Quantifying body composition from CT scans using commercially available software:

Applications in radiology

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Introduction

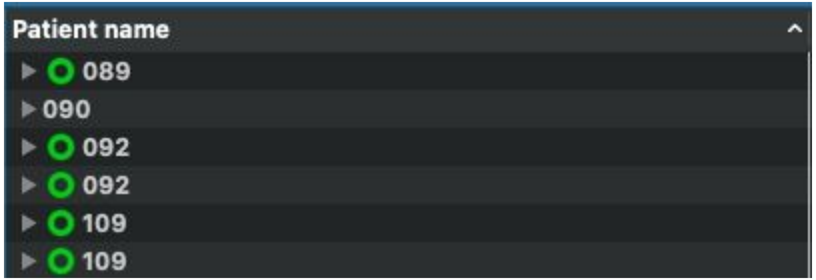
- Interest in body composition measurement techniques have skyrocketed over the last few years
- Measurement of this data has value in answering important research questions in many patient populations
  - Cancer patients
  - Transplant candidates and recipients
  - Other procedures (TIPS, EVAR)

Purpose

- Here we will provide an overview of a precise method to obtain body composition data from CT scans using the commercially available software OsiriX (Pixemo, Switzerland)

Methods

- OsiriX can be linked to an institution's DICOM network for easy retrieval of desired studies
- Patient data can be anonymized through the software to remain compliant with research protocols

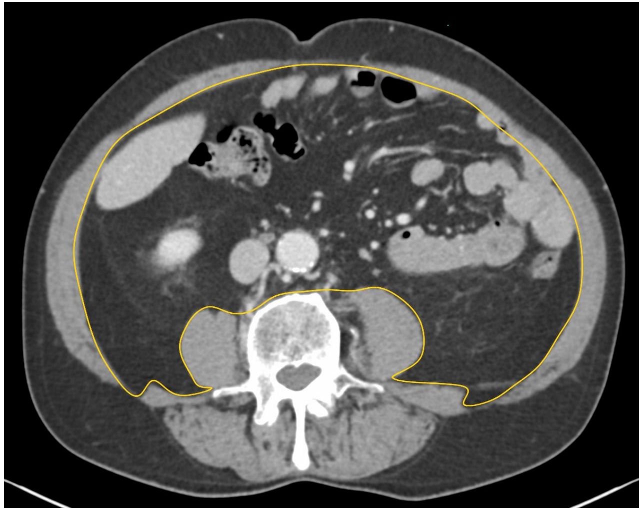


Methods

- Once a study is opened, localize the L3 vertebral level using the sagittal view and locate a slice at the L3 vertebral level
- Proceed with segmentation using the axial view

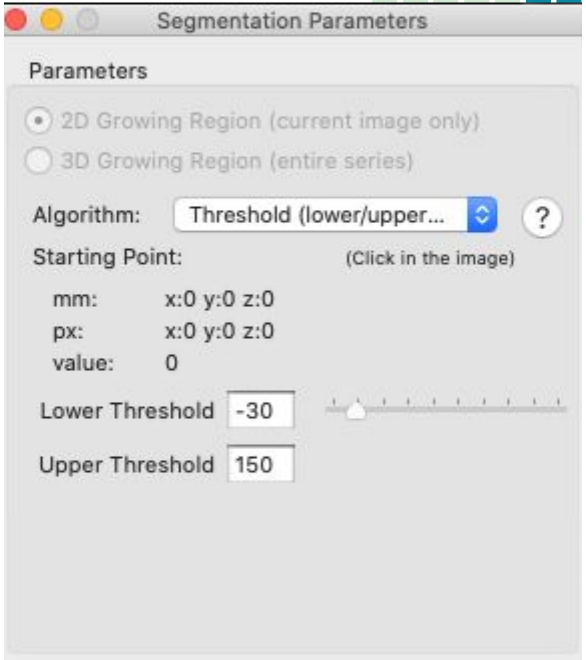
Methods

- On the selected axial slice, use the closed polygon tool to draw a boundary between the abdominal muscle layer and the visceral adipose tissue layer as shown



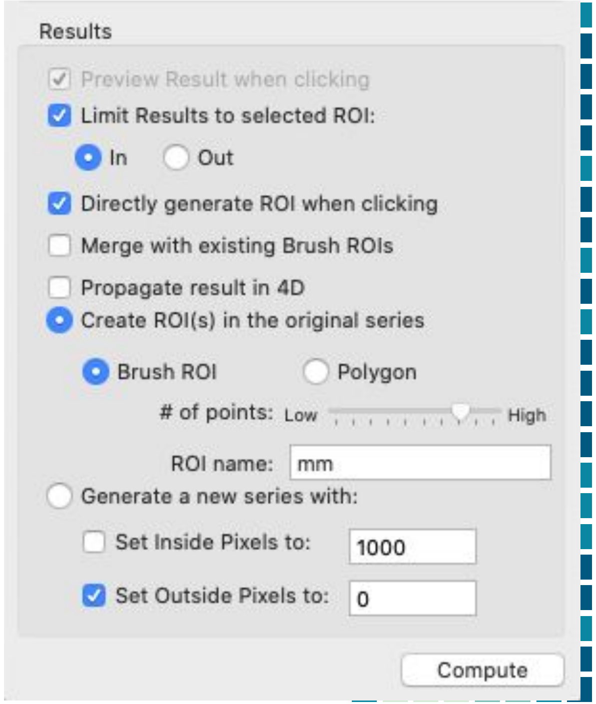
Methods

- Next the "Grow Region 2D/3D Segmentation" tool is used to create ROIs with chosen upper and lower HU values
- The three tissue types chosen for segmentation with their HU thresholds reported in the literature are below:
  - Subcutaneous Adipose Tissue (SAT): **-190 to -30 HU**
  - Visceral Adipose Tissue (VAT): **-150 to -50 HU**
  - Skeletal Muscle (MM): **-29 to +150 HU**

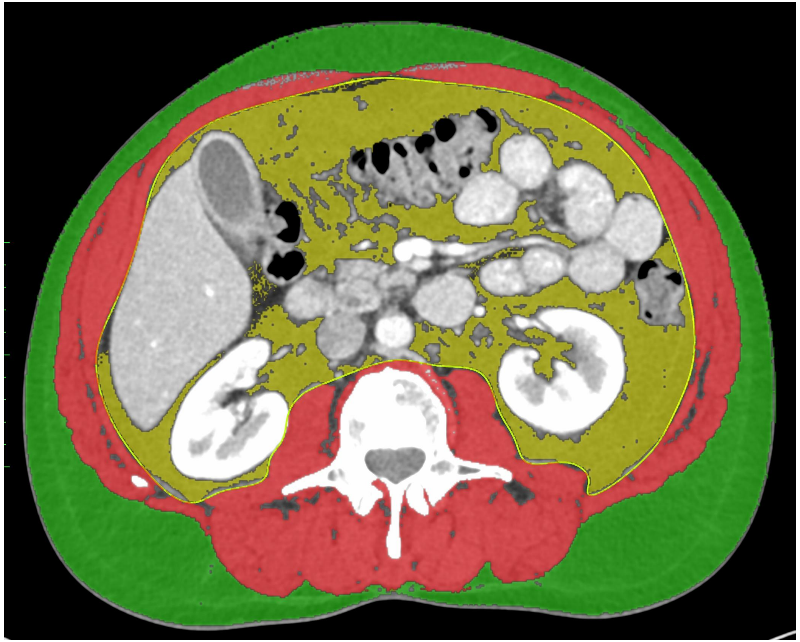


Methods

- When segmenting skeletal muscle and SAT, select the “Out” option to ensure that only pixels outside the polygon are chosen to represent this tissue
- Similarly, segmentation of VAT requires selection of the “In” option
- Label each ROI appropriately



Methods



Green: Subcutaneous Adipose Tissue (SAT)

Red: Skeletal Muscle (MM)

Yellow: Visceral Adipose Tissue (VAT)

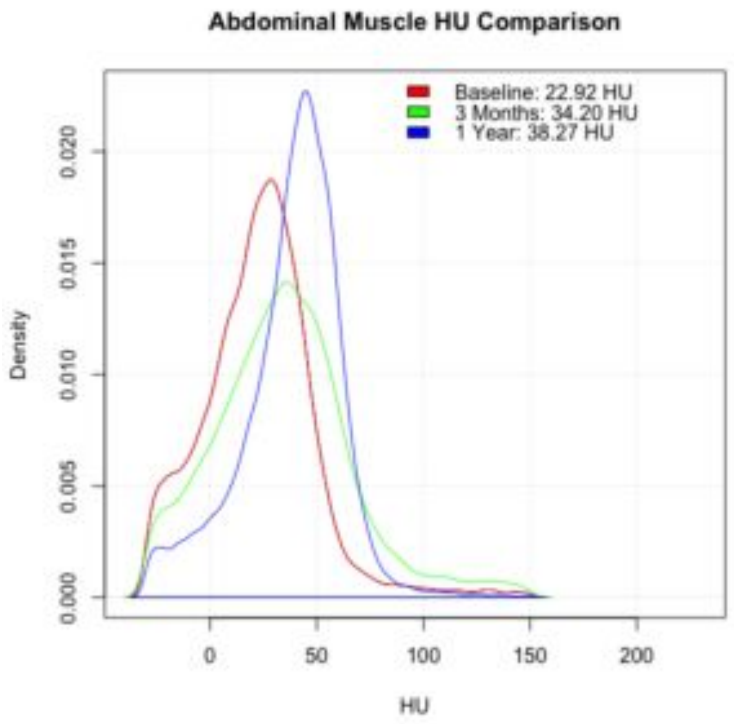
- Example of final segmentation
- Data can be exported using the “ExportROIs” plugin which creates a .csv file
- Relevant data includes the total area of the ROIs by label as well as the HU distribution within the tissues

Reliability Test

- An attending radiologist, a PGY-1, and a MS-2 segmented and quantified VAT, SAT, and skeletal muscle at the L3 vertebral level from 140 CT scans using this method.
- The area data of all three tissues was exported from OsiriX for statistical analysis.
- An intra-class correlation coefficient (ICC) calculation demonstrated an ICC of **0.998** for SAT area, **0.999** for VAT area, and **0.995** for skeletal muscle area.

HU Density Plots

- HU data from skeletal muscle can be used to create density plots using the software R (R Core Team, Austria)
- Changes in muscle density can be measured over time and graphically visualized using these plots



Conclusions

- The method described appears to accurately measure body composition metrics from CT scan regardless of the training level of the reader.
- This technique can be useful in prognostic studies where body composition can be correlated to patient outcomes i.e. oncology or surgical patients.
- Studies that follow patients with serial CT scans can use this technique to detect longitudinal changes in body composition.

References

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