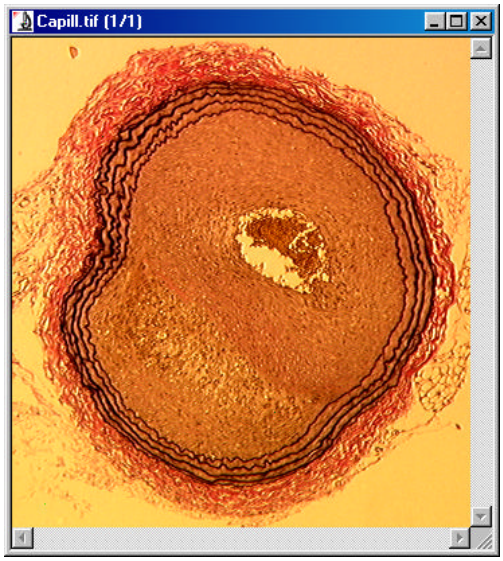
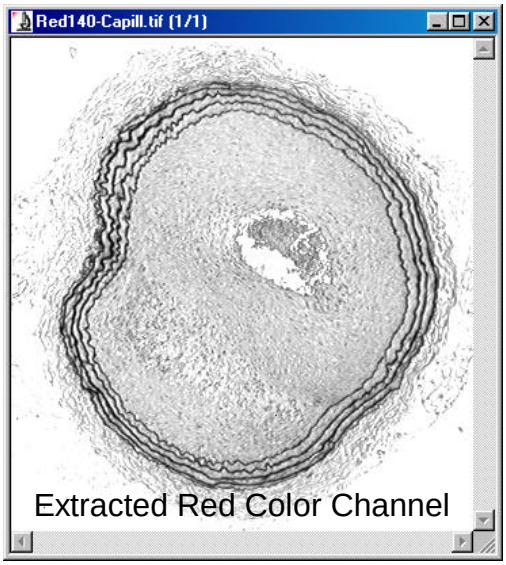
Measurement of Vessel Occlusion



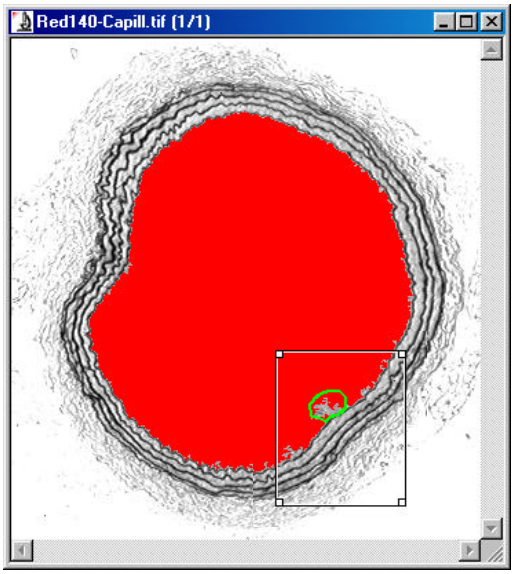
How can the degree of occlusion or stenosis in this image of a blood vessel be measured?

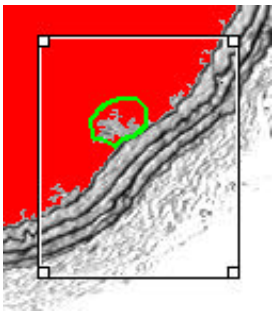
Although color images are desirable in many instances, it is not always necessary to work with the color image itself for successful image analysis. In this case, it was easier to separate the color image into its Red, Green, and Blue (RGB) color channels and work with the Red channel.

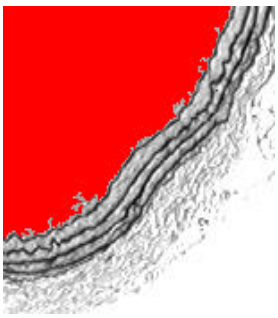


Extracted Red Color Channel

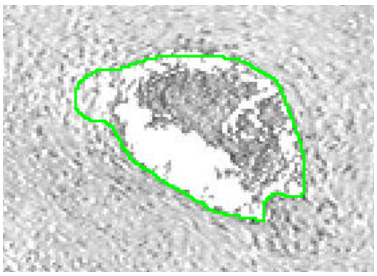
Solution:
1. Extraction of the Color Channels
2. Automatic Bright Object Count on Red Channel (Clean Borders set to All Borders and Fill Holes selected)
3. Manual image editing
4. Manual outline of vessel lumen
5. Creation of Mask (Binary) Images
6. Boolean XOR operation between masks
7. Measurement of Hole Ratio

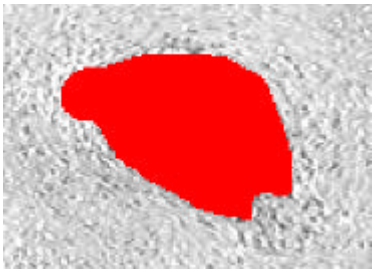




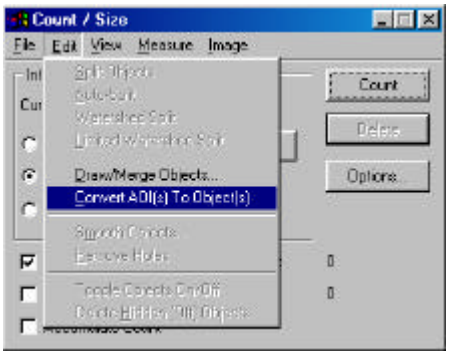


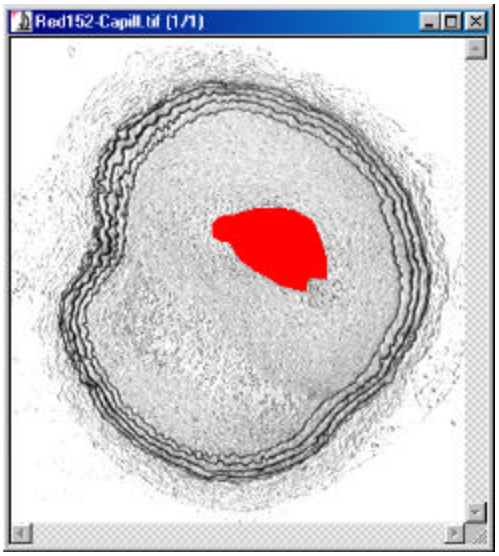
Often if is difficult to perfectly segment the region you want to measure. A small, darker region inside the vessel did not lie within the threshold range and was easily included manually. An AOI (area of interest – in yellow) was drawn around the unselected region and converted into part of the object.



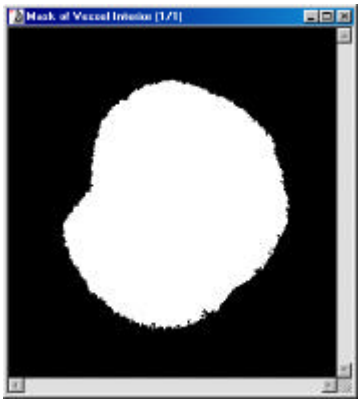


The space representing the remainder of the vessel lumen is manually outlined and the AOI is converted into an object.

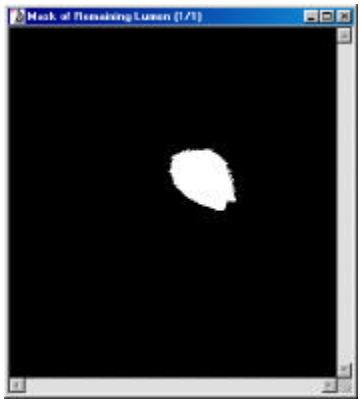




Mask (Binary) images are created fot the interior of the vessel and the space representing the lumen. The mask images are combined using a Boolean XOR (exclusive OR) operation to generate the image on the far right.



XOR



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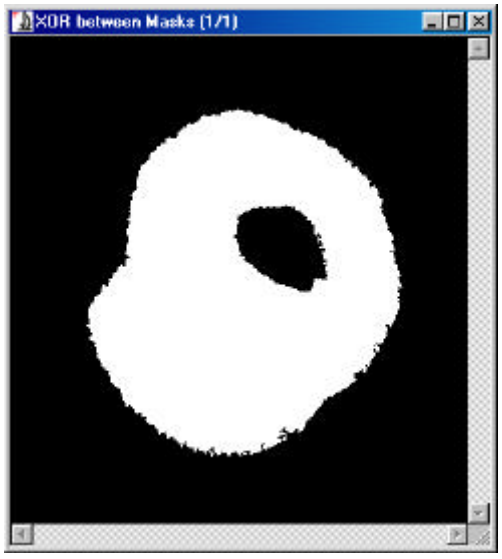
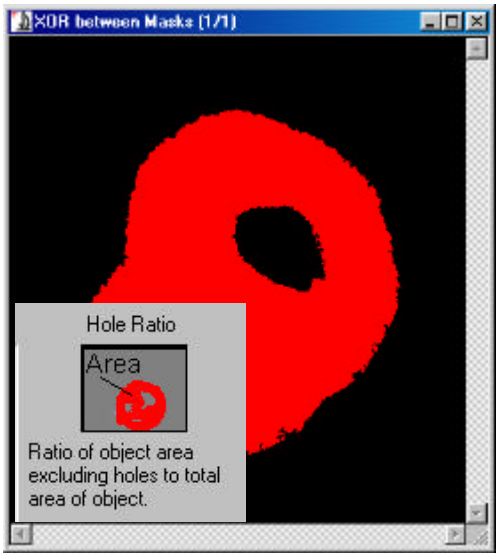
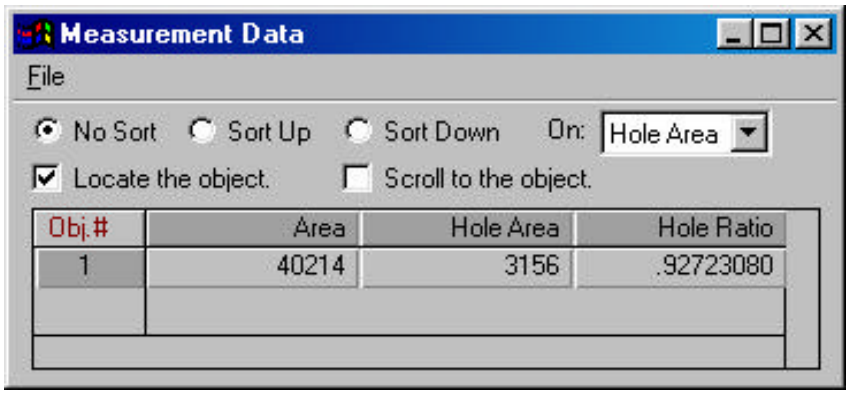




Measurements: Area of the object, Area of the Hole within the object, and Hole Ratio (ratio of object area, excluding holes, to the sum of the object area and hole area)



Obj.#	Area	Hole Area	Hole Ratio
1	40214	3156	.92723080

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