

EFEFCTS OF KYPHOTIC POSTURE ON NEUROMECHANICAL LOCOMOTOR CONTROL PATTERNS IN OLDER ADULTS WITH KYPHOTIC POSTURE

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INTRODUCTION

In geriatric clinics or community fitness centers, older adults with kyphotic posture walk or run slowly with decreased mobility in trunk, hip, and ankle joints. They often display symptoms of chronic back pain and falls. Despite the important clinical contribution of the head-arm-trunk (HAT) posture to locomotion, the underlying mechanisms are yet to be determined. Therefore, the purpose of this study is to determine the effect of kyphotic posture on locomotor control patterns.

METHODS

A convenience sample of twenty-four participants (9 healthy younger adults, 7 healthy older adults, 8 older adults with kyphotic posture) between the ages of 20-88 years was recruited. All subjects signed a consent form prior to participating in this study. Full scale of biomechanical analyses including kinematic, kinetic, and electromyography (EMG) measurements were used to determine neuromechanical locomotor control patterns in the lumbar spine, pelvis, hip, knee, and ankle joints when younger subjects walked with a torso brace that simulated kyphotic posture of older adults.

ANALYSIS/RESULTS

A separate one-way analysis of variance (ANOVA) was used to examine the effects of kyphotic posture on selected spatiotemporal, kinematic, kinetic and EMG parameters during locomotion. When appropriate, post hoc tests using Tukey's HSD procedure were employed to probe simple main effect and to contrast the cell means of the groups. Significance was assigned at $\alpha < 0.05$ for all analyses.

The ANOVA test revealed that younger adults with simulated kyphotic gait (YSK) showed significantly decreased walking velocity as compared to younger adults with upright gait (YU), older adults with upright gait (OU), and older adults with kyphotic gait (OK). Both YSK and OK groups in comparison with YU and OU groups demonstrated significantly decreased angular displacements of hip extension during terminal stance phase and ankle dorsiflexion during initial swing phase were decreased. A significant difference in hip extension moment among the four groups was observed and YSK displayed the greatest amplitude of hip moment and followed by OK. EMG muscle amplitude in hip and spinal extensors for YSK was significantly greater than that of OK (see **Table 1**):

	Stride Length	Velocity	Peak Angular displacement in hip extension	Peak Moment in hip extension	Peak Amplitudes in both gluteus maximus and lumbar paraspinalis
Statistical Significance (p-value)	0.21	0.01	0.002	0.0001	0.0001

Table 1. ANOVA results and statistical significance (p-value) of neuromechanical locomotor control patterns among younger 'upright' adults, younger 'simulated kyphotic' adults, healthy 'upright' older adults, and older adults with kyphotic posture (right side only). *Please note that spatiotemporal data were acquired from all subjects

and kinematic, kinetic, and EMG data were collected from 18 subjects.

CONCLUSION

Biomechanical evidence in this study demonstrated that anteriorly displaced center of mass (CM) of the HAT segment in both simulated and clinical kyphotic conditions considerably affected locomotor control patterns. It was evident that all posterior muscle forces, particularly hip and back extensors in younger adults with simulated kyphotic gait (YSK), were synergistically acting upon the multi-segments of the lower extremities that linked with the HAT segment and acted together as a single functional unit to restabilize the perturbed CM [4,5]. However, this was not the case for older adults with kyphotic gait, where no significant increase in hip and back extensors was noticed. This seems to indicate neuromechanical adaptation and supports the speculation that elderly forward-bent walkers with limited spinal mobility and weakness of the trunk and hip muscles (which are responsible for the upper body balance) may have to rely on other non-contractile structures such as ligaments and joint capsules [1-3].

CLINICAL IMPLICATION

The findings suggest that kyphotic posture obviously results in inefficient neuromechanical locomotor control patterns and provides additional information about underlying mechanisms of locomotor control in adults with kyphotic posture. Perhaps, relatively increased hip extension moment and decreased EMG activity in older adults

with kyphotic posture may be responsible for chronic lower back pain. In addition, the decreased angular displacement of ankle dorsiflexion (or ineffective toe-clearance) may cause trips or serious falls as an individual with kyphotic gait attempts to negotiate obstacles and cracks in pavement.

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