Appendix E-1: Measuring Forearm Rotation Osteologically (2-Camera Setup)

A 2-camera setup technique was adapted from a previously described osteological method for evaluating lower-extremity rotation (Fig. 1). Clay dots were placed on the respective osseous landmarks (the bicipital tuberosity, the radial styloid, the coronoid process, and the ulnar styloid). The radius or ulna was then placed between 2 cameras, such that camera viewfinders were aligned axially along the shaft of the bone to obtain photographs of the proximal and distal ends of the bones. The photographs were exported into the ImageJ software package (National Institutes of Health). The proximal and distal axial centers of each bone and the respective landmarks were recorded. The rotational angle (θ) formed between the respective axial centers and osseous landmarks was calculated:

$$\theta = \arctan \frac{Vertical\ difference\ between\ osseous\ landmarks}{Horizontal\ difference\ between\ osseous\ landmarks}.$$

The overall rotational measurement of each bone (Ψ) was calculated by subtracting proximal from distal rotational angles: $\Psi = \theta_{distal} - \theta_{proximal}$. Sign conventions (+/−) were adjusted on the basis of the laterality of each specimen, with a positive value for Ψ defined as the distal landmark being "supinated" in reference to the proximal landmark.
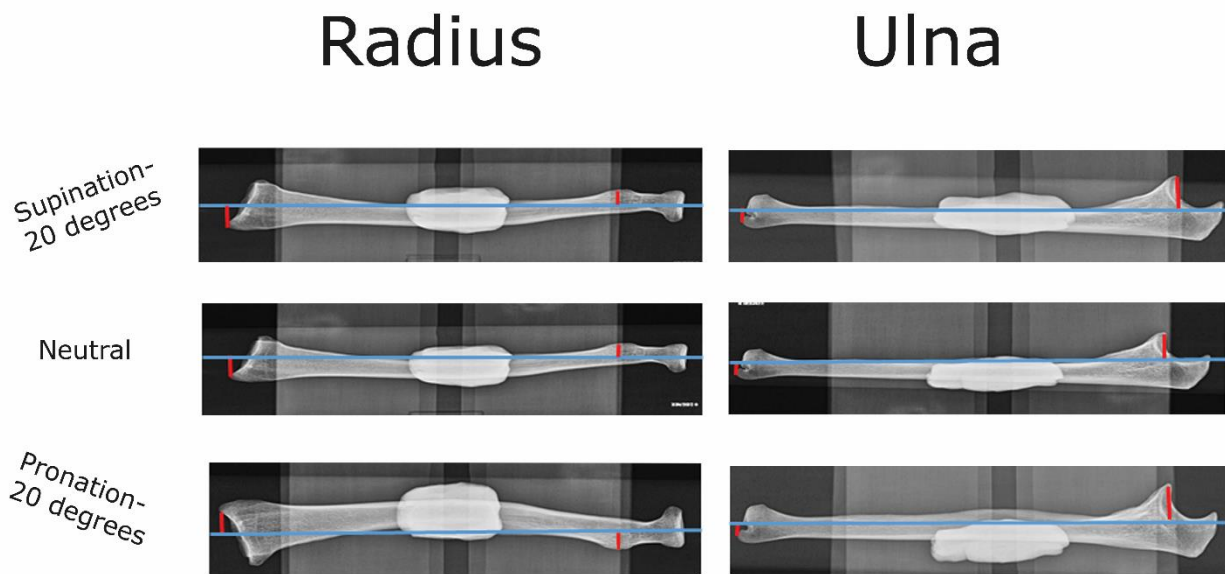

Fig. E-1
A corollary radiographic analysis of incremental rotation was performed. The results confirmed the findings of the photographic tilt-board experiment.