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# Application of geometric morphometrics and cross-sectional geometry to the study of the morpho-functional dynamics of the femur: a preliminary analysis

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One of the main goals of the study of posture and biomechanics is to understand the relationships between the structural organization and the functional dynamics of the anatomical elements which compose the body. The structure morphology of bones is closely associated to their function, but, a consensus on the correlation between bone structure and function has not yet been achieved. The aim of this study is to provide for the first an integrative approach to the study of bone structure. We propose to integrate the study of shape of the bone (i.e., the geometric morphometrics approach) with the study of biomechanics of the bone (i.e., the cross-sectional geometry approach) to understand the morpho-functional variation of the femur. The geometric morphometrics analysis allows to quantify the geometric variation of the anatomical structures by using Cartesian coordinates. The cross-sectional geometric analysis, based on the geometric distribution of bone in a cross-section, provides information on the direction and magnitude of the forces to which the bone is subjected during postural dynamics. The analysis was computed on a sample of CT-scan cross-section of the femur at midshaft. This analysis shows that the direction of the major load at this level is correlated with antero-lateral and postero-medial variations of the section, in agreement with the mechanical loading of the femur at midshaft. Because of the small sample size these results should be considered as preliminary. However, they provide the first morpho-functional characterization of the femur and represent a useful starting point for future investigations.

Key words
Cross-sectional geometry, geometric morphometric, posture, femur