EFFECT OF ARM USE ON HEAD AND TRUNK SEGMENT MOTION WHEN RISING FROM A CHAIR

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INTRODUCTION

Dynamic analyses during rising to stand from a chair, of the head, and trunk segments have been rarely investigated. Much of the research to date has examined a constrained motion in that the subjects rise with arms folded and kept as close to the body as possible. The use of the upper limbs, however, have been found to significantly affect movement strategies for the body's centre of mass (COM) [1]. When the arms were restricted the COM had a reduced forward displacement, and lowered horizontal and vertical linear momentum [2]. Although a significant difference was found in the ankle joint displacement [1], the effect of restricted arm motion on the motion of the head and trunk segments is unknown. The purpose of the study was to investigate the peak displacement of the head, thoracic and pelvic segments for a rise to stand from a chair when using the arms in a natural manner in comparison to crossed across the chest.

METHODS

Twelve female subjects rose to stand for three trials of each condition: in a natural manner and with the arms crossed across the chest. Data were collected using an 8 camera motion analysis system and a height adjustable chair set to 110% of fibular head to floor distance while standing. Retro-reflective markers were used to define the pelvis, thoracic and head segments with three markers per segment. Sagittal plane displacement of the head, thoracic and pelvic segments. and the thoracolumbar and cervicothoracic spines were calculated throughout the motion. Relative motion of the head and thoracic, and thoracic and pelvic segments were taken as the cervicothoracic and thoracolumbar spines respectively. A single marker each on the right humeral lateral epicondyle and greater tubercle allowed sagittal plane range of motion (ROM) of the right shoulder to be investigated. Paired Students t-tests were used to compare peak displacements.

RESULTS AND DISCUSSION

The head, thoracic and pelvic segments first flexed forward and then extended as the rise continued. During the pre-extension phase the thoracic segment flexed more than the pelvis causing relative thoracolumbar flexion. The thoracic segment flexion then slowed relative to the pelvic segment causing thoracolumbar extension for the remainder of the movement. For the cervicothoracic spine, the head and thoracic segment initially flexed forward, however the head segment forward flexion was less than that for the thoracic segment causing relative cervicothoracic spine extension prior to seat off. Extension of the thoracic segment then resulted in flexion of the cervicothoracic spine as the rise continued.

There was no significant difference between a natural and constrained rise to stand for the peak flexion of the thoracic and pelvic segments and the thoracolumbar spine (Table 1). The head segment was significantly more flexed during a constrained rise and the cervicothoracic spine was consequently less extended (Table 1). It is possible that greater head forward rotation was utilized to compensate for the reduced input to upper body momentum from the restricted arm motion of a constrained movement.

During a natural rise all subjects first flexed the shoulder prior to seat-off, then extended. During a constrained rise some subjects followed a similar movement pattern while others first extended the shoulder joint then flexed ie the upper limbs were bought closer into the trunk. The former strategy was similar to the motion used when the upper limbs were free to move and therefore may be considered a curtailed normal motion in an attempt to minimize the shoulder flexion motion. The latter strategy, however, is opposite in direction to the overall movement. Bringing the upper limbs closer to the chest may, however, increased the thoracic segment forward flexion and therefore the upper body centre of mass was brought forward and assisted in compensating for the loss of normal upper limb contribution to the overall movement. No differences were noted between the thoracic segment peak flexion for a free or constrained rise, however the differences may have been masked by the use of the two shoulder motion strategies within the group.

As would be expected there was a significant increase in shoulder joint ROM with a natural arm movement (Table 1). During the constrained motion, despite requesting the arms be held against the chest, motion still occurred at the shoulder joint as previously reported [1]. Forward upper limb motion was therefore thought to be concomitant to lower limb motion during rising to stand [1].

Table 1: Peak displacement (°).

	Natural	Constrained	p
Head	3.35 ± 4.75	8.39 ± 6.46	0.005*
Thorax	36.76 ± 4.91	37.08 ± 9.13	0.861
Pelvis	36.10 ± 6.73	36.71 ± 9.55	0.668
Cervicothoracic	-38.69 ± 8.27	-30.43 ± 8.66	0.019*
Thoracolumbar	32.48 ± 8.83	32.89 ± 8.07	0.707
Shoulder ROM	13.67 ± 4.45	8.16 ± 3.65	0.001*

Positive values are flexion and negatives values are extension
* significantly different at $p<0.05$

REFERENCES

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