Purpose:To efficiently visualize and accurately edit presegmented anatomies for radiotherapy planning in a fully 3D setting.

Methods:Anatomy representations (contours, surfaces) derived from prior segmentations are recreated as implicit surfaces--the zero level sets of implicit functions f(x,y,z)=k whose shapes are defined by radial basis functions (RBFs) centered on, and along normals to, the zero level (k=0). These smooth and continuous surfaces are re-shaped by altering the number and arrangement of the RBFs. Using a standard contouring program, the user overdraws the surface profiles in any combination of transverse, sagittal, or coronal views, and the 2D curves comprising the differences between the original surface profiles and the user edit-contours determine the arrangement of the new RBFs. Constructing smooth shape transitions between the new and old portions of the surface is a challenge--several methods were developed to define that portion of the surface spanned by the edit curves and to insure that the geometric transition from the old to the new surface is smooth and accurately renders the intended change. The surface reconstructed between the user-drawn edit contours is a form of spline interpolation, so that a few inputs can smoothly redefine a large surface. Extensive parallelization enables this expensive computation to run in nearly real time.

Results:The management of RBFs removed from the original shape and added to the new shape is essential to obtain a comprehensible and correct updated surface. Such surfaces are smooth and continuous and accurately represent the anatomy viewed in the drawing program single plane views. The updates are computed in 1-3 s and the user can operate in those views that provide the greatest shape information.

Conclusions:We present a novel method to efficiently edit 3D anatomic shapes by operating directly on the implicit surface representing the anatomy.

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