

# Sarcopenia Assessment Utilizing Thigh Muscle Measurement on Routine Full Body Radiographs: Correlation with Functional Status, Frailty and Grip Strength

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## INTRODUCTION:

Adult spinal deformity (ASD) patients commonly present with sarcopenia, a disorder of progressive loss of muscle strength and mass that is associated with worse postoperative outcomes. Routine full-body radiographic imaging (EOS) offers an opportunistic method to assess thigh muscle thickness and identify sarcopenia without additional costs or radiation exposure. This study aimed to assess EOS thigh and quadriceps muscle thickness measurements against clinical indicators of sarcopenia and investigate their impact on compensatory mechanisms in ASD patients.

**METHODS:** This is a retrospective study of prospectively collected data across 24 spine surgery centers in the U.S. between 2008 and 2020. Sarcopenia was defined using gender-specific thigh and quadriceps muscle thickness cutoffs from EOS imaging. Clinical frailty scores, grip strength, 3-meter walking time, epigenetic age, and perioperative outcomes were compared between sarcopenic and non-sarcopenic patients. Multivariate regression analyses assessed associations between thigh and quadriceps muscle thickness, sarcopenia status and compensatory spinopelvic and lower extremity radiographic parameters.

## RESULTS:

Among 540 ASD patients (60 years old, 71% female), 61 (11.3%) were sarcopenic. Sarcopenic patients had significantly lower BMI (23.6 vs. 27.3 kg/m<sup>2</sup>), higher clinical frailty scores (3.4 vs. 3.0), slower 3-meter walking time (12.2 vs. 10.5 seconds), longer hospital stays (10.2 vs. 7.0 days) increased 30-day cardiac events (8.2% vs. 2.9%), infections (4.9% vs. 1.0%), sepsis (1.6% vs. 0.0%) and spinal cord injuries (1.6% vs. 0.0%) (all p < 0.05). On multivariate regression analyses, smaller thigh and quadriceps muscle thickness and sarcopenia status significantly correlated with worse clinical frailty scores ( $\beta=-0.16$ ,  $\beta=-0.22$ ,  $\beta=0.58$ , all  $r^2=0.29$ ), lower grip strength ( $\beta=1.72$ ,  $\beta=2.77$ ,  $\beta=-8.43$ , all  $r^2=0.37$ ), slower 3-meter walking time ( $\beta=-0.41$ ,  $\beta=-0.58$ ,  $\beta=2.77$ , all  $r^2=0.22$ ) and older epigenetic age ( $\beta=-4.73$ ,  $r^2=0.13$ ,  $\beta=-11.38$ ,  $r^2=0.22$ ,  $\beta=10.35$ ,  $r^2=0.10$ ) (all p<0.05). Sarcopenia status was significantly associated with increased thoracic kyphosis ( $\beta=6.35$ ,  $r^2=0.49$ ), cervical lordosis ( $\beta=6.39$ ,  $r^2=0.08$ ), sagittal vertical axis ( $\beta=13.47$ ,  $r^2=0.56$ ) and knee flexion angle ( $\beta=1.99$ ,  $r^2=0.39$ ) (all p<0.05), but not significantly associated with pelvic tilt ( $\beta=-0.98$ ,  $r^2=0.56$ ), pelvic shift ( $\beta=0.86$ ,  $r^2=0.51$ ) nor sacro-femoral angle ( $\beta=-2.13$ ,  $r^2=0.31$ ).

**DISCUSSION AND CONCLUSION:** Full-body radiographic imaging-derived thigh and quadriceps muscle thickness measurements significantly correlate with clinical frailty, grip strength, 3-meter walking time and epigenetic age. The study reveals that sarcopenic ASD patients present with impaired proximal compensatory mechanisms and rely more on distal compensatory mechanisms instead including knee flexion and cervical lordosis. Therefore, integrating thigh and quadriceps muscle thickness measurements into preoperative assessment may improve surgical planning and patient management

in

ASD.



Figure 1: Full-Body EOS Image Showing AP Thigh Thickness (Left) (15 cm Proximal to the Adductor Tubercle) and LAT Quadriceps Thickness (Right) (15 cm Proximal to the Distal Terminus of the Blumensaat Line).

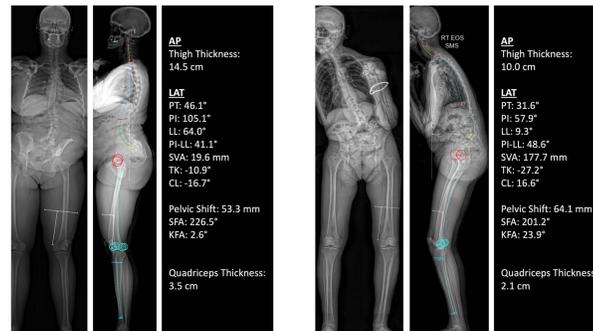


Figure 2: (Left) Representative case of a non-sarcopenic female patient (Right) and of a sarcopenic female patient.