# Spatial Characterization of Luminal Tapering in the Abdominal Aorta Using *In Vivo* CT Imaging

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The abdominal aorta demonstrates progressive reduction of luminal area from the aortic hiatus to the infrarenal level. Spatial characterization of this tapering using CT is essential for hemodynamic modelling, vascular surgical planning, and biomechanical modeling. Normative tapering data across discrete anatomical levels using ROI remains limited in current literature. This study aimed to quantify and spatially characterize luminal tapering of the abdominal aorta, to evaluate segmental and total tapering patterns, and to assess sex-based differences including the upper-to-lower tapering ratio as a novel index of segmental tapering distribution. A retrospective descriptive study was conducted using CECT abdomen images of 216 healthy adults (108 males, 108 females; mean age=53.8±15.4 years). Luminal cross-sectional area (CSA)was measured using ROI analysis at three anatomical levels (aortic hiatus, suprarenal, and infrarenal) using the RadiAnt DICOM viewer. Absolute and relative tapering were calculated for upper segment (aortic hiatus to supra renal), lower segment (suprarenal to infrarenal) and total aorta (aortic hiatus to infra renal). Upper to lower tapering ratio was derived for both absolute and relative tapering, where a ratio less than 1.0 indicates lower segment dominance. Statistical analysis was performed using Jamovi. Statistical significance was set at $p<0.05$. Lower segment relative tapering was significantly greater than upper segment in both males (30.16% vs 19.93%, $p<0.05$) and females (34.94% vs 22.42%, $p<0.05$). Males demonstrated significantly greater total absolute tapering ($p<0.05$) while females showed significantly greater total relative tapering (50.99% vs 44.94%, $p<0.05$). The mean±SD upper-to-lower relative tapering ratio was 0.626±3.761, with 79.6% demonstrating lower segment dominance. The ratio did not differ significantly between sexes ($p>0.05$). Significant progressive luminal tapering was confirmed across all three levels with greatest tapering in the infrarenal segment in both sexes. Males exhibited greater absolute tapering while females demonstrated greater relative tapering. The upper-to-lower tapering ratio provides a novel index of segmental tapering distribution. These normative values provide clinically relevant reference data for vascular intervention planning and biomechanical modelling of the abdominal aorta.

**Keywords**: abdominal aorta, luminal tapering, cross-sectional area, CECT, ROI, tapering ratio