CHANGES IN REGIONAL ACTIVITY OF THE PSOAS MAJOR AND QUADRATUS LUMBORUM WITH DIFFERENT TRUNK AND HIP TASKS AND SPINAL CURVATURES IN SITTING

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SUMMARY

Discrete regions of psoas major (PM) and quadratus lumbarum (QL) were found to be differentially active when performing a variety of maximal voluntary trunk and hip tasks. Differences in regional electromyographic (EMG) activity were also apparent in sitting with different spinal curvatures. Based on recordings of EMG activity, the region of PM that arises from the transverse processes (PM-t) appears to have a specific advantage for sitting in a short lordotic posture. This is likely due to the anatomy of the fascicles of PM-t, which have a combined potential to extend/lordose the lumbar spine and flex the hip, at least in a flexed hip position.

INTRODUCTION

PM and QL lie close to the instantaneous axes of rotation of the lumbar motion segments. This close proximity may lead to generation of torques in opposite directions by different fascicles (see Figure 1 for PM) and this could change in both magnitude and direction as the axis of rotation changes with modification of spinal curvature. Consequently, anatomically discrete regions of PM and QL may have differential functions on the lumbar spine.

On the basis of available biomechanical and anatomical data [1, 2], we hypothesised that anatomically discrete regions of PM and QL would be differentially active during voluntary lumbar spine and hip movements. We also hypothesised that activity would differ between muscle regions in sitting with subtle changes in lumbar curvature and hip positions.

METHODS

Twelve healthy participants performed seven different maximal voluntary trunk and hip tasks. Participants also adopted three different sitting postures that involved different spinal curvatures (slump, flat and short lordosis).

Fine-wire electrodes were inserted under ultrasound guidance to record EMG activity from the right side for PM fascicles originating from the transverse processes (PM-t) and vertebral bodies (PM-v) and from fascicles in the anterior and posterior layers of QL (QL-a and QL-p, respectively). Surface EMG was used to record from the right erector spinae (ES), obliquus externus (OE), and the combined obliquus internus/transversus abdominis (OI/TrA).

RESULTS AND DISCUSSION

The discrete regions of PM and QL showed different activation patterns for the maximal voluntary trunk and hip tasks, and also for the different sitting postures. For the maximal voluntary efforts, PM-t activity was greater in lumbar extension than flexion tasks, and did not change as a function of hip positions although it was recruited to ~20% of its recorded maximum during hip flexion tasks. This finding implies the activity of PM-t is likely to be more affected by position of the lumbar spine than that of the hip. Unlike PM-t, activity of PM-v did not differ between trunk flexion and extension tasks, and was greater during hip flexion than during trunk efforts. Thus, PM-v may be more active as a hip flexor than producing torques about lumbar spine. As hypothesised, activity of QL-a and QL-p differed between the tasks utilising maximal voluntary efforts. QL-p was more active during trunk extension and laterally-flexion tasks than the other tasks, whereas QL-a showed greater activity only during trunk lateral-flexion than the other tasks.

For the sitting tasks, both PM-t and PM-v were active to a greater percentage of their recorded maximum than the other muscles, except OI/TrA. PM-t was more active when sitting with a short lordosis than a flat posture with a less extended lumbar spine, whereas PM-v was similarly active in these two sitting postures. The anatomy of PM-t implies that it may have the potential to meet a concurrent demand to extend the lumbar spine and maintain flexion of the hip (Figure 1). In contrast, activity of the discrete regions of QL was not affected by subtle changes in spinal curve or pelvic rotations in the sagittal plane during different sitting postures.

Spinal curvature for three regions of the spine and hip position were determined from 3D-motion data and used to verify the attainment of the three target sitting postures.

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Figure 1: PM-t has potential to extend the lumbar spine and flex the hip, whereas activity of PM-v is more biased towards trunk and/or hip flexion. “x” indicates the approximate instantaneous axes of rotation of the lumbar motion segments (adapted from Bogduk et al [1]). PM-t, transverse process portion of psoas major; PM-v, vertebral body portion of psoas major.

CONCLUSIONS
Recruitment of anatomically discrete regions of PM and QL differ during varying maximal voluntary trunk efforts and in different sitting postures. These differential activities are important to consider for clinical and biomechanical applications.

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