The Effects of Kinesiophobia on Spinal Motion Parameters Following Recovery from an Episode of Low Back Pain.

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Introduction

Pain-related fear is associated with submaximal performance on a variety of physical challenges in individuals with chronic low back pain. The fear-avoidance model of low back pain and disability suggest that individuals with elevated levels of pain-related fear tend to perceive pain in a threatening, catastrophic manner (e.g., as a sign of tissue damage) and thus are more likely to engage in escape or avoidance behaviors. According to the model, individuals who tend to avoid threatening situations and behaviors are less likely to recover from an initial back injury and more likely to suffer from depression, disuse syndrome, and chronic pain and disability.

Although avoidance is typically considered as a reluctance to engage in specific behavior or to execute maximal effort, it is also possible that avoidance may take the form of altered motor coordination (i.e., performing the behavior, but in a different manner). Results from a recent study provide preliminary support for this notion in individuals with subacute back pain, demonstrating that those with high versus low pain-related fear used significantly less flexion of the lumbar spine when performing a standardized full body reaching task. While it is currently unknown if people with high pain-related fear continue to display differences in motor behavior after resolution of symptoms, Marras and colleagues, using a movement paradigm that requires participants to perform rapid trunk flexion and extension tasks while maintaining the trunk at various twist angles (i.e. 0, 15, 30, ± 2 degrees), have reported that low back pain sufferers show decreased peak velocity and acceleration of the trunk and that these limitations can persist after participants are no longer symptomatic. It remains to be determined if these findings generalize to less constrained movement tasks and whether they are particularly evident in high versus low pain-related fear.

Accordingly, the present study was designed to examine the relationship between pain-related fear and motor behavior during performance of a standardized reaching task in individuals who had recently recovered from an episode of low back pain.

Methods

Participants

Eighty-eight participants (46 females, 42 males) who had recovered from an episode of low back pain and were pain free for 4 weeks (± 2 weeks) performed a series of reaching movements to three targets located in a mid-sagittal plane. Prior to the start of the reaching trials subjects completed the Tampa Scale for Kinesiophobia (TSK).

Physical Performance Measures

Starting from an upright standing posture, the participant performed three movement trials (at a comfortable pace) with their right hand, then three trials with left hand. The movement trials were then repeated at a fast-pace movement speed. See Figure 1.

Data Collection & Analyses

The 3D motions of the trunk, pelvis, and limb segments were recorded using the Motion Monitor System. An Euler angle sequence was used to derive the three dimensional joint motions of the hip (i.e. motion of the pelvis relative to the thigh) and lumbar spine (i.e. motion of the thorax relative to the pelvis). Sagittal-plane joint excursions, peak angular velocities, and peak-to-peak angular accelerations of the hip and lumbar spine were then extracted. To examine potential group differences in reaching movements, 3-way MANOVAs for repeated measures design were performed with a between subject factor of group (high pain-related fear, low pain-related fear) and within subject factors of movement speed (comfortable, fast pace) and target height (high, middle, low).

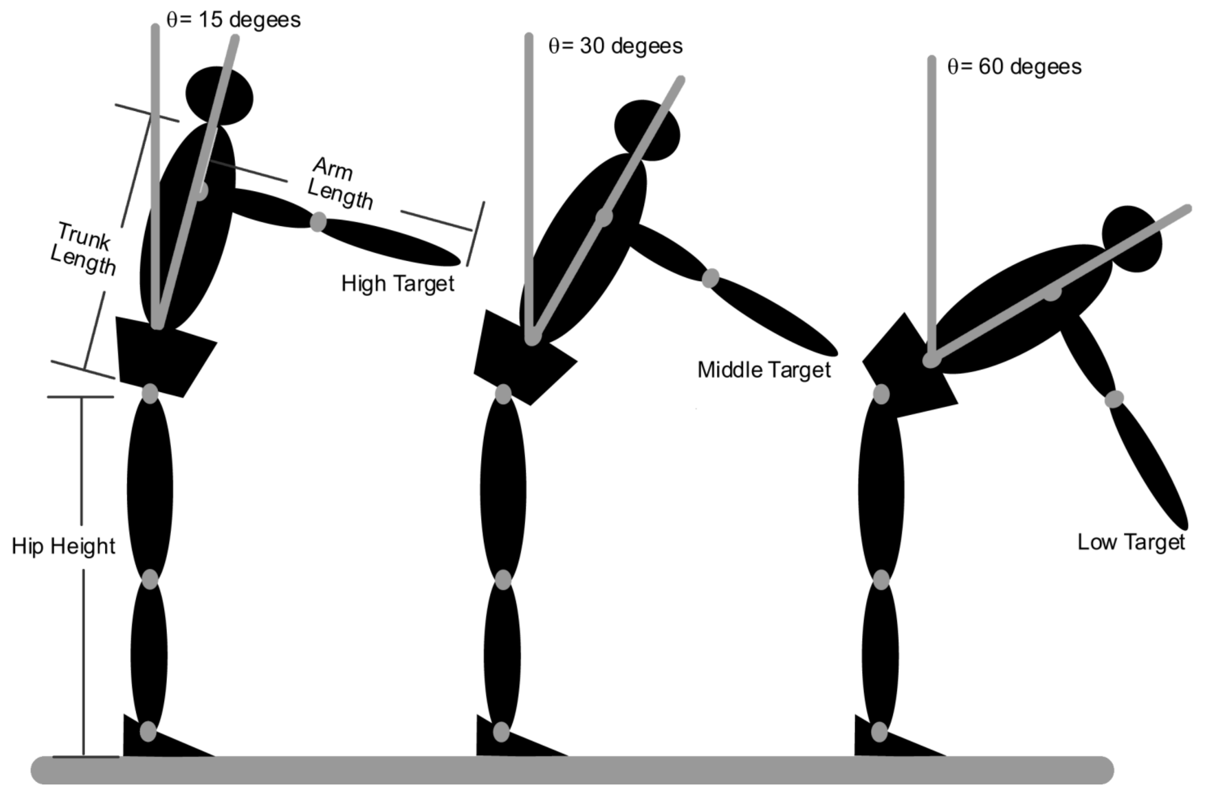

Figure 1. A diagrammatic representation of how target locations were normalized to each subject's anthropomorphic characteristics. Target locations were determined for each subject based on their hip height, trunk length, and arm length. The high target was located such that the subject could, in theory, reach the target by flexing the hips 15° with shoulder flexed to 90° and the elbow extended. The low target could be reached by flexing the hips 60°.

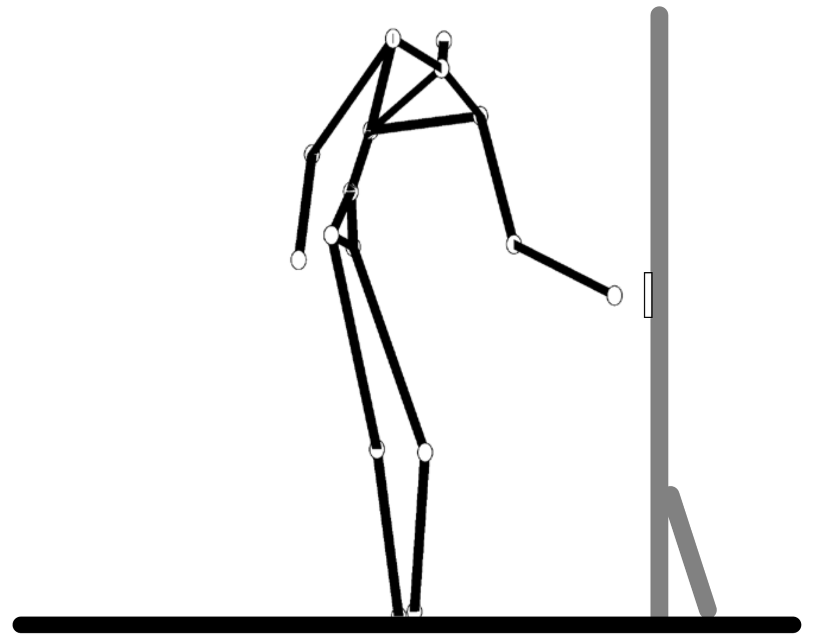

Figure 2. A representative participant performing the reaching task to the middle target location is shown. The figure is derived from the known locations of the joint-centers (i.e. ankles, knees, hips, lumbar spine, thoracic spine, shoulder, elbows and wrists) at target contact.

Table 2. Participant Characteristics

	Mean (SEM)	Range
Age (years)	30.9 (1.1)	19-57
Height (cm)	170.1 (1.0)	152.4-195.3
Weight (kg)	74.2 (1.6)	43.1-117.9
Scale for Kinesiophobia	35.4 (0.6)	23-53
PASS Escape/Avoidance	16.1 (0.6)	4-34

Results

Descriptive Data

Participant characteristics are provided in Table 1. To ensure groups were balanced by gender and to be consistent with our previous investigations, the median splits were conducted separately by sex (TSK: Mdn = 16 for women and 15 for men). The high and low fear groups did not differ significantly in terms of age, height, or weight.

Movement Time. As expected, analyses of movement time confirmed that participants moved nearly twice as fast during the fast-pace trials (M = 814.9 ms, SD = 13.2) compared to the comfortable-pace trials (M = 1371.8 ms, SD = 26.0), (p<.001). There were no differences between the groups for either the comfortable-pace movement or the fast-pace movements.

Joint Excursions. Analyses of angular excursions revealed no significant differences at the lumbar spine. An interaction of speed by group was observed for the thoracic spine (p<.01), reflecting significantly smaller thoracic excursions for fast-pace versus comfortable-pace reaches only in the high fear group (p<.01). In addition, a significant hand by group interaction was observed for the right hip (p<.01). This interaction indicated that individuals with high fear had less hip flexion compared to the low fear group, although this difference was significant only for left handed reaches (p<.05). There was no main effect of group and no other interactions involving group. The movement pattern of a typical participant is illustrated in Figure 2.

Peak Velocity. A significant speed by hand by group interaction was observed for the lumbar spine (p<.05). As illustrated in Figure s 3A-B, this interaction indicated that participants who are high in pain-related fear have lower peak velocities when performing fast-pace reaching movements as compared to the low fear group. This effect is particularly evident for left handed reaches. Furthermore, significant speed by group interactions were observed for all three joints (p<.05). In general these two-way interactions suggested that fast-pace reaching movements were associated with smaller peak velocities in the high versus low fear groups (See Table 2). These differences were significant for the hip (p<.05) and the lumbar spine (p<.05), but not for the thoracic spine. There was no main effect of group and no other interactions involving group.

Peak-to-Peak Acceleration. A significant speed by hand by group interaction was observed for the lumbar spine (p<.01) as shown in Figures 3C-D. Consistent with the findings for peak velocity, this interaction indicated that participants who are high in pain-related fear have lower peak-to-peak accelerations during fast-pace reaches as compared to the low fear group. Again, this effect is particularly evident for left handed reaches. In addition, significant speed by group interactions were observed for the lumbar spine (p<.01) and hip (p<.05). These two-way interactions reflected that peak-to-peak acceleration is lower in the high versus low fear groups for fast-pace reaches (See Table 2). This was significant for the lumbar spine (p<.05), but only marginal for the hip (p=.07). There was no main effect of group and no other interactions involving group.

Conclusions

➢Participants with high pain-related fear had smaller peak angular velocity and acceleration of the spine and hip compared to participants with low pain-related fear.

➢While there is ample evidence that pain-related fear predicts future pain and disability in individuals with both acute and chronic low back pain, the present study shows that pain-related fear maps on to differences in peak velocity and acceleration of the lumbar spine even after resolution of back pain.

➢Individuals with high pain-related fear who show lower peak velocity and acceleration of the lumbar spine may have an increased risk for re-injury when faced with an unexpected load (e.g. a slip or fall) that requires the ability to generate higher peak joint velocities and accelerations of the lumbar spine .

Acknowledgment

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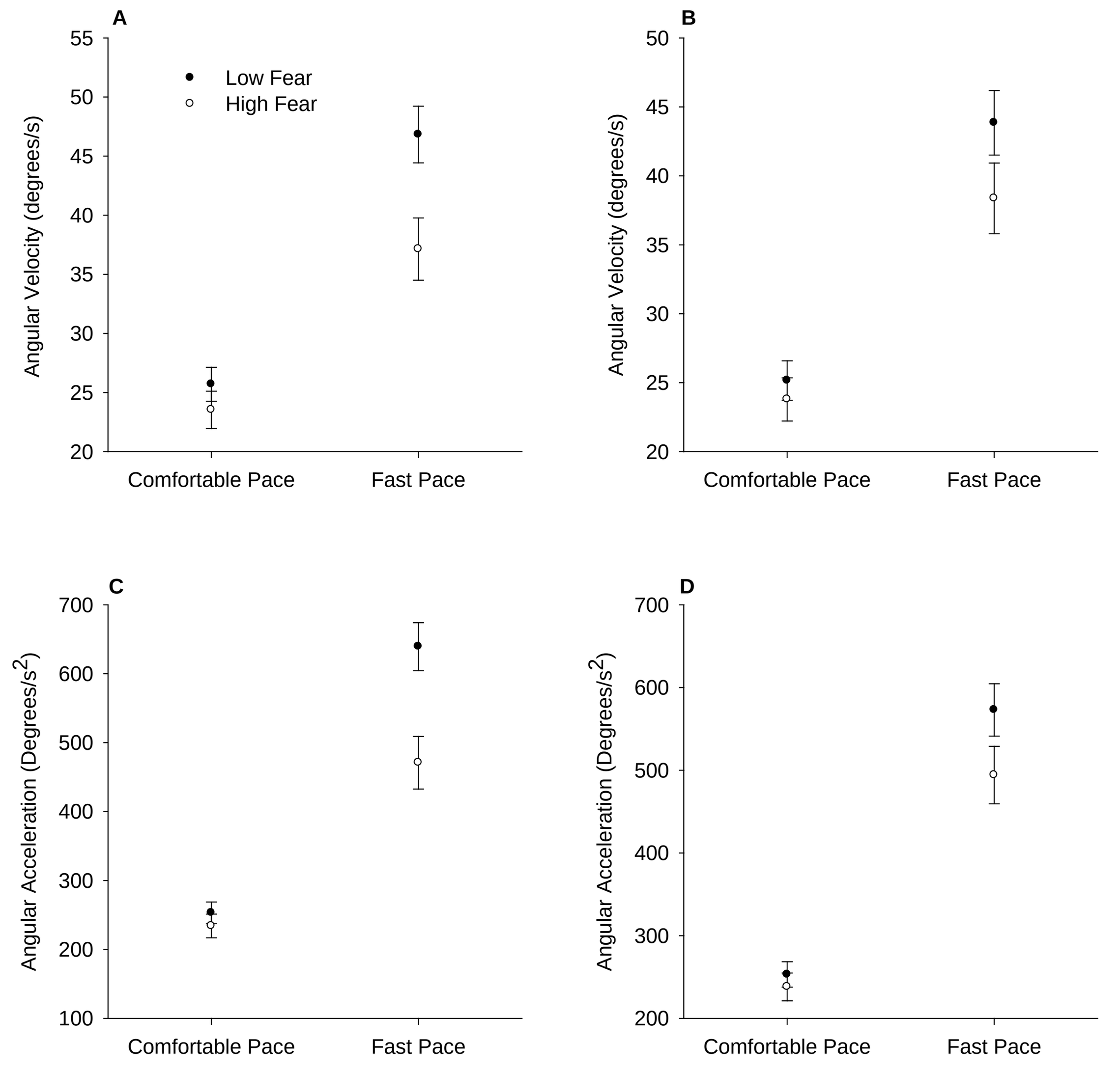

Figure 3. The effects of pain-related fear on the peak angular velocity of the lumbar spine are shown for A) left hand reaches B) right hand reaches. Peak lumbar accelerations are shown for C) left hand reaches D) right hand reaches.

Table 2. The means and SEM of joint excursions and their higher order variables are shown for fast-paced reaches with the left and right hands. The groups were determined from a median split on TSK scores.

		Scale for Kinesiophobia			
		Low-Fear (n=48)		High-Fear (n=40)	
		Left Hand	Right Hand	Left Hand	Right Hand
Hip	Angle (°)	29.7 (1.3)	28.4 (1.3)	25.0 (1.4)	25.9 (1.4)
	Velocity (°/s)	77.1 (3.5)	79.5 (3.9)	64.4 (3.9)	68.5 (4.3)
	Acceleration (°/s²)	771.2 (38.3)	784.2 (40.9)	673.0 (42.0)	681.1 (44.8)
Lumbar	Angle (°)	13.5 (0.8)	13.5 (0.8)	12.3 (0.9)	12.7 (0.9)
	Velocity (°/s)	45.8 (2.3)	43.5 (2.2)	36.9 (2.5)	38.0 (2.5)
	Acceleration (°/s²)	639.1 (34.8)	572.7 (31.6)	470.7 (38.1)	494.1 (34.6)
Thoracic	Angle (°)	6.6 (0.6)	6.7 (0.6)	6.1 (0.6)	6.2 (0.7)
	Velocity (°/s)	28.8 (1.8)	29.6 (2.0)	25.8 (2.0)	27.3 (2.2)
	Acceleration (°/s²)	461.9 (27.2)	461.5 (29.2)	422.3 (29.8)	443.2 (32.0)