A NEW INVARIANT PARAMETER CHARACTERIZING THE POSTURAL ALIGNMENT OF YOUNG HEALTHY ADULTS

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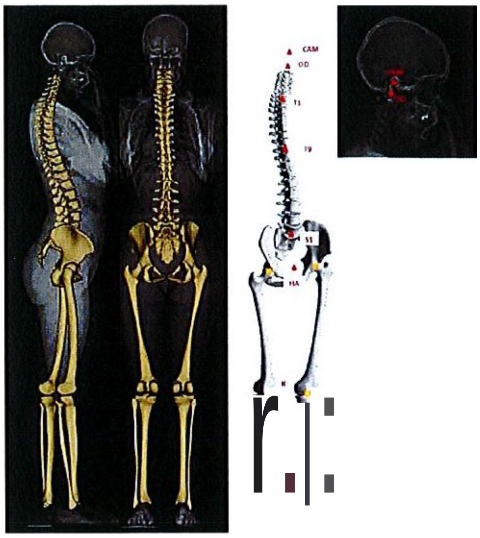
Introduction and Objectives: Postural troubles can have negative impact on skeleton disorders for aging adults. The first step in understanding these aging postural troubles is to observe and quantify the erected posture of young healthy adults' skeletons from radiographies. However, previous studies inthe literature focused on the alignment of the spine and pelvis segments [1], rarely including the head neither the lower limbs. Our study aims to describe the postural alignment of young asymptomatic subjects from head to feet from bi-planar standing radiographies.

Methods: 69 asymptomatic subjects were included in the study: mean age 26.3years old (SO: 4.7). 30 reconstructions of the head, spine, pelvis and lower limbs segments' skeleton were performed from bi-planar radiographies (EOS lmaging, Paris, France) using well documented models (2-4] (Figure). In addition, two stereo-corresponding points localizing the acoustic meati were digitized to compute their center (CAM) [5]. Full description of the postural alignment of the volunteers was made by evaluation of parameters in 30 in the anatomo-gravital frame (frontal plane is the vertical plane going through bath acetabulum centers, and transversal and sagittal planes are orthogonal to the patient frontal plane). The origin of the frame is the middle of the centers of each acetabulum (HA). Firstly, reference values for each parameter studied were computed. Secondly, relationships between these parameters were investigated.

Results: Values found for spinal curvatures, pelvic parameters and lower limbs geometrical parameters (Table} were similar to those reported inthe literature (1,4,5]. Inclinations of different lineswere investigated to characterize the erected posture. The closest line to the vertical passed through the following points: CAM, the most superior point of dentiform apophyse of C2 (OO), the centers of C3 to L5 verte brai bodies, and the center of the sacral plate (S1). Its inclination was in average of 3.1° (SO: 1.9°). The linejoining either CAM or OO to HA are the less variable between subjects with an angle (SD) respectively of 2.9° (1.7°) and 2.9° (1.6°) with the vertical. Itwould be interesting to record those two inclinations for comparison with aging and pathological populations, as the head, characterized by the segment OO to CAM, might be the last one to be adjusted in compensatory mechanism to keep the head upon the pelvis. The line CAM-HA has been reported to be a good indicator to identify postural trouble (5]. Offsets from HA of both knee's center and ankles' center were in average less than 6cm (S0<2cm) ahead of HA and at less than 1cm (S0<12mm) of HA in the medio-lateral direction. This can be an estimate of the alignment of the lower limbs with the upper body. While well-known correlations were found between spinal curvatures and pelvic parameters: L1S1 lordosis with sacral slope (R^2=0.87) and with pelvic incidence (R^2=0.62); pelvic incidence with sacral slope (R^2=0.73}, no other correlations were found with the lower limbs' parameters, confirming the pelvis as an independent link between the spine and the lower limbs for this population of young adults.

Figure:



Caption: Bi-planar radiographies with 30 model: identification of CAM, OO, **T1,** T9, 81, HA, K (middle of both knees points) and A (middle of both ankles).

Conclusion: A description of the postural alignment in 30, of the geometry of the spine, pelvis and lower limbs, in sagittal and frontal planes of the young healthy adult has been reported. Head upon the pelvis was an invariant. As expected, the spine is overall almost vertical (Incl close to 0°). This study would serve as a basis for future comparisons when investigating aging populations.

Table:

Ferguson C3-C7 Lordosis(°)	9(4)	
Ferguson T1-T12 Kyphosis(°)	27(7)	
Ferguson L1-81 Lordosis(°)	30(8)	
Pelvic Incidence(°)	51(9)	
Sacral Slope(°)	41(9)	
Pelvic Tilt(°)	11(6)	
Overhang of S1(mm)	-20(10)	
Femoraltorsion(°)	R: 13(10)	L: 14(11)
Tibial torsion(°)	R: 37(6)	L: 36(7)
Femoro-tibial Rotation(°)	R: 6(4)	L: 7(6)
Femoral Neck Shaft Angle(°)	R: 128(4)	L: 128(4)
Angle with the vertical of the line that best fits in the least square sense: CAM, OO, all the vertebrai body' centers from C3 to L5, and S1(°)	3(2.0)	
Angle with the vertical of the line that connects CAM to HA(°)	3(1.5)	
Angle with the vertical of the line that connects OO to HA(°)	3(1.5)	
	X: -44(18)	Y: 0(7)
Distance between K and HA(mm)	X: -54(13)	Y: 1(12)

Caption: Mean (SD) of studied parameters. R **(L):** Right (Left) side. X: antero-posterior direction; Y: medio-lateral direction.

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Disclosure of Interest: None Declared