle stretching

Each of the above stretches were held for 15 seconds and performed for 15 reps and 1 set.

Gluteus Maximus Activation Group

Following exercises are given for the subjects of

Experimental group:

1. Band Hip Thrust
2. Step Up
3. Lateral Step Up
4. Cross Step Up
5. Inline Lunges
6. Traditional Lunges
7. Squats
8. Bulgarian Split Squats

1. Band Hip Thrust

Subjects were asked to take a resistance band, one end of resistance band was rapped on one foot and other end on other foot, band grabbed in U shape, asked to pull it down into the waist, knees

at 90 degree, then by sitting in couch drop down hitting middle of back to the couch, feet should be underneath the knees, then thrust and straight up. (15 reps x 3 sets)

2. Step Up

Subjects were asked to stand in front of the step stool, one leg kept on stool; hip, knee and ankle placed at 90 degrees, trunk in neutral and then step up, stay for 1 second and then step down. Repeated for other leg. (15 reps x 3 sets)

3. Lateral Step Up

Subjects were asked to stand beside the step stool, leg next to stool was placed on the stool so that hip, knee and ankle were at 90 degrees, trunk in neutral position, then step up stay for 1 second, then step down. Repeated for other leg. (15 reps x 3 sets).

4. Crossover Step Up

Subjects were asked to stand beside the step stool, foot which is away from the stool is crossed over and placed on the stool, then asked to drag themselves up and land on the other side. Repeated for other leg (15 reps x 3 sets)

5. Inline Lunges

Subjects were asked to hold Dowel bar along the center of the spine at the back, it touches back of head, upper back and the middle of butt, upright posture was maintained then asked to stand on a straight line, one foot front and the other at the back with some distance, descent to the lunge position right knee touches the center of the line, return to starting position. Repeated for other leg. (15 reps x 3 sets)

6. Traditional Lunges

Subject's hands were placed on their waist or could have dumbbells on both hands then asked to step forward with one leg, bend both knees to 90 degrees, thigh placed parallel to ground, other thigh stretched back and knees behind the heel, trunk straight then come back to neutral position. Repeated for other leg. (15 reps x 3 sets)

7. Squats

Subjects were asked to stand with foot to their shoulder width apart, arms lifted in front and trunk

should be straight then asked to push their hips back like sitting in an imaginary chair, thigh parallel to ground and knee in line with toes, go down and come up. (15 reps x 3 sets)

8. Bulgarian Split Squats

Subjects were asked to stand before the low couch so that the couch should be behind the subject, front foot on ground, rear foot on couch, hands on waist, asked to bring themselves down like lunges, knee should not pass the toes and then come up. (15 reps x 3 sets).

Spinal Stabilization Group

Following exercises are given for the subjects of control group:

1. Crunches
2. Dead Bug
3. Side Plank
4. Prone Cobra
5. Bird Dog
6. Bridges
7. Planks

1. Crunches

Subjects in supine and knees bent, foot together and flat on the ground, hand lased and placed behind the head, abs engaged and head and the shoulder were lifted off the floor, hold the position for 2 counts then slowly loosen the back down to ground. (15 reps x 3 sets)

2. Dead Bug

Subjects in supine with hands extended towards ceiling perpendicular to ground. Hip, knee and ankle placed at 90 degree, then asked to lower one leg down to the ground and simultaneously lower opposite hand to ground. Repeated for other side. (15 reps x 3 sets)

3. Side Plank

Subjects in side lying, elbows placed under the shoulder elbow 90 degrees. Legs straight, then lift the hip away from ground, the hip should be straight, it should not be too high to low. Hold for 30 seconds, repeat for other side. This could also be done as side planks with leg raise. (3 reps)

4. Prone Cobra

Subjects in prone, arms at the side, face down on the floor. Simultaneously lift the head and chest

upward and turn the hands outward and lift the leg hold for 10 seconds, then ask to relax. (5 reps x 3 sets)

5. Bird Dog

Subjects were in quadruped position, spine in neutral position. Simultaneously extend one leg outward parallel to ground and then reach the opposite arm forward parallel to ground. Repeated for other side. (15 reps x 3 sets)

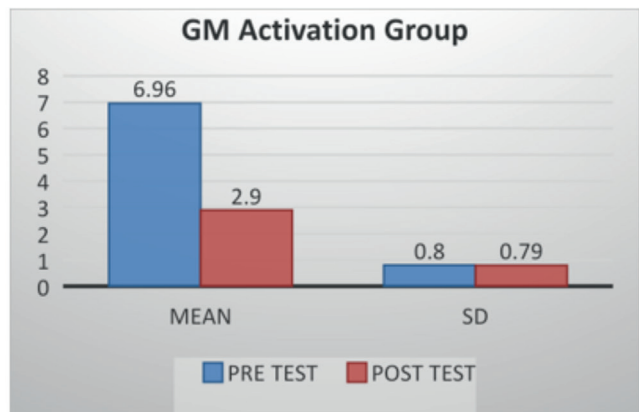
6. Bridges

Subjects in supine with knees bent, arms by the side, back lifted as they inhale and lower when exhaled. Also performed with single leg. (15 reps x 3 sets).

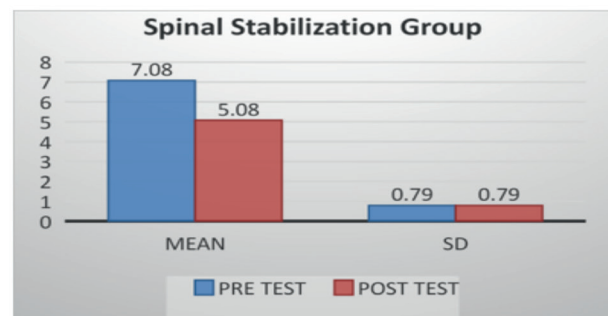
7. Planks

Subjects in prone, hands underneath the shoulders, curl the toes on the mat for grip then asked to press up to top of pushup, tighten glute and abdominals, then elbows bent drop to the forearm, then asked to keep the forearm parallel to each other and hold for 30 seconds. Could also be performed by lifting one leg. (3 reps)

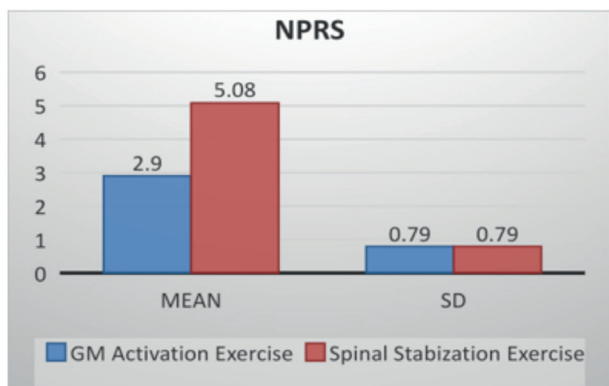
Data Analysis



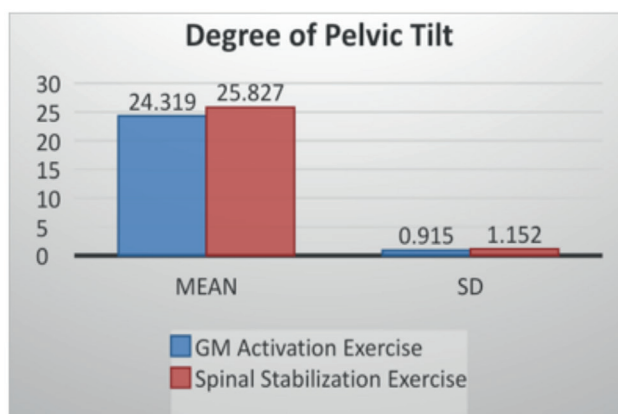
Graph - 1: Comparison between Pre-test and Post-test values of GM Activation Group - NPRS.



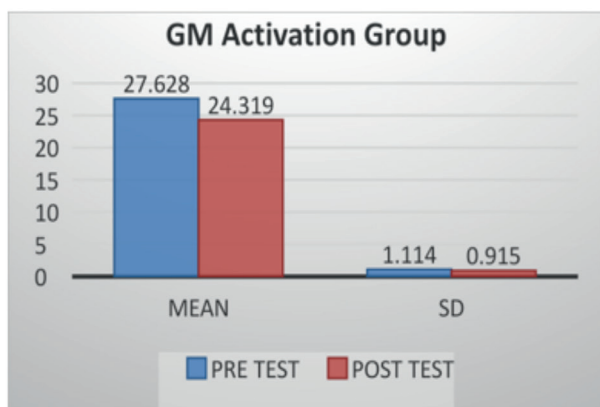
Graph - 2: Comparison between Pre-test and Post-test values of Spinal Stabilization Group - NPRS



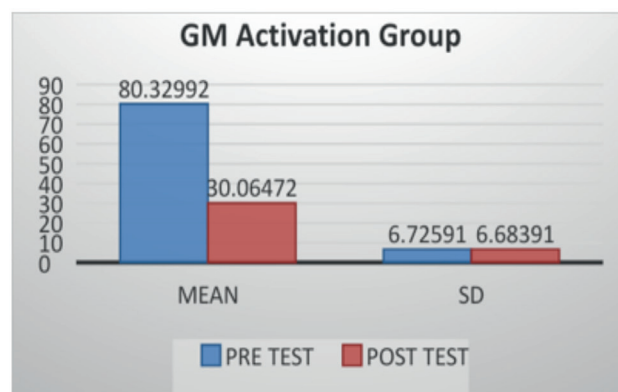
Graph - 3: Comparison between Post-test values of GM Activation Group and Spinal Stabilization Group - NPRS.



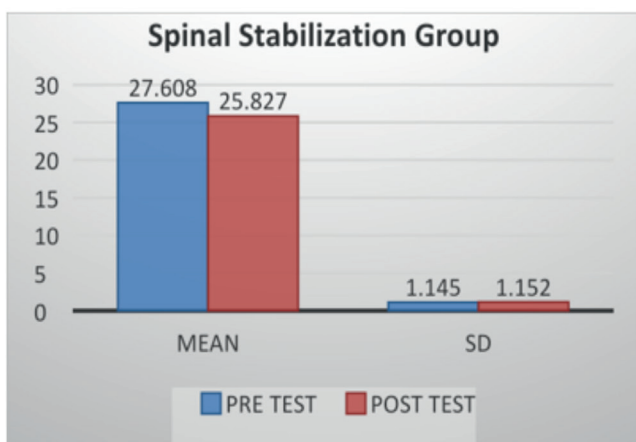
Graph - 6: Comparison between Post-test values of GM Activation Group and Spinal Stabilization Group - Degree of Pelvic Tilt



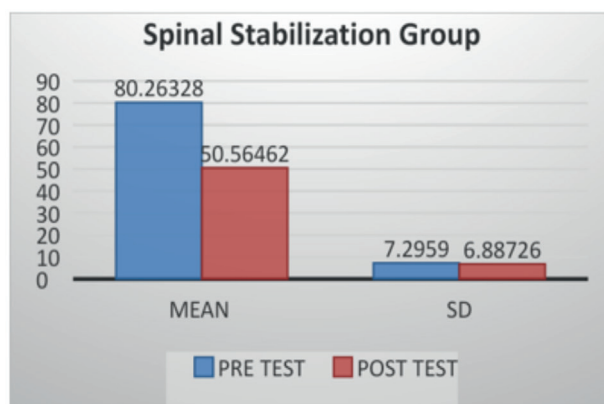
Graph - 4: Comparison between Pre-test and Post-test values of GM Activation Group - Degree of pelvic tilt



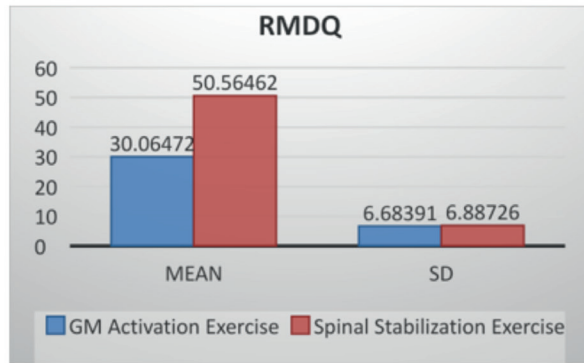
Graph - 7: Comparison between Pre-test and Post-test values of GM Activation Group - RMDQ



Graph - 5: Comparison between Pre-test and Post-test values of Spinal Stabilization Group - Degree of Pelvic Tilt.



Graph - 8: Comparison between Pre-test and Post-test values of Spinal Stabilization Group - RMDQ



Graph - 9: Comparison between Post-test values of GM Activation Group and Spinal Stabilization Group - RMDQ

Result

Statistical analysis of quantitative data showed statistically significant differences not only in the GM Activation group but also in the Spinal Stabilization group.

Graph - 1: In Experimental Group, NPRS Pre-test and Post-test mean values were $6.96(\pm 0.80)$ and $2.90(\pm 0.79)$, $t=128.5647$.

Graph - 2: In Control Group, NPRS Pre-test and Post-test mean values were $7.08(\pm 0.79)$ and $5.08(\pm 0.79)$, $t=124.4990$.

Graph - 3: In NPRS, Post-test mean values for Experimental and Control Group was $2.90 (\pm 0.79)$ and $5.08 (\pm 0.79)$, $t=21.8508$ and $P < 0.0001$

Graph - 4: In Experimental Group, Degree of Pelvic Pre-test and Post-test mean values were $27.628(\pm 1.114)$ and $24.319(\pm 0.915)$, $t = 29.7837$.

Graph - 5: In Control Group, Degree of pelvic tilt Pre-test and Post-test mean values were $27.608(\pm 1.145)$ and $25.827(\pm 1.152)$, $t = 12.4722$.

Graph - 6: In Degree of Pelvic Tilt, Post-test mean values for Experimental and Control Group was $24.319 (\pm 0.915)$ and $25.827 (\pm 1.152)$, $t = 11.4580$ and $P < 0.0001$.

Graph - 7: In Experimental Group, RMDQ Pre-test and Post-test mean values were $80.32992(\pm 6.72591)$ and $30.06472(\pm 6.68391)$, $t = 324.1635$.

Graph - 8: In Control Group, RMDQ Pre-test and Post-test mean values were $80.26328(\pm 7.29590)$ and $50.56462(\pm 6.88726)$, $t = 237.7014$.

Graph - 9: In RMDQ, Post-test mean values for Experimental and Control Group were $30.06472(\pm 6.68391)$ and $50.56462(\pm 6.88726)$, $t = 23.8812$ and $P < 0.0001$.

Both the groups are similar at the baseline $P > 0.05$. The results suggest that findings are considered to be statistically significant with P value < 0.0001 . Post-test mean values of NPRS, Degree of pelvic tilt and RMDQ in Experimental Group were less than Control Group thus GM Activation Group is considerably more effective than Spinal Stabilization Group among Mechanical Low back pain subjects.

Discussion

Purpose of this present study is to evaluate effectiveness of GM activation in correcting anterior pelvic tilt, reducing pain and improving Functional Outcome among Mechanical Low back pain subjects.

Finding of this current study revealed that Gluteus Maximus activation exercises are very effective in correcting anterior pelvic tilt among mechanical LBP subjects. These results are in agreement with previous research done by Kevin McCurdy et al. in which both flexion bias exercise and GM activation exercise were employed in maintaining the normal angle of pelvis¹³ The trunk exercise contributes a lot to the recovery of mechanical low back pain¹⁴. In an early study conducted by Preece SJ, Willan P et al., in the year 2008 Apr to determine the variations in the morphology of pelvis, in which he included 30 cadaver pelvis and each of the specimen was positioned in the anatomical position and angle between ASIS-PSIS is drawn and measured bilaterally and found that the range of value for ASIS-PSIS is 0-30 degrees¹⁵ and in our study the angle 0-30 degree was taken as normal range and the angle above this degree will be considered as anterior pelvic tilt.

Conclusion

According to this study, Gluteus Maximus activation exercises are more effective in correcting the anterior pelvic tilt, reducing pain and improving the functional outcome among Mechanical Low back pain subjects.

Ethical Clearance: Taken from the institutional ethical committee. ISRB number- 03/038/2022/ ISRB/SR/SCPT.

Funding: Self funding.

Conflict of Interest: Nil.

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