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Effect of Hamstring Flexibility on Hip and Lumbar Spine Joint Excursions During Forward Reaching Tasks in Individuals With and Without Low Back Pain

Erica N. Johnson, BS and James S. Thomas, PhD, PT

School of Physical Therapy, Ohio University, Athens, OH

Abstract

Objective—To examine the correlation between hamstring flexibility and hip and lumbar spine joint excursions during standardized reaching and forward bending tasks.

Design—Retrospective analysis of data obtained during two previous prospective studies that examined kinematics and kinetics during forward bending tasks in individuals with and without low back pain (LBP).

Setting—The two previous studies were conducted in the Motor Control Lab at Ohio University.

Participants—Data from a total of 122 subjects from two previous studies. Study 1: 86 subjects recovered from an episode of acute LBP (Recovered). Study 2 (unpublished findings): 18 chronic low back pain subjects (LBP) and 18 healthy matched controls (Healthy).

Interventions—Not Applicable.

Main Outcome Measure—Correlation values between hamstring flexibility as measured by straight leg raise (SLR) and amount of hip and lumbar spine joint excursions used during standardized reaching and forward bending tasks.

Results—No significant correlation was found between hamstring flexibility and hip and lumbar joint excursions during forward bending tasks in the LBP or Recovered groups. Straight leg raise had a significant negative correlation with lumbar spine excursions during reaching tasks to a low target in the Healthy group (Right SLR: $P=.011$, Left SLR: $P=.004$).

Conclusions—Hamstring flexibility is not strongly related to the amount of lumbar flexion used to perform forward bending tasks in individuals who have chronic LBP or who have recovered from LBP. More research needs to be conducted to examine the influence of hamstring flexibility on observed movement patterns to further evaluate the efficacy of flexibility training in the rehabilitation of patients with low back pain.

Reprint requests to James Thomas PhD, PT, School of Physical Therapy, Grover Center W-290, Athens, OH 45701-2979, thomasj5@ohio.edu.

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Keywords

Hip joint; Low back pain; Range of motion; articular; Rehabilitation

Low back pain is a prevalent and costly health concern with various etiologies. Approximately 90% of adults will suffer from an episode of LBP at some time in their lives, 50% will have a recurrent episode and 5–10% will develop chronic and potentially disabling LBP^{1–3}. Mechanical LBP is one of the common causes of LBP; however, there is no clear consensus on the best treatment for this condition. Conservative treatment may include manipulation, myofascial release, exercise, modalities, and a number of other treatment options. Conservative treatment often includes flexibility exercises, especially of the hamstrings. Many clinicians support this practice based on the theory that normal hamstring length will prevent excessive lumbar flexion during postures that place the hamstrings in a lengthened position such as forward bending^{4, 5}. McGill has shown that increased lumbar flexion during forward bending tasks increases anterior shearing forces on the spine and increases risk of injury⁶. Thus, if decreased hamstring flexibility leads to increased lumbar flexion during forward bending tasks it may increase the risk of injury to the spine from mechanical stresses. However, few studies have examined the influence of hamstring flexibility on hip and lumbar spine joint excursions during forward reaching or bending tasks. Therefore, we performed a retrospective examination of data from our lab to evaluate the influence of hamstring flexibility as measured by hip flexion with the knee extended (i.e. straight leg raise) on hip and lumbar spine joint excursions.

METHODS

Data from subjects of two prior investigations were analyzed for this study. Study 1 consisted of one group of subjects: Recovered-currently pain free after an acute episode of low back pain (n= 42 men, 44 women)⁷. While the original study consisted of 88 subjects, complete range of motion (ROM) data was only available for 86. Mean age was 30.9 with a range of 19–57 years old. Study 2 consisted of two groups of subjects: Healthy-no history of low back pain (n=8 men, 10 women) and Chronic Low Back Pain (LBP)-back pain greater than 3 months duration (n=8 men, 10 women) (A.I. McCallum, unpublished data, 2009). Mean age for the Healthy and LBP groups were 23.8 and 22.2, respectively, with a range of 18–37 years old. Subjects were recruited from the Athens and greater Columbus area by advertisements placed in the general community. All procedures were approved by the Institutional Review Board of Ohio University. Signs and symptoms consistent with mechanical LBP were required for inclusion into the Recovered and LBP groups. In these two prior studies, hamstring flexibility was assessed with the knee straight (SLR) using a bubble goniometer following standard methods⁸. Hip flexion ROM was also assessed with the knee bent to evaluate the full flexion range available. No movement restrictions were found with hip flexion in any of the subjects that would limit evaluation of hamstring flexibility. In both studies, subjects performed reaching tasks to two target locations based on their individual anthropometric characteristics. Targets were positioned in the mid-sagittal plane such that the subject could reach the high and low targets with 15° and 60° of hip flexion, respectively, while maintaining 90° of shoulder flexion. Subjects in Study 1 then performed a maximum FBT by starting in a standing position and bending forward as far as possible as if to touch the toes while keeping the legs and arms straight. Joint motions were measured using The Motion Monitor^a, a magnetic based kinematic system. The change in joint angle from initial to final posture (i.e. target contact or end range flexion) was extracted using custom software. To assess the influence of hamstring flexibility on joint excursions, separate bivariate correlation analyses were performed between SLR measures and hip and

lumbar spine joint excursions used during the standardized reaching tasks and the forward bending task. These analyses were performed separately for the right and left sides.

RESULTS

Excursions of the lumbar spine and hip during the reaching tasks and forward bending task were not significantly correlated with SLR for the Recovered or LBP groups. A significant negative correlation was found in the Healthy group between SLR and lumbar spine excursions only during the forward reaching task to the low target (Table 1). Mean(SD) right SLR values for the Recovered, Healthy, and LBP groups were $56.3^{\circ}(\pm 9.3)$, $80.7^{\circ}(\pm 12.3)$, and $72.3^{\circ}(\pm 10.5)$, respectively. Mean(SD) left SLR values were $61.3^{\circ}(\pm 10.3)$, $77.2^{\circ}(\pm 13.7)$, and $68.2^{\circ}(\pm 12.2)$ for the Recovered, Healthy, and LBP groups, respectively. A one-way analysis of variance analysis revealed mean that the SLR in the Healthy group was significantly greater than the mean SLR in the LBP group ($p < .05$). However, there was no corresponding significant difference between the Healthy and LBP group for amount of lumbar excursion used during the forward reaching tasks.

DISCUSSION

In accordance with the theory that increased hamstring flexibility decreases the amount of lumbar flexion required during forward reaching tasks, individuals with greater hamstring flexibility would have been expected to exhibit less lumbar flexion excursion when completing forward reaching tasks than those with limited hamstring flexibility. The significant negative correlation between hamstring flexibility and lumbar excursion during the forward reaching task to the low target found in the Healthy group supports this relationship. However, no correlation between lumbar excursion and hamstring flexibility, as measured by SLR, was found in the Recovered or LBP group for forward reaching, nor was there a correlation between total lumbar excursion and hamstring flexibility in the Recovered group during the forward bending task. These results indicate that hamstring flexibility is not strongly related to the amount of lumbar flexion used to perform these tasks in these individuals. These results support the findings of a study by Esola, in which individuals with a history of LBP used more lumbar flexion during the beginning phase of forward bending from $0-30^{\circ}$ at which time the hamstrings are not placed in a lengthened position⁵. That study also reported no correlation between total lumbar excursion and hamstring length during the forward bending task⁵. Another study by Li found that the amount of lumbar motion observed during partial and full forward bending was not significantly affected after a stretching intervention to increase hamstring flexibility, even though SLR and active knee extension increased significantly⁹. In light of these findings, it may be reasonable to assume that increasing hamstring length would not affect the amount of lumbar excursion exhibited during forward reaching tasks in individuals with LBP or who have a history of LBP. Moreover, a recent study showed that a daily stretching protocol increases hamstring stretch tolerance, but does not result in lasting changes in muscle extensibility¹⁰. It remains to be determined if there is a lower limit of hamstring flexibility at which forward bending patterns would be altered, but that is outside of the scope of this study. The relatively small number of subjects in the Healthy and LBP is a further limitation of this study. More research needs to be conducted to examine the influence of hamstring flexibility on observed movement patterns to further evaluate the efficacy of flexibility training in the rehabilitation of patients with low back pain.

CONCLUSIONS

Contrary to expectations, individuals with LBP or a history of LBP did not exhibit a significant correlation between hamstring flexibility, as clinically measured by the SLR, and

the amount of lumbar flexion excursion used to complete forward reaching tasks. These results indicate that hamstring flexibility is not strongly related to the amount of lumbar flexion used to perform these tasks in these individuals. In light of these findings, it is reasonable to assume that increasing hamstring length would not affect the amount of lumbar excursion exhibited during forward bending tasks in individuals with LBP or who have a history of LBP. Thus the efficacy hamstring of flexibility training in the rehabilitation of patients with low back pain needs to be reexamined.

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List of Abbreviations

LBP	low back pain
ROM	range of motion
SLR	straight leg raise

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Table 1

Correlation values between hamstring flexibility and lumbar excursions and mean joint excursions data.

Correlation Values			Excursion Data			
	SLR Right		SLR Left		Mean Joint Excursion degrees(SD)	
	Recovered/healthy/LBP		Recovered/healthy/LBP		Recovered/healthy/	LBP
FBT						
hip	.167	ND	.151	ND	84.64(28.9)	ND
lumbar	.144	ND	.102	ND	58.72(26.5)	ND
High Target						
hip	-.022	-.123	-.191	.034	-.087	-.384 9.28 (7.7) 5.45 (4.8) 4.79 (3.7)
lumbar	-.015	-.172	.248	-.016	-.212	.244 5.53 (5.8) 7.36(4.0) 5.46 (3.8)
Low Target						
hip	.183	.246	-.310	.176	.115	-.260 61.47(18.5) 47.29(16.1) 46.52(14.3)
lumbar	.081	-.585*	.025	-.016	-.646*	-.007 33.0(14.1) 48.05(6.7) 46.43(12.9)

Correlation values for hip and lumbar spine joint excursions during forward bend test (FBT), reaching to high target (High Target), and reaching to low target (Low Target) with straight leg raise range of motion (SLR). Significant correlations $p < 0.05$ are indicated with an asterisk (*). Mean joint excursion values (SD) for the hip and lumbar spine during the FBT and during reaches to the high and low targets.