Bone and Muscle

RESEARCH ARTICLE

Comparing Two Self-Hip Mobilizations on Range of Motion and Jump Height in Healthy Adults

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Abstract

Study Design: Randomized control, double blinded, exploratory trial

Purpose: The purpose of this study was to compare the effects of two hip self-mobilizations, posteroanterior (PASM) and lateral (LSM) on hip extension passive range of motion (PRoM) and vertical jump performance in healthy adults between the ages of 18-35.

Methods: Sixty participants consisted of 31 females and 29 males with an average age of 24.5 (3.73) years were randomized between PASM and LSM groups. Participant's pre and post-intervention hip extension PRoM was measured with a universal goniometer and jump height was measured with a Just Jump Mat system. All mobilizations were performed with the band (Rogue® monster bands) being secured to a steady surface, providing a lateral distraction for LSM and anterior distraction PASM force and 10 repetitions were performed on each leg. The force provided by the band was specific per participant based on their body weight.

Results: The mixed 2x2 ANOVA test (α=.025) and CI 95% showed that there was a significant difference between overall pre-PRoM (25.71°) and post-PRoM (28.59°) ($p<.05$). However, there was no significant difference between PASM and LSM interventions pre-post PRoM ($p>.05$). Additionally, no significant differences were found between PASM and LSM interventions from pre-post jump height ($p>.05$).

Conclusion: The results of this study offered preliminary evidence that PSM and LSM self-mobilizations using mobility bands with an adjusted distraction force may immediately improve hip extension PRoM in healthy adults with no known lower extremity pathology. However, PSM and LSM self-mobilizations don't have a direct effect on jump height since more factors such as strength, body composition, agility, etc. can affect the jumping performance.

Keywords: Self-mobilizations; Mobility bands; Hip range of motion; Rehabilitation; Jump height

Introduction

The femoroacetabular joint is a very stable structure that plays a key role in lower extremity mobility. The performance of activities such as ambulation; rising and lowering from a chair; ascending and descending stairs is very much dependent on the hip biomechanics operating effectively [1]. There are several barriers that may limited the hip joint from working properly such as muscular, articular and neural. Restricted hip mobility has been known to have detrimental effects on the hip, lumbar spine and other parts of the lower extremity (LE) [2]. Capsular restrictions, soft tissue restrictions and decreased motor control have all been shown to contribute to decreased hip mobility, muscle performance and secondary impairments such as pain [3]. These impairments can affect an individual's ability to perform fundamental functional motions such as squatting, jumping, pivoting and running.

Joint mobilization techniques have been widely used to increase hip mobility, decrease pain and improve force production at the hip joint [4]. While the exact analgesic and biomechanical effect that occur within the joint capsule are still under investigation, these techniques are still used to address capsular restrictions and altered joint kinematics. While the effectiveness of joint mobilization is very much dependent on the skill of the practitioner, self-mobilization techniques (SM) are not. Self-mobilizations with mobility bands has gained increased popularity among clinicians, athletes and gym goers over the last decade. Research by Short, Shorts, Strack, Anloague and Brewster [5], as well as Walsh and Kinsella [6] suggest that utilizing mobility bands to perform self-mobilizations with movement may be effective at improving hip mobility and function.

Mobilizations with movement (MWMs) has been used to treat various musculoskeletal dysfunctions, including dysfunctions that had previously been considered difficult to treat [7], suggested that MWMs improve range of motion by altering the activity of the mechanoreceptors at the treated joint.

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According to Baeske [8], MWMs normalizes abnormal afferent input from the mechanoreceptors of the joint being glided and causes an increase in strength. However, studies have shown that mobilizing normal tissues can cause a decrease in muscle output due to the strain on tissues and less activation at the site being glided [8]. Mechanoreceptors respond to specific directions and different load levels, which highlight the importance of a proper treatment plane, direction of force and amplitude of force. Although, physical therapists strive to provide a consistent force during manual mobilization, there is still variability.

Traditional mobilizations, such as the Maitland approach, address range of motion (RoM) and/or pain by using predetermined percentages of force at specific frequencies. Measurement of exact force applied through a joint can be very difficult and difference between clinicians may excise based off of experience and skill level. In an *in-vivo* study by Loubert, Zipple, Klobucher, Marquardt and Opolka [9] a minimum of 2.0 mm of posterior translation was observed at the femoroacetabular joint for normal hip flexion to occur. The results of this study demonstrated that a force equal to half of their body weight distracted the joint to its maximal capacity [9]. Since each mobility band has a specific pounds per force, in theory, this widely used gym tool can be used for self-mobilizations. This would be especially true if a force at least equal to an individual's weight was applied to the femoroacetabular joint according to the studies mentioned above. When calculated, these bands can produce a standard force, increasing reliability of the mobilization being performed.

There are limited research studies in the literature regarding the effects of self-mobilization techniques on hip RoM and jumping performance. Therefore, we aimed to determine the effect of a lateral hip self-mobilization (LSM) *vs.* posteroanterior (PASM) hip self-mobilizations using mobility bands with the adjusted distraction force on passive hip extension range of motion (RoM) and jump performance in healthy adults. We hypothesize that the posteroanterior (PASM) hip self-mobilizations with movement will be more effective than the lateral hip self-mobilizations (LSM) with movement in weight bearing in improving force production and range of motion in healthy adults.

Methods

Participants

Sixty healthy adults between the ages of 18 to 35 years old consisting of thirty-one females with mean age of 24.42 ± 3.38 years old and twenty-nine males with mean age of 24.28 ± 3.45 years old volunteered to participate the study. Participants were excluded if they had any hip, knee, ankle injuries within the past 6 months, any history of hip, knee, ankle surgeries, pain with squatting, latex allergy and any subject that weighed over 280 lbs. Each participant read and filled out a written informed consent describing the purpose of the study, the study procedures, possible risks or benefits and were provided the researcher's contact information prior data collection. Participants also completed a demographic sheet regarding their age, dominant leg, injury or surgery history and activity level. This exploratory randomized control trial was approved by the Dominican College Institutional Review Board (IRB# 2017-0306-03).

Procedures

After completion of the demographic information collection process, participants were weighed using the same electric scale on level ground throughout study to determine which mobility band they would use during the intervention. Each participant had a baseline goniometric reading of hip extension passive range of motion (PRoM) of dominant leg in degrees [10] and baseline jump height which was recorded using the Just Jump Mat (Figure 1), a reliable and valid instrument for measuring jump height (ICC= .92 (females), ICC= .84 (males) [11]. After performing the randomly assigned intervention each participant received a final goniometric reading of hip extension PRoM of their dominant leg and final jump performance reading. The same researcher performed and recorded goniometric measurements throughout the study and the same researcher performed and recorded the jump performance. The researcher read a prewritten dialogue that was used for each participant for jumping directions to ensure consistent jumping directions. Jump performance was measured in terms of jump height in inches.

Joint Mobilization Intervention

Participants were randomly allocated to one of two mobilizations, PASM (n=30) or LSM (n=30) by drawing out of a hat. To ensure a consistent mobilization force between participants, a force of at least one half the participant's bodyweight was applied. Rogue® monster bands (Rogue fitness®, Columbus, Ohio) have a predetermined elastic potential when stretched to one half their resting length. Utilizing this information, researchers were able to determine the type of band and distance in which the band needed to be stretched to achieve the desired force. Two different Rogue® monster bands (Green=65

Figure 1: Jumping performance measurement with Just Jump Mat.

Band& Distance	Green-1	Green-2	Green-3	Black-1	Black-2	Black-3
Weight (lbs)	0-130	131-159	160-190	191-200	201-244	245-287
Distance (in)	61	66	71	61	66	71
lbs/F	63.4	79.3	95.1	97.6	122	146

Table 1: Determining Band and Resistance for Inventions (Rogue Mobility Band rest length= 41"; designated elastic force is achieved at ½ rest length (61.5").

lbs and Black=100 lbs) were utilized, stretching each to one of three pre-determine distances, as seen in Table 1. Using the participant's body weight, a computer algorithm provided the researcher with which Rogue® band and at what distance would provide a mobilization force equaling to half of a participant's body weight. The researcher read a prewritten dialogue for the randomly assigned self-mobilization to each participant to ensure consistency. In addition, the researcher ensured that the adequate force, distance and repetitions were followed. Each participant performed the intervention they were assigned to for 10 repetitions and held position for 2 seconds and performed on bilateral lower extremities (Figure 2). Participants ended the intervention on their dominant leg to decrease time between the intervention and post-test measures of jump height and PRoM. A dowel was used for PASM to avoid trunk compensations.

Statistical Analysis

Statistical analysis was performed using IBM Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics were calculated for the participant's characteristics as well as all other dependent variables.

This data was assessed for normal distribution and homogeneity of variance assumptions. A 2x2 mixed between-within subject analysis of variance (ANOVA) with α level set at p=.05 and confidence interval (CI) set at 95% was used to determine if any significant differences between groups existed, as well as within groups.

A Pearson correlation was conducted to evaluate the correlation between the levels or weights of pound per force (lbs/F) and post PRoM.

Results

A total of 60 participants were eligible to participate in the study, 31 females and 29 males. Thirty-one of the 60 participants were allocated in the LSM group and 29 were allocated into the PASM. Table 2 shows the distribution of females to males in each group as well as the mean age and weights determined at the time of the study.

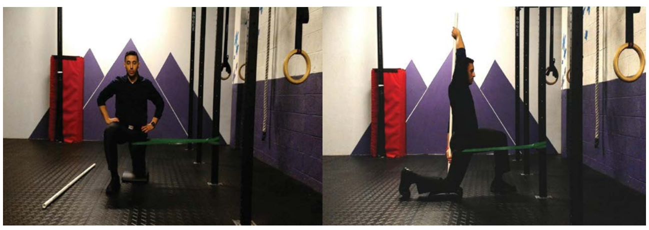

Figure 2: Lateral (LSM) and Posteroanterior (PASM) self-mobilizations with the band (Rogue® monster bands).

Mobilization		Gender (F/M)	Age Mean(SD)	Weight (lbs) Mean (SD)
LSM			24.58 (4.02)	168.17 (32.52)
	N=31	16/15		
PASM			24.10 (3.45)	168.24 (46.41)
	N=29	15/14		
Total			24.35 (3.73)	168.21 (39.50)
	N=60			

Table 2: Group Demographics.

Hip Extension PRoM

Post mobilization PRoM increased in both groups. The PRoM of the LSM group increased from 25.16 (5.88) to 28.16 (5.84) while the PASM group increased from 26.45 (6.71) to 29.14 (6.65). A 2 x 2 two-way mixed analysis of variance was computed with Time (pre-post) being the within-participants factor and mobilization group (LSM, PASM) being the between-participants factors. PRoM was the dependent variable. The ANOVA showed a significant main effect of Time, F (1, 56) = 23.392, $p < .001$, R^2 = .295. No significant difference was detected between mobilization groups, F (1,56) = .602, p = .441, R^2 = .011 (Figure 3).

Jump height

A 2 x 2 two-way mixed analysis of variance was computed with time (pre-post) being the within-participants factor and mobilization group (LSM, PASM) being the between-participants factors. Jump height was the dependent variable. There was a minimal increase in jump height in the LSM group from pre to post mobilization [17.50 (5.14) to 17.80 (5.38)]; however, the ANOVA showed no significant main effect of Time, $p > .20$. When jump heights were compared for between groups effects, no significant differences were seen F (1,56) = 2.407, p = .126, R^2 = .041 (Figure 4).

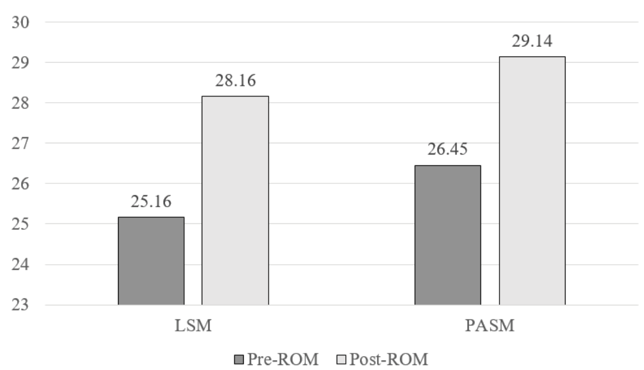

Figure 3: Comparison of pre- and post-test PRoM hip extension of LSM and PASM.

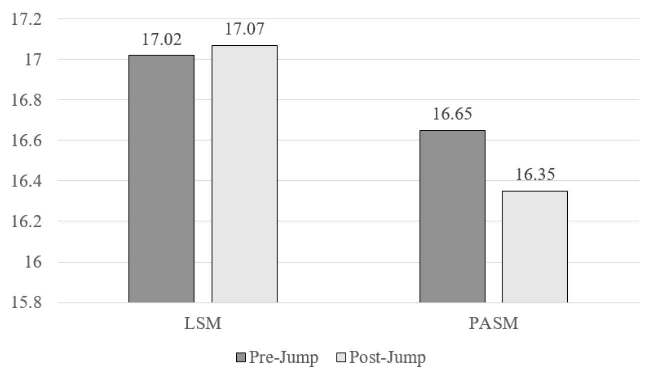

Figure 4: Comparison of pre- and post-test mean jump height of LSM and PASM.

Correlation component

A Pearson correlation was conducted to evaluate the correlation between the levels or weights of pound per force (lbs/F) and post PRoM. Results show that lbs/F were negatively correlated to post PRoM, r (N = 60) = -.623, p < .001. The result show that a lower lbs/F was associated with a higher PRoM.

Discussion

The results of this study offered preliminary evidence that self-mobilizations using mobility bands may immediately improve hip extension PRoM in healthy adults with no known lower extremity pathology but may not have any effect on jump height. Both PASM and LSM demonstrated statistically significant improvements on hip extension PRoM post intervention in comparison to pre-intervention testing. No significant differences in PRoM were found between groups for pre and post PRoM. In comparison, self-mobilizations demonstrated no significant differences between and within groups from pre to post jump height testing.

The findings related to PRoM are consistent with the literature and clinical recommendations that joint mobilizations are an appropriate intervention for improving PRoM [3]. There are very few high-level studies that investigate the effects of self-mobilizations on hip extension PRoM [12-16]. While the use of self-mobilizations and mobility bands are widely used by rehabilitative clinicians such as athletic trainers and physical therapists, the majority of recommendations are based on expert opinion.

Although neither PASM nor LSM had an effect on jump height, consideration should still be given to them for future inquiry. In addition to the original clinical question, further investigation of the results yielded significant differences in pre and post PRoM and jump height related to sex and mobilization force. Based on a Pearson correlation analysis, researchers found that there was a negative correlation between pounds of force (lbs/F) and post PRoM. This suggests that a greater band force was associated with lower PRoM values.

Although further investigation into the exact mode, prescription and force of self-hip mobilizations is required, the initial findings in this study may assist future studies in developing proper prescription of self–hip mobilizations in the treatment of hip pathology. In a case series by Shorts, Shorts, Strack, Anloague and Brewster [5], self-mobilizations were used during the sub-acute phase of rehabilitation for six athletes with hip and lumbar spine movement based impairments. Since it used self-mobilizations as adjunct treatments, this underlines the importance of further investigation into the use of self-mobilizations in both clinical and athletic settings [5]. To our knowledge, our study was the first in attempting to create standard of force using mobility bands which was based on the individualized weight of each participant.

Yerys and colleges found there was an increase in gluteus maximus strength after applying Grade 4 hip mobilizations [17]. While we did not observe an increase in jump height which we associated with an increase in LE strength, the utilization of a distraction force of at least one half an individual's body weight did demonstrate improvements of PRoM hip extension in our study. Although further investigation is needed, these findings may assist clinicians to determine the exact exercise prescription for improving hip PRoM and activity performance when using self-mobilizations.

An improvement in PRoM was observed, however, generalization of these findings into practice, is still limited. Overall, the population included in this study consisted primarily of young active, healthy adults from the ages 18 to 35 with the assumption of normal hip arthrokinematics. Over 80% of participants in the study reported engaging in exercise or recreational activities consisting of three or more hours per week. Due to these limitations, the effects of self-mobilization in older, younger, or more sedentary populations are still unclear and would require further investigation.

It is important to determine the effectiveness of self-mobilizations for physical therapists and rehabilitative clinicians to properly prescribe home exercise program consisting of joint mobilizations. An effective home exercise program should be individually tailored in order to reach the desired outcome of the patient, such as increased jump height, strength, PRoM/ARoM and/or agility. Physical therapists and exercise professionals are more precise in the construction of home exercise programs focused on exercise and stretching. However, due to the complexities of joint mobilizations, it is difficult to achieve the same precision when recommending self-mobilizations. By determining a set force that is based on a percentage of an individual's body weight, as done in this study, clinicians can instruct their patients on the exact distance that they need to pull the band to achieve the desired effect during self-mobilizations. This can also increase an individual's independence in their own treatment and not rely on their physical therapist for continued manual correction for a reoccurring condition.

In conclusion, both LSM and PASM interventions increased overall hip extension PRoM. However, no differences were seen between groups. Although LSM and PASM had no significant effect on jump height, the study may provide an example of specific force required to optimize hip extension RoM.

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