A study of 2D landmark data accuracy in representing 3D mouse skull form.

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Though 3D landmark technology is increasingly available, studies still incorporate 2D landmarks for ease, budgetary reasons, and theoretical appropriateness. Understanding how accurately 2D landmarks reflect 3D objects is necessary to improve research design, to determine the aptness of 2D data, and to enable integrated analysis of 2D and 3D landmark datasets. To characterize the differences between 2D and 3D data, we acquired photographs of the inferior, lateral, and superior aspects of thirty mouse skulls. 2D coordinates of 15 visible landmarks were captured from these images and scaled for comparison. Micro-CT images were acquired for these skulls and 3D coordinates of all landmarks were recorded using eTDIPS software. Linear distances (LD) between landmark pairs were calculated from the 2D (LD₂D) and 3D (LD₃D) landmark coordinates. Differences between corresponding LDs (LD₃D−LD₂D) were calculated. We hypothesized that 1) overall, LD₃D > LD₂D and 2) LD₃D−LD₂D will increase as the distance between involved landmarks along the plane perpendicular to the 2D camera lens increases.

Most LD₃D−LD₂D are significantly different from zero, but are quantitatively small. Our results support hypothesis 2. Surprisingly, LD₂D > LD₃D in some cases. This seems to be a product of 2D measurement scaling and the variation in distance of some 2D landmarks from the lens of the camera. Although 3D landmarks may represent biological forms more accurately, 2D landmarks can provide accurate spatial data; the degree of accuracy depending on the relative orientation of the biological surface and the photographic plane.

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