# **Original Research Article**

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20172020

# Comparison of active calf muscle stretching versus ankle mobilisation on low back pain and lumbar flexibility in pronated foot subjects

K. Vadivelan<sup>1</sup>\*, J. S. Poyyamozhi<sup>2</sup>, G. Dinesh Kumar<sup>3</sup>, C. Rajan Rushender<sup>3</sup>

Department of Physiotherapy, <sup>1</sup>SRM College of Physiotherapy, SRM Nagar, Potheri, Kattankulathur, Kancheepuram District, Tamil Nadu, India

Received: 10 April 2017 Accepted: 28 April 2017

# \*Correspondence:

Dr. K. Vadivelan,

E-mail: karulvela@gmail.com

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

#### **ABSTRACT**

**Background:** Low back pain is the common symptom of the lumbar region that more than 80 percent of people experience in their lifetime.

**Methods:** Quasi-experimental study was conducted with three intervention groups. Ankle mobilization (Group I), Active stretching of calf muscle (Group 2), No Intervention (Group 3). This study was carried out in the Department of Physiotherapy at SRM University, Chennai. 21 subjects were included in the study, with 7 subjects in each group. **Results:** Median age was found to be 20 (19–21), 19 (18–20) and 21 (20–22) in group 1, group 2 and group 3

respectively and no significant difference was seen between the groups, p value 0.11) There was a significant improvement seen in visual analogue scale, in both the intervention groups before and after intervention. The median and IQR for ankle mobilization group pre and post intervention was 6 (IQR, 5–6) and 4 (IQR, 3–5) respectively, with a p value <0.01.

**Conclusions:** Overall results have shown that both the intervention groups have similar effects in reducing lower back pain and improving lumbar flexion, compared to the control group.

Keywords: Calf muscle stretching, Ankle mobilisation, Back pain, Experimental study

#### INTRODUCTION

Low back pain is the common symptom of the lumbar region that more than 80 percent of people experience in their lifetime. Causes for low back pain are various, but generally the damage in the soft tissues of body trunk and the weakening of muscle strength are known to be the main cause. Other studies have reported that pronated foot function was associated with low back pain in women and this remained significant after adjusting for age, weight, smoking and depressive symptoms and have suggested that pronated foot function may contribute to low back symptoms.

It would be especially difficult to treat low back pain entirely if the essential corrections of pronated feet are not done as the foot and lumbar region are functionally connected through the kinetic chain of lower limbs and the possibility of the lower back pain will become recurrent and chronic.<sup>2,4,5</sup>

Pronation of the foot is a compound movement that combines abduction, eversion and dorsiflexion. An over pronated foot is one in which the heel bone, angles inward and the arch collapses, thereby tends to push off almost completely from the big toe and second toe. As a result, the shock from the foot's impact doesn't spread

<sup>&</sup>lt;sup>2</sup>Dhanalakshmi Srinivasan Medical College, Siruvachur, Perambalur, Tamil Nadu, India

<sup>&</sup>lt;sup>3</sup>SRM Medical college Hospital and Research Centre, SRM Nagar, Potheri, Kattankulathur, Kancheepuram District, Tamil Nadu, India

evenly throughout the foot and the ankle has trouble in stabilizing the rest of the body. Additionally, an unnatural angle forms between the foot and ankle, causing the achilles tendon to bow or angle in that same direction and the foot splays out abnormally.

Some studies have reported that, excessive hip lateral rotation and excessive foot pronation on the same side of the unilateral low back pain suggested a possible connection between low back symptoms, hip, and lower extremity dysfunction.<sup>6</sup>

Compensatory over-pronation may occur for anatomical reasons such as a tibia vara of 10 degrees or more, fore-foot varus, limb length discrepancy, ligamentous laxity, or because of muscular weakness or tightness in the gastrocnemius and soleus muscles.

Any number of structural deformities can cause medial deviation of the subtalar joint axis, in medial deviation, the subtalar joint axis is medially translated or internally rotated compared with the normal subtalar joint axis location. As a result, the pronation moments are increased and the supination moments are decreased by the action of ground-reactive force on the plantar structures of the foot and by the actions of ligamentous and muscular tension on the bones of the foot.

# Characteristics of pronated foot

- Talar head palpation-In a pronated foot, the talar head will be more palpable on the medial side.
- Supralateral and infralateral malleolar curvature-In a pronated foot, the curve below the malleolus will be more acute than the curve above due to the valgus orientation of the foot.
- In frontal flane- a pronated foot will demonstrate a more everted heel position, posteriorly.
- Prominence in the region of the talonavicular Joint-In a pronated foot, the talonavicular joint will be more prominent.
- Congruence of the medial longitudinal arch-A pronated foot will demonstrate a low arch with flattening in the central portion.
- Congruence of the lateral border of the foot-A pronated foot will exhibit a concave profile.
- Abduction/adduction of the forefoot on the rear footwhen viewed from directly behind, a pronated foot will result in more of the forefoot being visible on the lateral side due to forefoot abduction.

Comparison of active calf stretching versus ankle mobilisation on low back pain and lumbar flexibility in pronated foot subjects is done with true control group in this study.

#### **Objectives**

- To compare the efficacy of ankle mobilization and active calf muscle stretching with controls in reducing lower back pain in pronated subjects.
- To compare lumbar flexion among the three groups.

## **METHODS**

#### Study design

This was a Quasi-experimental study with three intervention groups

- 1. Ankle mobilization (Group 1)
- 2. Active stretching of calf muscle (Group 2)
- 3. No Intervention (Group 3)

#### Study setting

This study was carried out in the Department of Physiotherapy at SRM University, Kattankulathur. Chennai.

## Sample size

Total 21 subjects were included in the study, with 7 subjects in each group

# Sampling technique

All the study subjects were included in the study by convenient sampling

# Study duration

This study was carried out for a period of 2 weeks.

## Inclusion criteria

Inclusion criteria were subjects with more than 10 mm difference after navicular drop test, associated with complaints of low back ache, age between 17-25 years, both males and females.

# Exclusion criteria

Subjects with any recent history of: lower limb surgery, lumbar intervertebral disc prolapse, spinal stenosis, patients with neurological problems, patients with rheumatic conditions.

# Materials required

Chair, marker, chart paper, ruler, translucent, non-stretchable measuring tape, couch, pillow, hand towel.

After attaining approval for the study, each volunteer gave informed written consent prior to participation. Each group was assigned to participate in the 2-week study. Screening for the presence and extent of the pronated foot were confirmed by "Navicular Drop Test", of which the distance between navicular bone from the ground had to be dropped for more than 10 mm to be positive. With the subject sitting in a relaxed position, the most medial prominence of the navicular tuberosity was palpated and marked with an ink marking pen. A marker and chart paper was then used to mark the level of navicular bone and the height of the navicular tuberosity from the ground was measured with a ruler. The same was performed when the subject was standing relaxed in the weight bearing position. The difference in the navicular heights was then measured and those with lesser than 10 mm difference were deemed ineligible for the study. The measure of navicular drop has been used as an indicator of pronation at the foot. It is defined as the distance the navicular tuberosity moves in standing, as the subtalar joint is allowed to move from its neutral position to a relaxed position.8

# Trunk flexion test (TFT)

While the subject was made to stand in upright position, the examiner marks the location of C7 and then instructed to slowly bend forward the trunk. The distance between C7 and S1 is then measured.

## Trunk extension test (TET)

In prone lying, with hands held backward toes spread over 45 cm, the subjects were asked to bend their trunk backward, so that chin would be lifted as high as possible. The distance from the mat to chin was measured.

# Visual analogue scale (VAS)

VAS is used in measuring in order to grasp the criterion of pain. It is an index showing patient's subjective pain, and it is commonly used in measuring the strength of pain in study. By drawing the 10 cm line, left side would be the area of zero where pain does not exist, and right side would be the area where the strength of pain gets stronger. Grade is measured from zero to ten, and it was applied by measuring the marking point of patients into distance.<sup>9</sup>

# Group A: Ankle mobilization [n=7]

Subject position

The subject is in side-lying or prone, with the leg supported on the table.

#### Therapist position

At the side of the subject's leg end, with the shoulder and arm aligned parallel to the bottom of the foot.

The Talus is stabilized with the proximal hand and the base of the distal hand is placed on the sides of the calcaneus medially to cause a lateral glide and laterally to cause a medial glide

Grade III distraction force (to stretch joint structures and increase joint play) is applied in caudal direction, while the base of the hand is pushed against the side of the calcaneus parallel to the plantar surface of the heel.

After carrying out for 30 seconds, relax for the same amount of time.

Ten times would be one set, three sets in a day and three times a week for 2 weeks in total.

# Group B: Active calf muscle stretching of ankle [n=7]

Subjects in long sitting position will be performing active stretching of Calf muscles, under supervision.

Subjects will be instructed to dorsi-flex the ankle joint up to maximum motor range and maintain this posture for ten seconds continued with ten seconds of relaxation.

Performed ten times, three sets a day and three times in a week for 2 weeks in total.

It is based on the suggestion of DeLorme that the effective number of repetitive exercise is ten times. 10

# Group C: Control group [n=7]

Subjects will not receive any intervention during the study.

#### Statistical analysis

Visual Analogue Scale, Trunk Flexion Test, Trunk Extension Test and Oswestry Disability Index were our primary outcome variables and the three groups which were compared were the primary explanatory variables. Data was checked for normal distribution using normality plots and histogram, since the data was non normally distributed, Non parametric tests were used. The outcome variables were compared with the baseline parameters, before and after intervention Wilcoxon signed rank test was used to assess the median differences after intervention and the results were presented by median and interquartile range. P value <0.05 was considered statistically significant.

#### **RESULTS**

A total of 21 subjects were included in this study. The total study population was further divided into three

groups comprising 7 subjects each, based on the implemented interventions like ankle mobilization, active calf muscle stretching and control group.

Table 1: Comparison of baseline parameters among the three study groups.

Parameter	Group 1	Group 2	Group 3	Pvalue
Age	20 (19–21)	19 (18–20)	21 (20–22)	0.11
Gender				
Male	0(0%)	4(57.1%)	6(85.7%)	0.05
Female	7(100%)	3(42.9%)	1(14.3%)	0.03

Table 2: Comparison of improvement in VAS (visual analogue scale) among the three study groups.

Parameter	Group 1 median (IQR)	Group 2 median (IQR)	Group 3 median (IQR)
Pre intervention	6 (5 - 6)	6 (6 – 6)	5 (4 – 7)
Post intervention	4 (3 – 5)	4 (3 – 5)	4 (4 – 6)
P value	< 0.01	0.01	0.08

Table 3: Comparison of improvement in ODI (Oswestry disability index) among the three study groups.

Parameter	Group 1 median (IQR)	Group 2 median (IQR)	Group 3 median (IQR)
Pre intervention	22 (11-22)	8(6-11)	22 (13-26)
Post intervention	11 (8-15)	4 (4-9)	20 (13-24)
P value	0.09	0.04	0.08

Table 4: Comparison of improvement in TFT (trunk flexion test) among the three study groups.

Parameter	Group 1 median (IQR)	Group 2 median (IQR)	Group 3 median (IQR)
Pre intervention	46 (44 – 46)	45 (41 – 49)	50 (46 – 50)
Post intervention	48 (47 – 50)	48 (42 – 54)	50 (46 – 51)
P value	0.10	0.02	0.08

Table 5: Comparison of improvement in TET (trunk extension test) among the three study groups.

Parameter	Group 1 median (IQR)	Group 2 median (IQR)	Group 3 median (IQR)
Pre intervention	24 (19 – 26)	25 (22 – 28)	21 (19 – 26)
Post intervention	27 (20 – 31)	26 (24 34)	21 (20 – 25)
P value	0.04	0.02	0.56

Median age was found to be 20 (19–21), 19 (18–20) and 21 (20–22) in group 1, group 2 and group 3 respectively and no significant difference was seen between the groups, p value 0.11.

There was a significant improvement seen in visual analogue scale, in both the intervention groups before and after intervention. The median and IQR for ankle mobilization group pre and post intervention was 6 (IQR, 5–6) and 4 (IQR, 3–5) respectively, with a p value <0.01. The median and IQR for active calf stretch groups pre and post intervention was 6 (IQR, 6–6) and 4 (IQR, 3–5) respectively, with a p value 0.01.

Significant improvement in Oswestry Disability Index was seen post intervention in the group with active calf stretch intervention. The median and IQR for active calf

stretch groups pre and post intervention was 8 (IQR, 6–11) and 4 (IQR, 4–9) respectively, with a p value 0.04.

There was no significant difference observed in group with ankle mobilization and control group when assessed for Trunk Flexion Test, pre and post intervention. The median and IQR for the group with active calf stretch intervention, pre and post intervention were 45 (IQR, 41–49) and 48 (42–54) respectively, which showed a significant difference with a p value of 0.02.

The both intervention groups, ankle mobilization and active calf stretch showed significant improvement in Trunk extension test, post intervention with p values 0.04 and 0.02 respectively. There was no difference observed post intervention in the control group, (p value 0.56).

#### **DISCUSSION**

In this current study we have studied a total of 21 subjects divided in to three different groups with 7 subjects each. Interventions like ankle mobilization and active muscle stretching were implemented among two groups and the third was the control group.

No notable difference was observed between the groups, when assessed for baseline parameters like age and NDT.

Significant improvement was seen in the visual analogue score after the intervention in both the intervention groups. The median and IQR for ankle mobilization group pre and post intervention was 6 (IQR, 5–6) and 4 (IQR, 3–5) respectively, with a p value <0.01. The median and IQR for active calf stretch groups pre and post intervention was 6 (IQR, 6–6) and 4 (IQR, 3–5) respectively, with a p value 0.01.

Significant improvement in Oswestry disability index was seen post intervention in the group with active calf stretch intervention. The median and IQR for active calf stretch groups pre and post intervention was 8 (IQR, 6–11) and 4 (IQR, 4–9) respectively, with a p value 0.04.

The group with active calf muscle stretching had reported a significant improvement in the TFT scores, with their pre and post intervention, median and IQR values to be 45 (41–49) and 48 (42–54), with a p value of 0.02.

The both intervention groups, ankle mobilization and active calf stretch showed significant improvement in Trunk extension test, post intervention with p values 0.04 and 0.02 respectively. There was no difference observed post intervention in the control group, (p value 0.56).

Similar results were reported by Kuukkanen et al, where they have reported significant difference post treatment in parameters like TFT and TET in the intervention groups when compared to the control group. <sup>11</sup>

Among different methods that can be applied to pronated foot, active stretching was the most preferred as it could be performed independently by patient at home, which would increase the flexibility and reduce lower back pain. 12

Not much difference was observed between the two intervention groups in reducing lower back pain and improving the lumbar flexibility. Results from our study were similar to those obtained by Yoon et al, who have also stated that active stretching along with some mobilizing exercises would be a better therapy, in relieving lower back pain. <sup>13</sup>

#### CONCLUSION

- Improvement in Visual analogue score and Oswestry Disability Index was almost similar in both the intervention groups compared to the control group.
- Group 1 (ankle mobilization) showed better improvement than Group 2 (active calf stretching) in Trunk extension test, whereas in Trunk flexion test, Group 2 (active calf stretching) showed better improvement than group 1.
- Overall results have shown that both the intervention groups have similar effects in reducing lower back pain and improving lumbar flexion, compared to the control group.

#### Limitations

Due to the smaller sample size, amount of change in outcome variables could not be compared across the study groups.

#### **Recommendations**

Further studies, with higher sample size are recommended.

Funding: No funding sources Conflict of interest: None declared

Ethical approval: The study was approved by the

Institutional Ethics Committee

#### REFERENCES

- 1. Wheeler AH. Diagnosis and management of low back pain and sciatica. Am Family Phy. 1995;52(5):1333-41.
- Fordyce WE, Brockway JA, Bergman JA, Spengler D. Acute back pain: a control-group comparison of behavioral vs traditional management methods. J Behavioral Med. 1986;9(2):127-40.
- 3. Menz HB, Dufour AB, Riskowski JL, Hillstrom HJ, Hannan MT. Foot posture, foot function and low back pain: the Framingham Foot Study. Rheumatol (Oxford, England). 2013;52(12):2275-82.
- Brantingham JW, Lee Gilbert J, Shaik J, Globe G. Sagittal plane blockage of the foot, ankle and hallux and foot alignment-prevalence and association with low back pain. J Chiropractic Med. 2006;5(4):123-7.
- 5. Cailliet R. Low back pain syndrome: FA Davis Company; 1988.
- 6. Cibulka MT. Low back pain and its relation to the hip and foot. J Orthop Sports Phy Ther. 1999;29(10):595-601.
- 7. Clarey DC. The inter-relationship between Excessive Pronation of the foot and Chronic Spinal Complaints. Available at http://www.vasylimedical.

- com/pdf/VasyliMedical%20The%20Interrelationshi p%20between%20Excessive%20Pronation.pdf. Accessed on 20 December 2016.
- 8. Mueller M, Host J, Norton B. Navicular drop as a composite measure of excessive pronation. J Am Podiatr Med Association. 1993;83(4):198-202.
- 9. Scott J, Huskisson EC. Vertical or horizontal visual analogue scales. Ann Rheum Dis. 1979;38(6):560.
- 10. DeLorme TL, Schwab RS, Watkins AL. The response of the quadriceps femoris to progressive-resistance exercises in poliomyelitic patients. J Bone Joint Surg Am. 1948;30(4):834-47.
- 11. Kuukkanen T, Malkia E. Effects of a three-month therapeutic exercise programme on flexibility in subjects with low back pain. Physiotherapy research international. J Res Clin Phy Ther. 2000;5(1):46-61.

- 12. Kisner C, LA C. Therapeutic Exercise. Philadelphia: 2002
- 13. Yoon KS, Park SD. The effects of ankle mobilization and active stretching on the difference of weight-bearing distribution, low back pain and flexibility in pronated-foots subjects. J Exer Rehabil. 2013;9(2):292-7.

Cite this article as: Vadivelan K, Poyyamozhi JS, Kumar GD, Rushender CR. Comparison of active calf muscle stretching versus ankle mobilisation on low back pain and lumbar flexibility in pronated foot subjects. Int J Community Med Public Health 2017;4:1870-5.