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Abstract Title

Does a single segment trunk model adequately reveal trunk movements for a simple reaching and grasping movement?

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Abstract Text

Introduction

The trunk represents almost 50% of the total mass of a person [1] and, because it comprises multiple segments, has a large range of motion [2]. Trunk posture and movement are important in the execution of activities of daily living (ADL), especially for those related with arm function [3]. However, in movement analysis, the trunk is usually defined as a single rigid, cylindrical segment between the shoulders and pelvis. This oversimplification ignores the large movement potential the trunk has [2], and therefore does not enable a complete evaluation of trunk movement.

Research question

Does a single segment trunk model adequately reveal trunk movements for a simple reaching and grasping movement?

Methods

The University Ethics Committee (ref:47565) approved the project. Eleven people (7 male; (mean ±SD) age: 27.82 ±3.18years, height: 1.74 ±0.11m; weight: 75.0 ±12.7kg) participated after signing the consent form. An upper-body marker-set was used: left/right acromion, iliac-crest, ASIS; manubrium, S1; five inverted "L" clusters of 3 markers: two 2.5cm lateral of C7, T3, T7, T11 and L3, with the third marker on the long end of the "L" with the length adjusted based on the participant' s size. These defined a single-segment-trunk (acromia to iliac-crests), and upper-, mid- and lower-thoracic, and upper- and lower-lumbar segments (multi-segment-trunk). Participants were asked to stand from a hight-adjustable bench, walk to a low table and lean to collect a mug before returning to the bench. Motion capture data were recorded (100Hz), tracked, and processed. Segmental angles (in relation to the absolute coordinate system) were estimated for the "leaning to collect" section of each trial. The total displacement in each plane and a combined 3D movement (sum of the three planes) of the single-segment-trunk and of the multi-segment-trunk compared with a paired sample t-test.

Results

Table 1 shows the difference in the combined 3D movement for the single-segment-trunk when compared to the multi-segment-trunk (t = 27.95, p<.01) and for each of the planes of movement (t = 18.21, 11.19, 14.15, p<.01, for sagittal, frontal and horizontal). The standardised mean difference was considered very large (8.07 ±8.06).

Table 1 Cumulative movement comparison for the single-segment-trunk (SST) and the multi-segment-trunk (MSS) trunk, for the combined 3D movement (Total) and for the separate planes of motion (sagittal, X; frontal, Y; and horizontal, Z)

		Mean	Std. Deviation	Std. Error Mean	95% CI of the Difference Lower	95% CI of the Difference Upper		Significance (p)
Pair 1	MSS - Total – SSFT - Total	841.21	104.23	30.09	774.98	907.44	27.955	<.001
Pair 2	MSS - X – SST - X	392.87	74.74	21.57	345.38	440.36	18.208	<.001
Pair 3	MSS - Y – SST- Y	139.37	43.13	12.45	111.97	166.78	11.195	<.001
Pair 4	MSS - Z – SST - Z	308.96	75.63	21.83	260.90	357.02	14.150	<.001

Discussion
This simplified approach identified the scale of additional information that could be gained from a multi-segment-trunk. Further exploration should focus on understanding if the amount of movement in a multi-segment-trunk vs single-segment-trunk is of a very different magnitude; it should also look specifically at where are the more important differences. Additional development might focus on understanding the best representation of the trunk movement when assessing ADL in clinical populations.

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