INVESTIGATING THE RELATIONSHIP BETWEEN HIP POSITION AND LUMBAR SPINE RANGE OF MOTION

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INTRODUCTION

There is a clear anatomical relationship between the spine and the hip joint, as they are connected via the pelvis. However, the relationship between hip position and lumbar spine range of motion (ROM) is not yet well understood. The top of the sacrum forms the base for the L5 vertebrae, therefore changing the position of the pelvis will also affect the movement of the lower lumbar spine. Relaxed standing normally causes the pelvis to rotate slightly posteriorly, resulting in erect posture without active muscular control due to the strong iliofemoral ligaments on the anterior hip joint resisting further rotation [1]. The resting position (mechanical neutral zone [2]) of the hip is defined as the position where the capsule and ligaments surrounding the joint are in their most slack position, therefore resulting in the least resistance to movement. In the hip joint, this occurs at approximately 30° of both flexion and abduction, with slight external rotation [3]. This suggests that changing the hip position from standing neutral posture, to positions such as abduction and external rotation, has the potential to alter the relationship between the hip joint, pelvis and lumbar spine. The purpose of this study was to determine the relationship between various hip positions and the ROM exhibited in the lumbar spine. It was hypothesized that adopting an abducted and externally rotated hip position would lead to the greatest increase of ROM at the lumbar spine, while abduction alone and external rotation alone would lead to less of an increase compared to a neutral hip position.

METHODS

Healthy young adult participants (n=12, 6 male and 6 female) were recruited from the university population and exhibited no current or history of hip or back pain or associated injuries. All participants demonstrated at least 120° of active hip flexion, which has been stated in previous literature as the minimum degree of flexion for healthy ROM [4]. An active marker motion capture system (Optotrak™ Northern Digital Inc., Ontario, Canada) was used to record body segment and joint movement. Markers were placed in rigid body clusters on the lumbar spine at vertebral levels T12 and S1, on the lateral aspect of the left thigh and lateral aspect of the left shank. Rigid bodies located on the leg were placed at 50% of segment length. Electromyography (EMG) was recorded to measure muscle activity bilaterally of the thoracic (T9) and lumbar (L3) erector spinae, gluteus medius and biceps femoris (AMT-8™ Bortec Biomedical Ltd., Alberta, Canada). Maximum voluntary contractions were performed according to standard procedure in previous EMG literature [5,6]. Participants performed full trunk flexion and extension, trunk lateral bend and trunk axial twist ranges of motion in four different hip positions. Neutral hip position was self-selected by the participant, with the instruction to stand in a comfortable neutral width stance and feet facing forward. Hip abduction was defined as twice the distance of their self-selected neutral width stance. Hip external rotation was defined as the participant’s forefoot on a 45° angle outward, while the heel remained in the same position. The fourth position was combined hip abduction and external rotation (as described above). Participants were instructed to go to their end trunk range of motion, while keeping their hips facing forward. Three trials of each movement were completed in each of the four hip positions. The dependent variables (3D lumbar spine motion, EMG amplitudes) were compared between all hip positions within each task. A significance level of $\alpha <0.05$ was used for all statistical comparisons.
RESULTS AND DISCUSSION

Lumbar spine angles were normalized to the average maximum ROM angle each individual achieved in the neutral hip position. Therefore, a value of 1 is indicative of no change in ROM from the neutral position, as the average over three trials would be equal to the average ROM in neutral hip position. Significant increases in lumbar spine flexion were observed in the abducted and combined abducted and externally rotated hip positions when compared to neutral; however no differences were observed between abduction, external rotation, and combined abduction and external rotation (Figure 1). Significant increases in lumbar spine extension were observed when the hips were positioned in abduction, and combined abduction and external rotation when compared to neutral hip position. In lumbar spine flexion and lumbar spine extension, no significant differences were noted between abduction alone and combined abduction and external rotation, which suggests that either hip position increases lumbar spine ROM when moving in the sagittal plane.

![Figure 1](image1.png)

**Figure 1**: Normalized lumbar spine flexion and lumbar spine extension ranges of motion in each hip position: neutral, abduction, external rotation and combined abduction and external rotation.

No significant differences were observed during lumbar spine lateral bend (Figure 2). This suggests that potentially during neutral stance, the hip joint is in the best position for the greatest amount of ROM when moving in the frontal plane. Significant increases in lumbar spine axial twist were observed when the hips were positioned in abduction, and combined abduction and external rotation compared to neutral (Figure 2). The increases of ROM demonstrated during abduction were also significantly greater than external rotation, suggesting that abduction is the best hip position for movements in the transverse plane for the greatest increase in lumbar spine ROM.

![Figure 2](image2.png)

**Figure 2**: Normalized lumbar spine lateral bend and lumbar spine axial twist ranges of motion in each hip position: neutral, abduction, external rotation and combined abduction and external rotation.

CONCLUSIONS

Altering hip position is one potential way to increase ROM in the lumbar spine. Increases in lumbar spine ROM were observed when the hips were positioned in abduction, and combined abduction and external rotation during lumbar spine flexion, extension, and axial twist. This suggests these hip positions increase ROM the most during sagittal plane and transverse plane movements.

REFERENCES