



ENIGMA-SHAPE

Subcortical Shape QA Manual

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Quality Assurance Basics

It is important to check the quality of the shape models generated by the ENIGMA Shape Analysis pipeline. After creating the subcortical shape models and running the Auto QA steps to generate .png images for each subcortical shape model, you are ready perform a visual quality inspection.

Requirements:

1. QA .png images generated using the *Auto QA for Subcortical Surfaces* protocol.

Steps:

1. Create a quick QA Log to keep track of your ratings for all structures (see example QA log on following slide)
2. View and rate all shape structures from 1-3 (examples in following slides)
 - **3: Pass**
 - **2: Moderate Pass**
 - **1: Fail**

QA Log Example

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Subject ID	ROI_11	ROI_12	ROI_13	ROI_17	ROI_18	ROI_26	ROI_49	ROI_50	ROI_51	ROI_52	ROI_53	ROI_54	ROI_58	
2	100														
3	101														
4	102														
5	103														
6	etc.														
7															
8															
9															
10															
11															
12															

Keep track of all 1-3 ratings for each structure in a QA Log.

QA Ratings

Quality rate all shape structures by viewing the .png files created by the AutoQA protocol. View each 3-D model as well as corresponding T1 image to check the accuracy of each shape model. The QA .png images include both the 3-D surface as well as shape boundaries overlaid on the T1 image to assess accuracy of the shape model.

- **3: Pass** – Shape accurately reflects true structure (based on T1) and is without any significant artifacts (spikes or holes). Shape boundaries reflect underlying anatomical boundaries to a great extent.
- **2: Moderate Pass** – Shape reflects true structure with minor artifacts (spikes or holes) and minor deviations from underlying anatomical boundaries.
- **1: Fail** – Shape inaccurately reflects structure with significant artifacts (spikes or holes) and/or under/overestimations of the underlying anatomical boundaries (based on T1).

QA Troubleshooting

From time to time you may encounter a subcortical model that deviates from the examples provided in this guide.

If you are unable to make a 1-3 rating for a given structure, please do not hesitate to forward specific QA questions (including .png of structure in question) to the IGC team for help:

Dr. Boris Gutman (bgutman@gmail.com)

Chris Ching (Chris.Ching@loni.usc.edu)

Adam Mezher (adammezher@gmail.com)

QA Examples

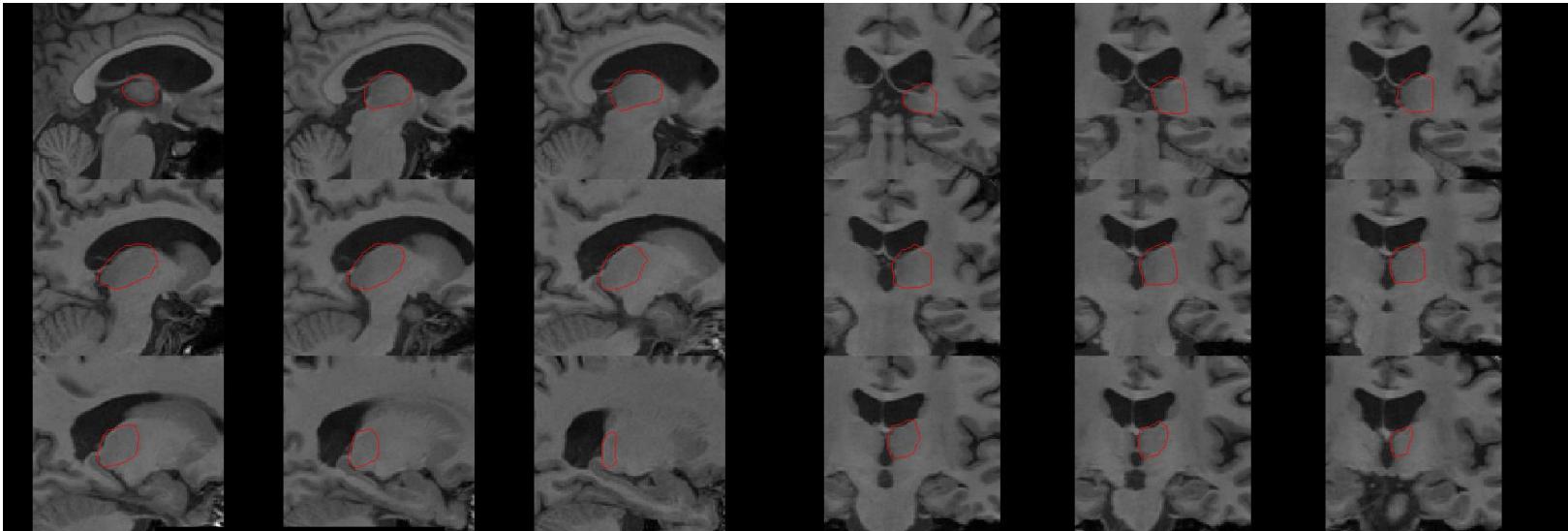
Including rating notes

ROI 10/49

Left/Right Thalamus

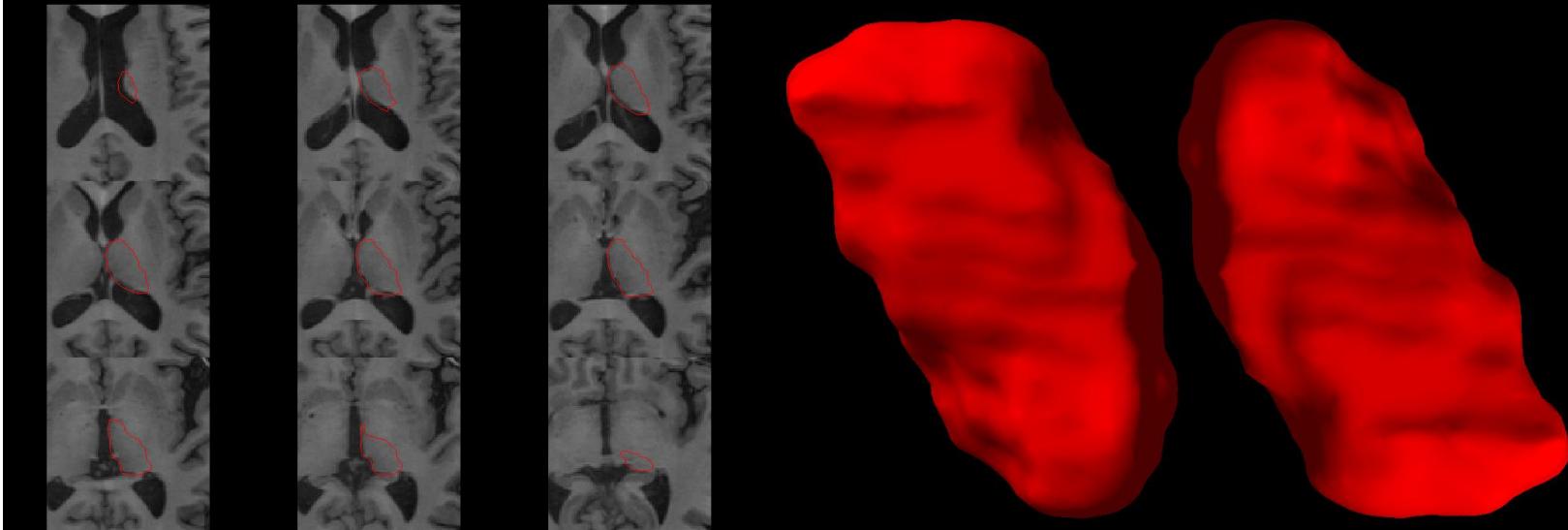
Overall: Very few fails unless T1 image quality is poor. Tends to be one of the most consistently segmented structures.

Rating: 3 (Pass)

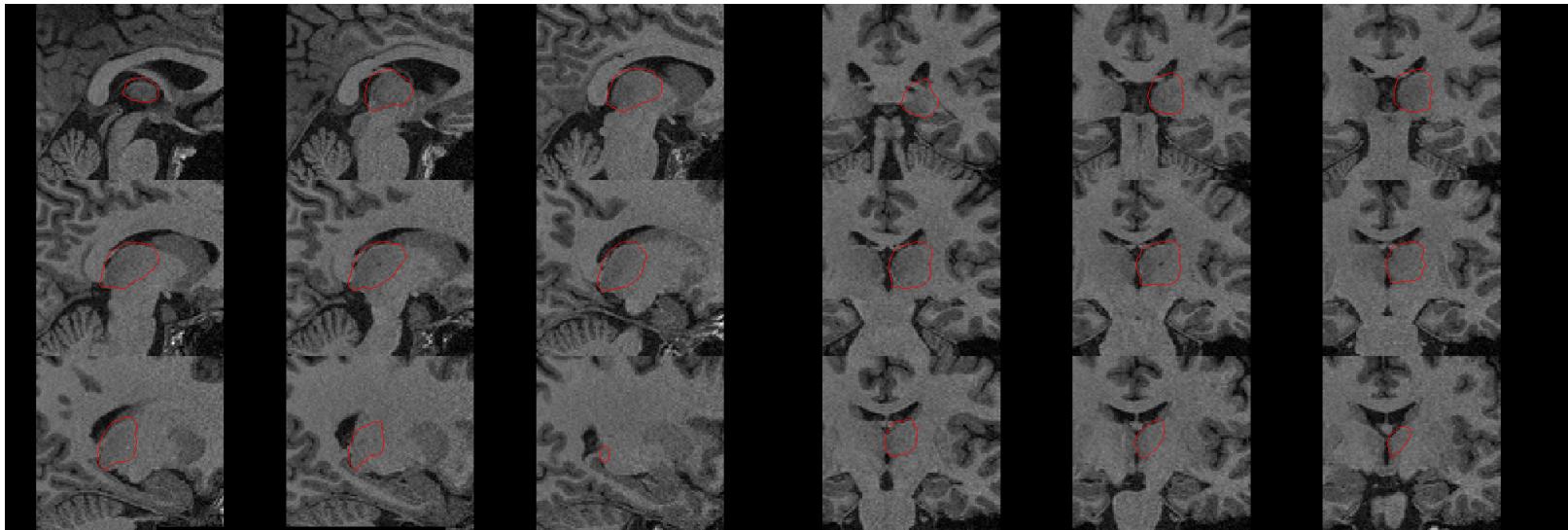


Z Score = 1.35: use

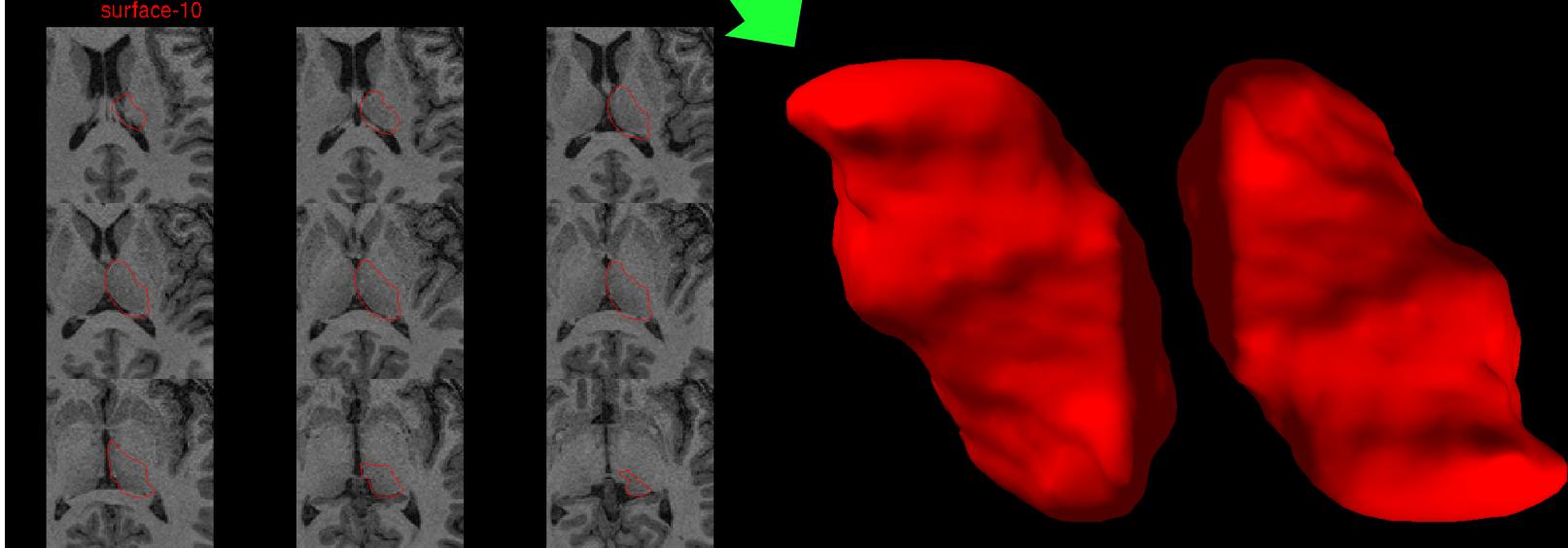
surface-10



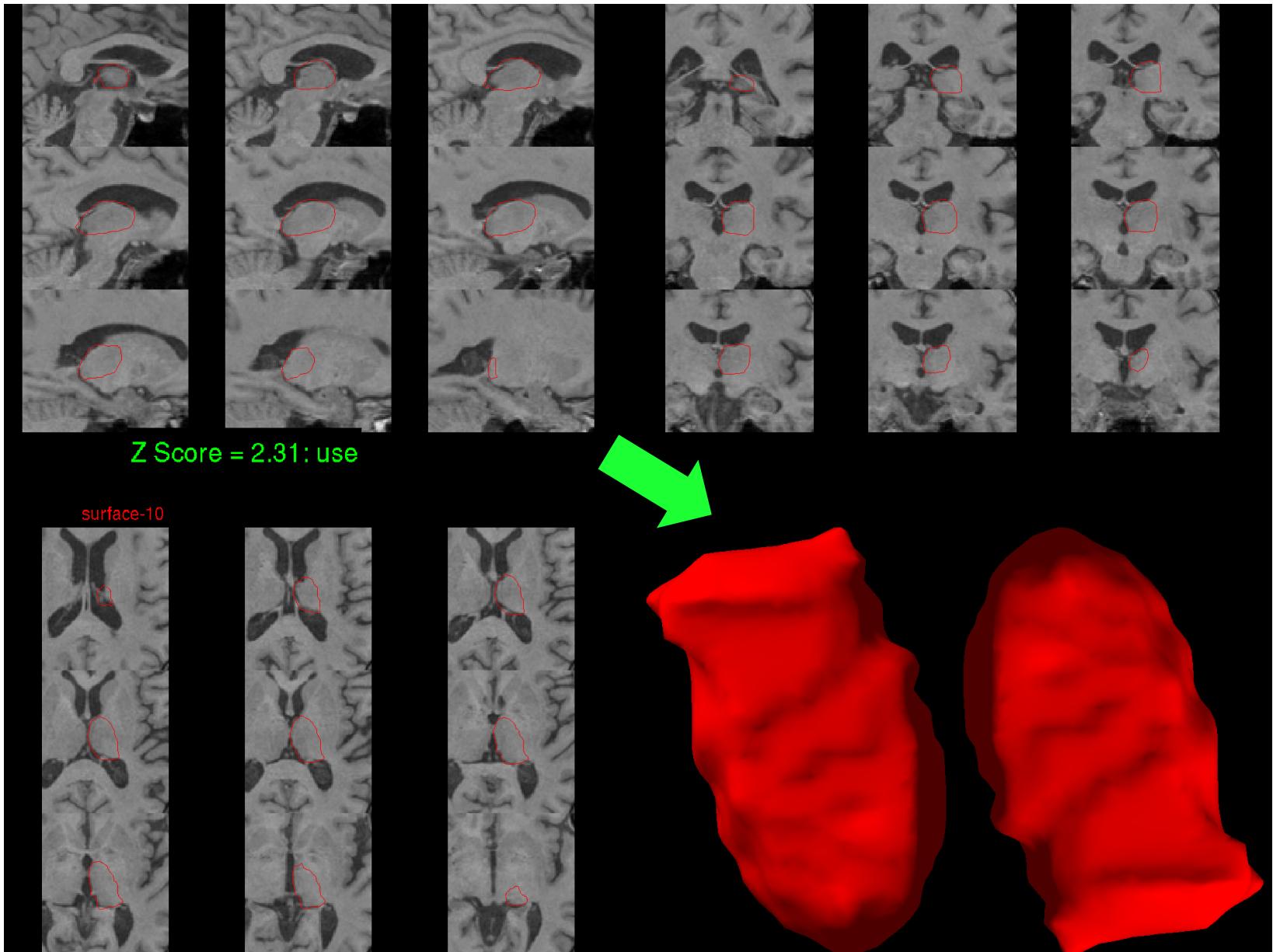
Rating: 3 (Pass) – Some minor overestimation and minor visual irregularity in posterior region. Generally reflects underlying anatomy.



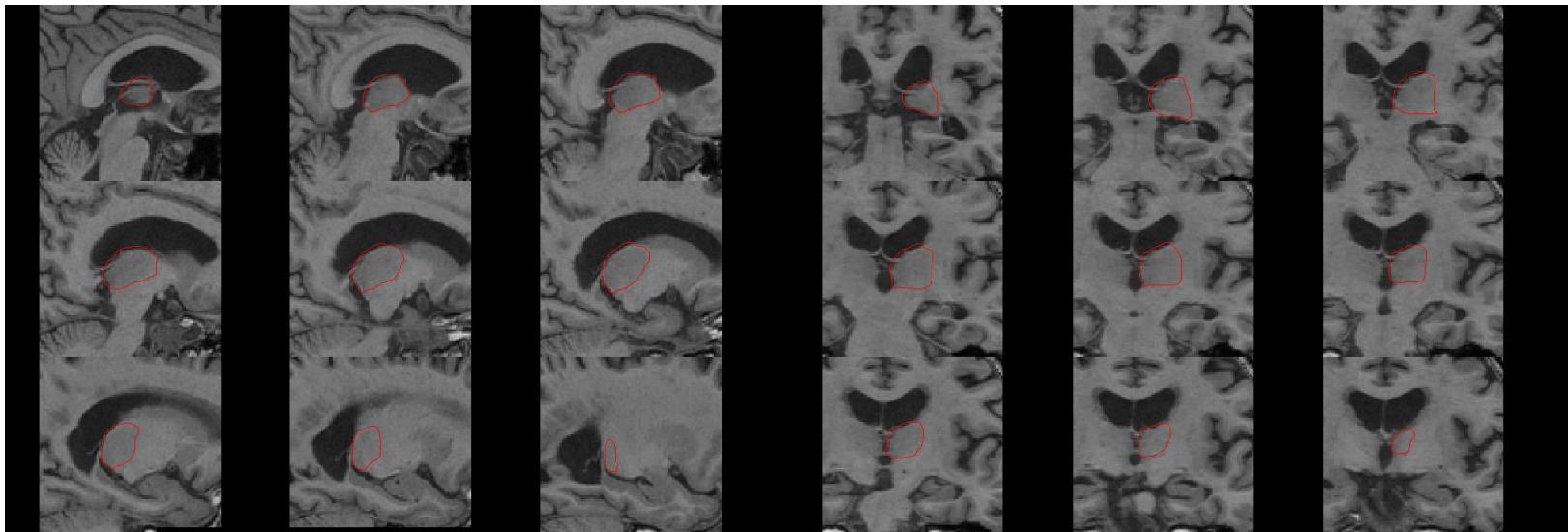
Z Score = 2.48: use



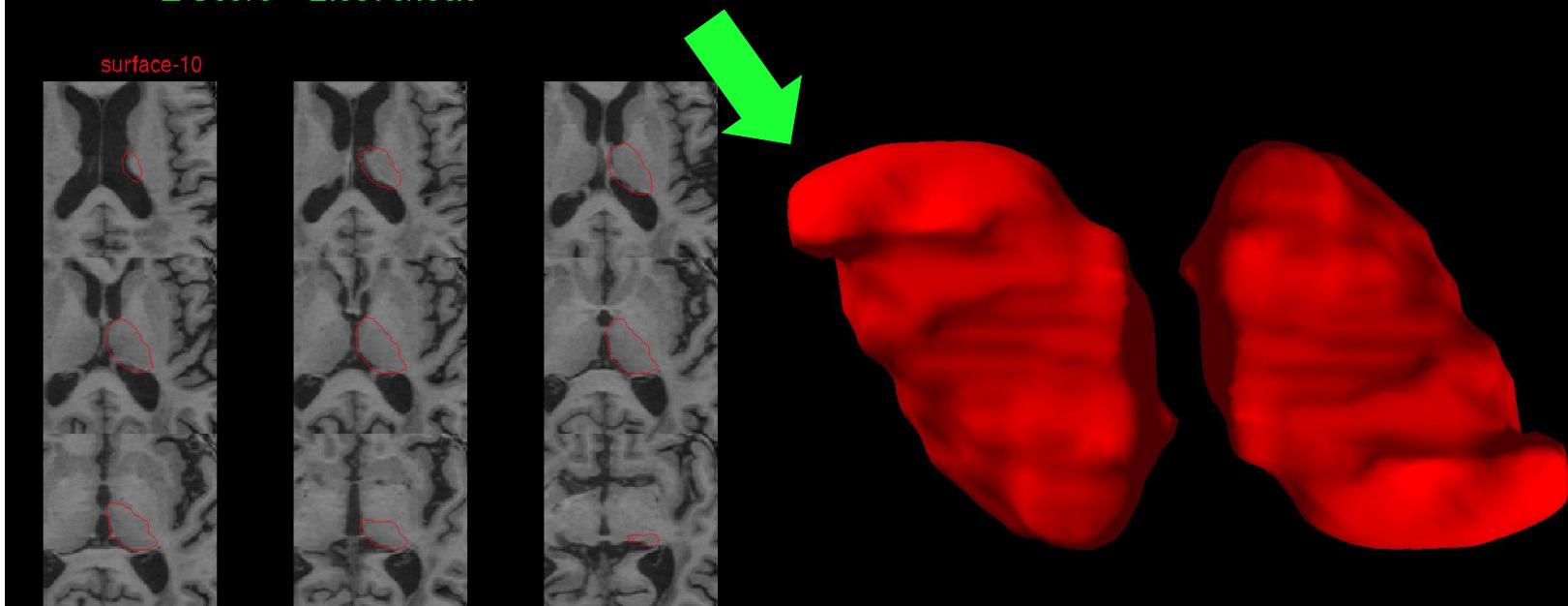
Rating: 3 (Pass) - Some minor overestimation and common posterior flattening of shape. Generally reflects underlying anatomy



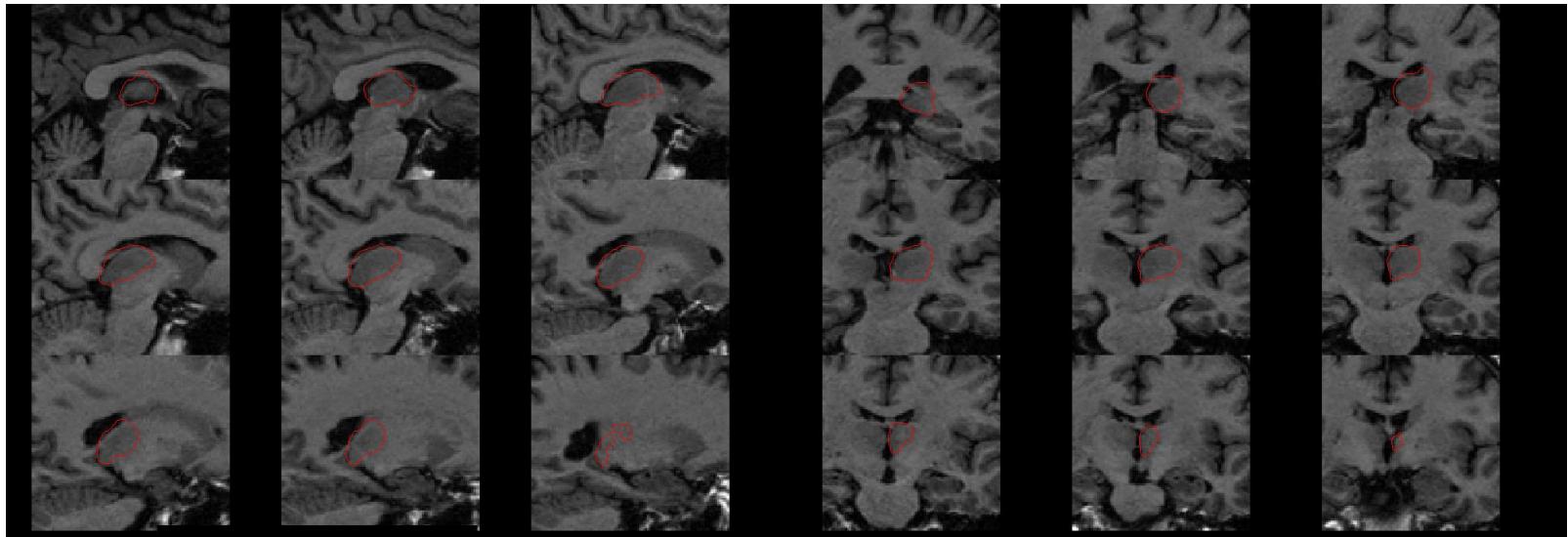
Rating: 2 (Moderate Pass) – Visually smaller (see Z score) and some posterior irregularity (arrow). Generally reflects underlying anatomy.



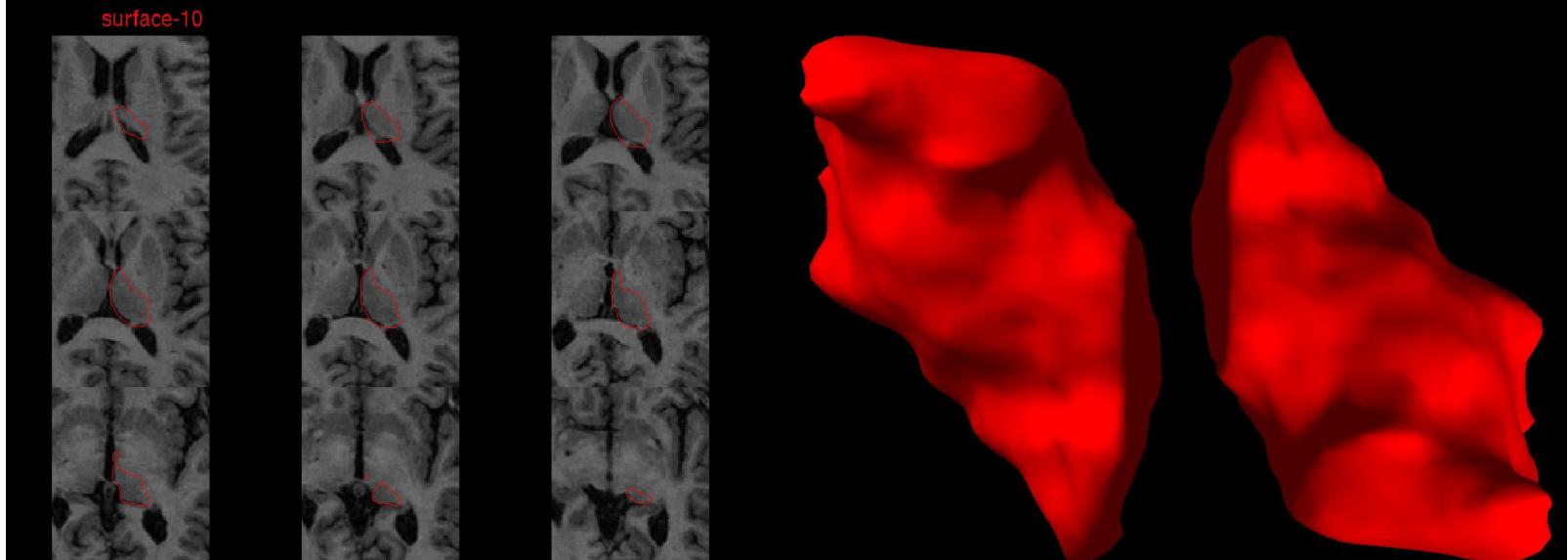
Z Score = 2.89: check



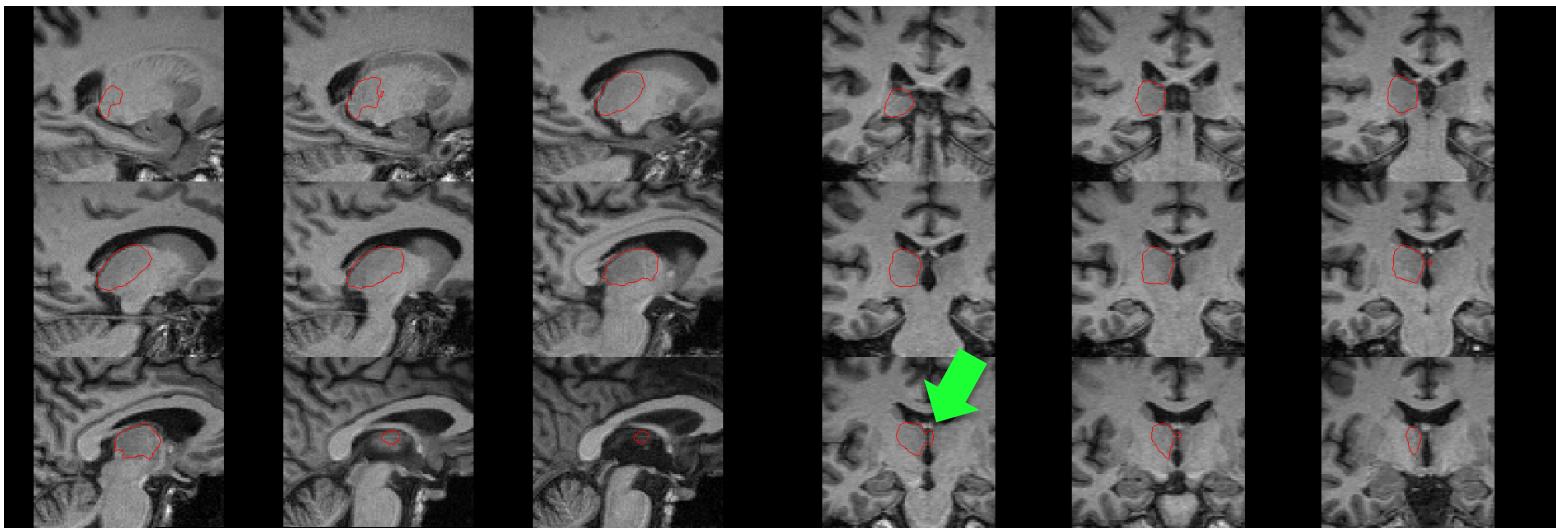
Rating: 2 (Moderate Pass) – Visual irregularities compared to other subjects with some border overestimation. Generally reflects underlying anatomy



Z Score = 2.81: check



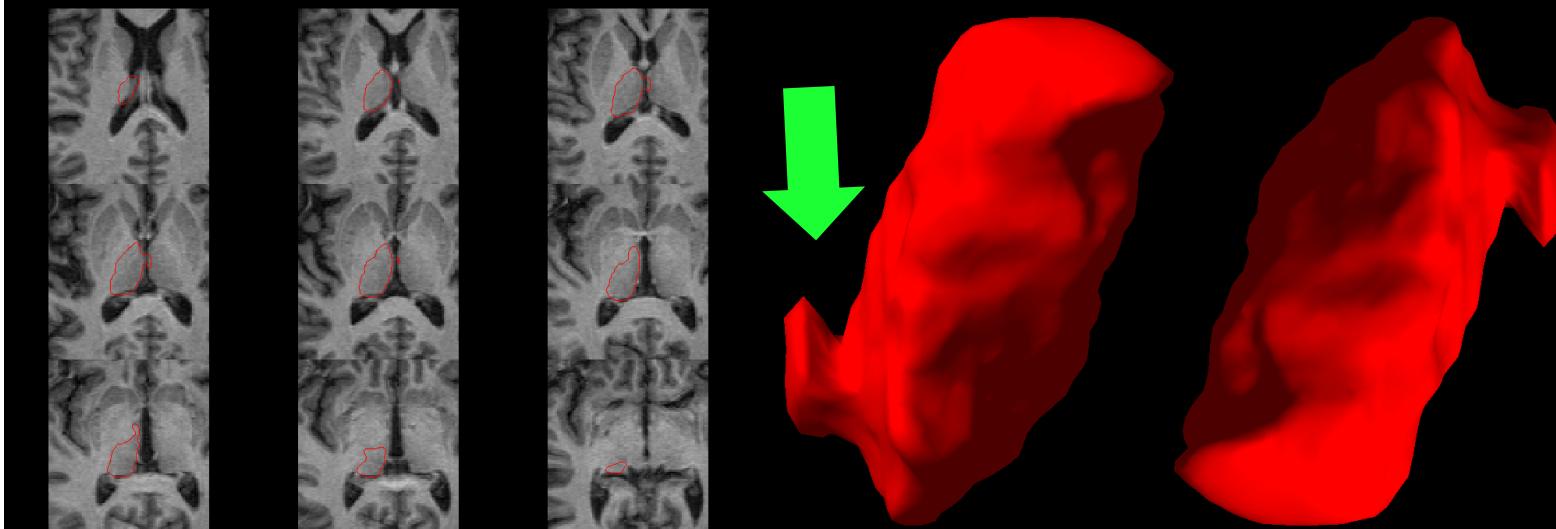
Rating: 1 (Fail) – Severe edge irregularity (arrow) that does not reflect underlying anatomy.



Z Score = 3.26: check

Subject: 44020

surface-49

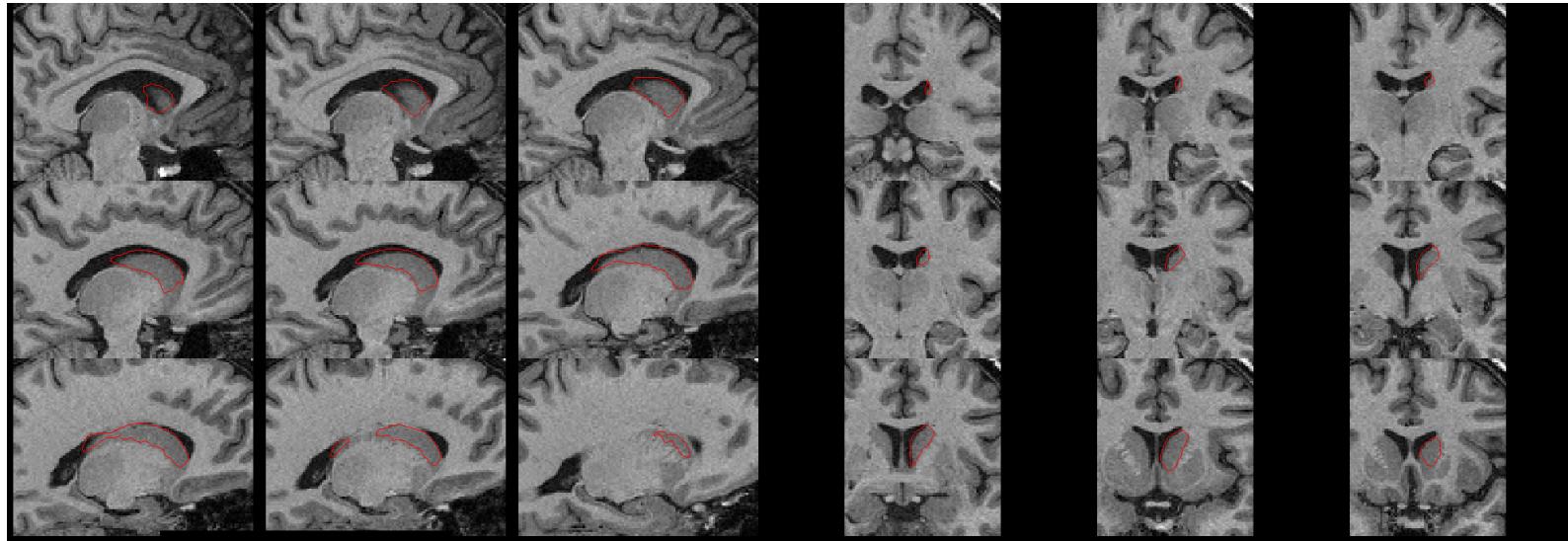


ROI 11/50

Left/Right Caudate

Overall: Very few fails unless T1 image quality is poor. Tends to be one of the most consistently segmented structures along with the thalamus.

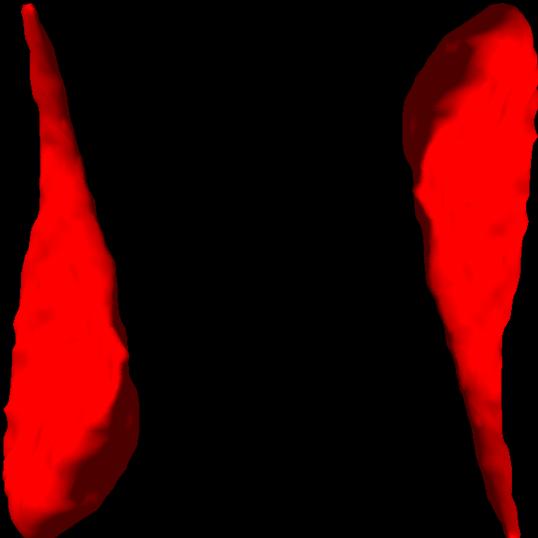
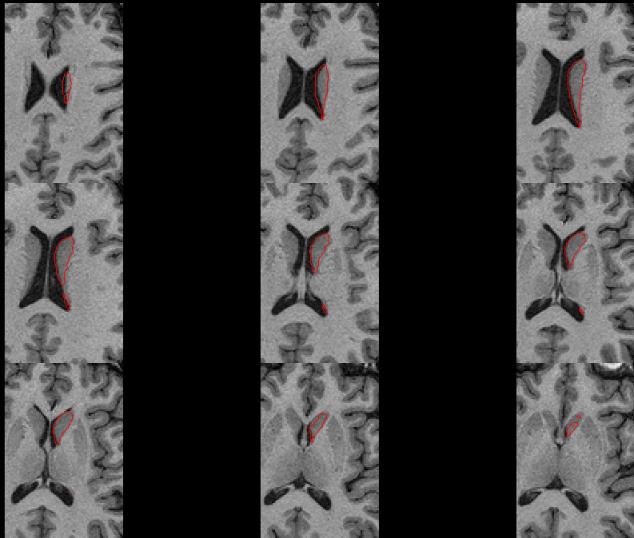
Rating: 3 (Pass)



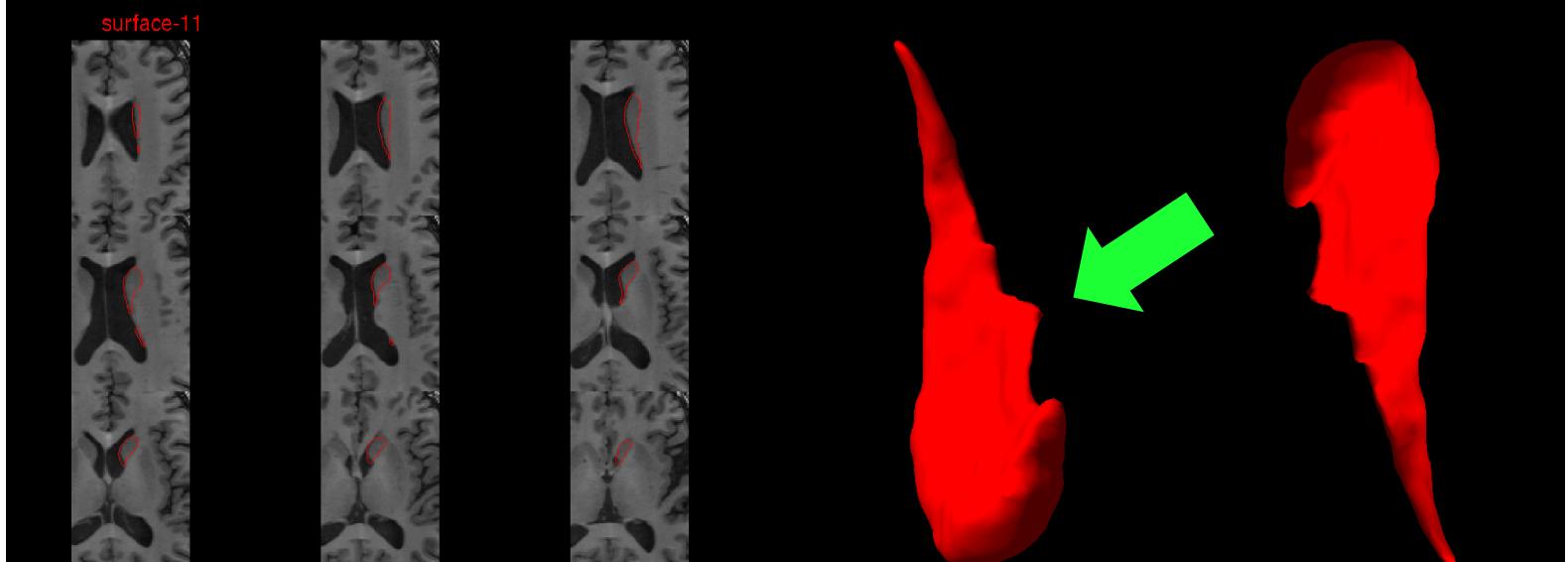
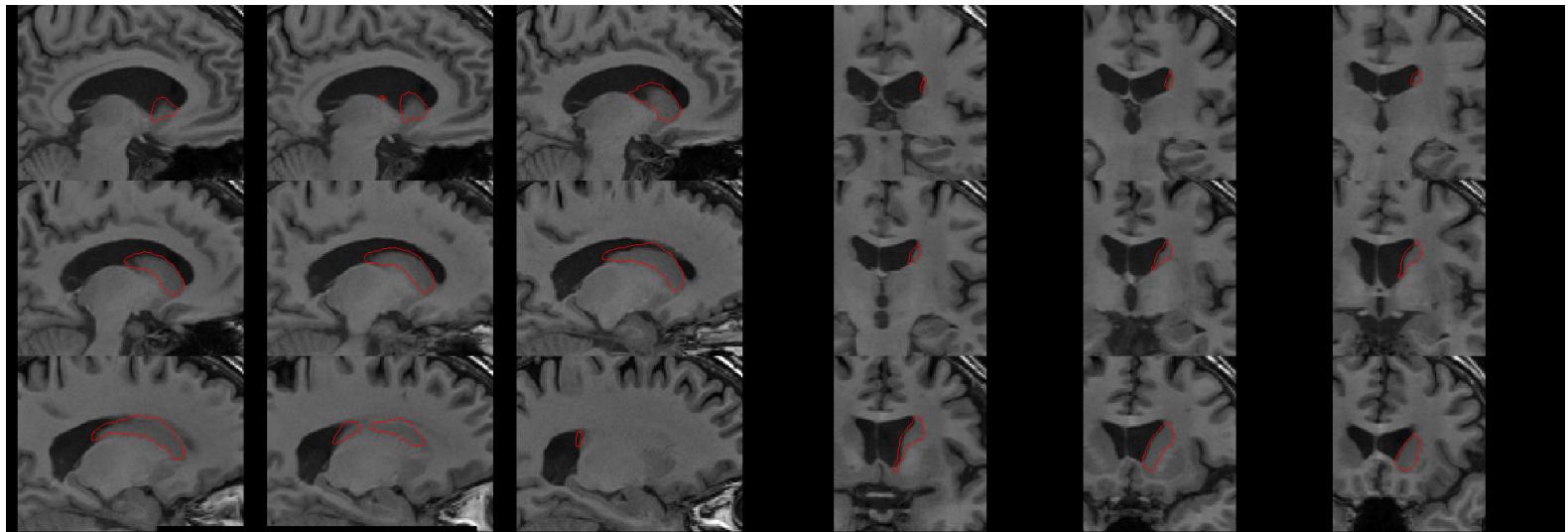
Z Score = 1.29: use

Subject: 3108

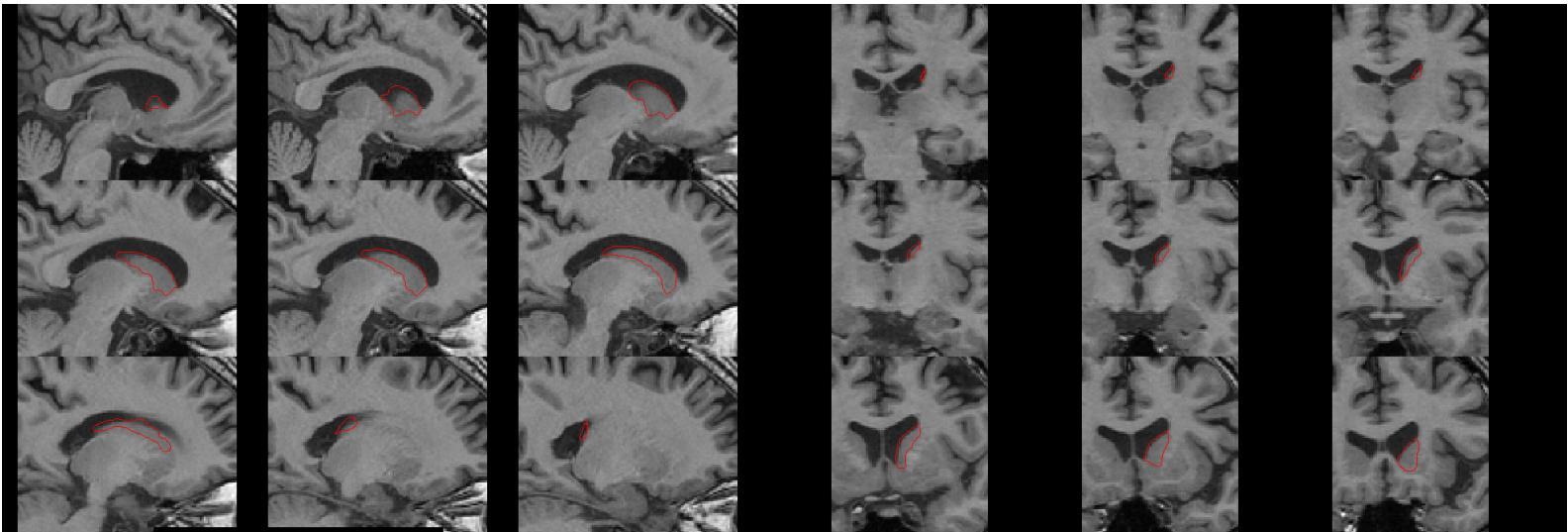
Surface++



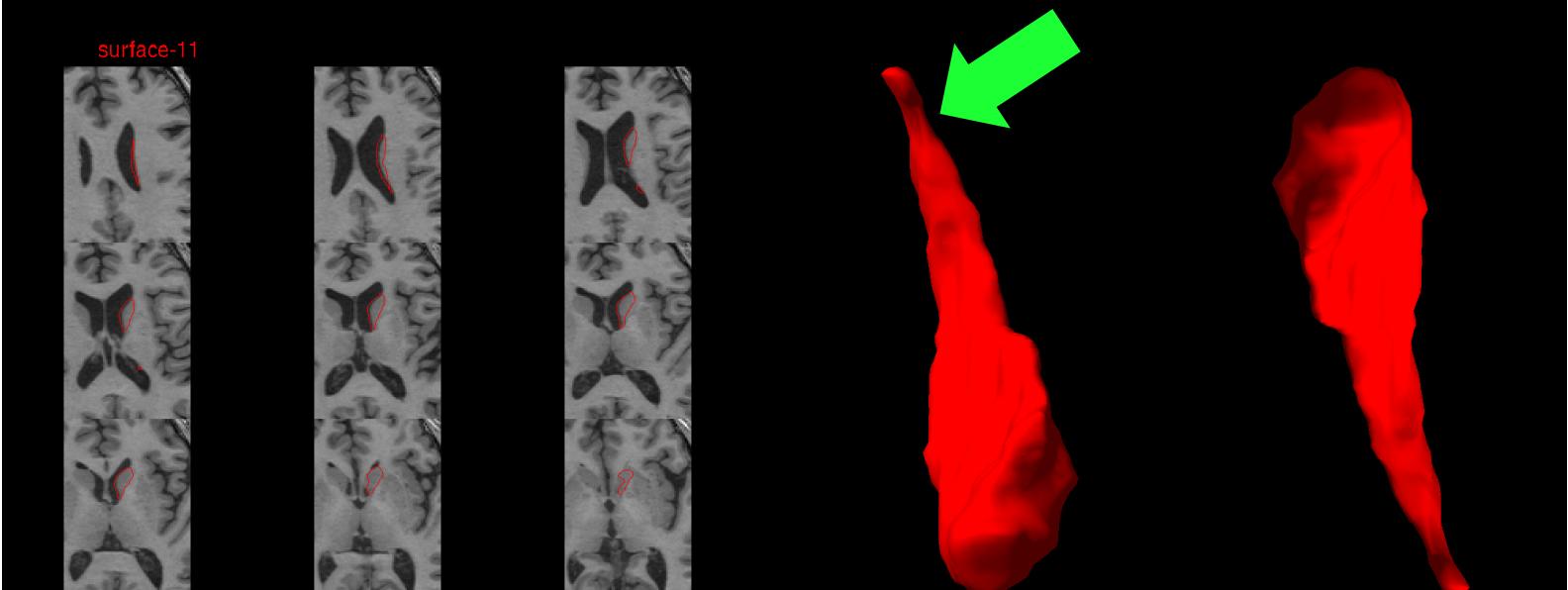
Rating: 2 (Moderate Pass) – Visual irregularities (jagged edge see arrow)
compared to other smoother subjects and some border overestimation, but generally
reflects underlying anatomy.



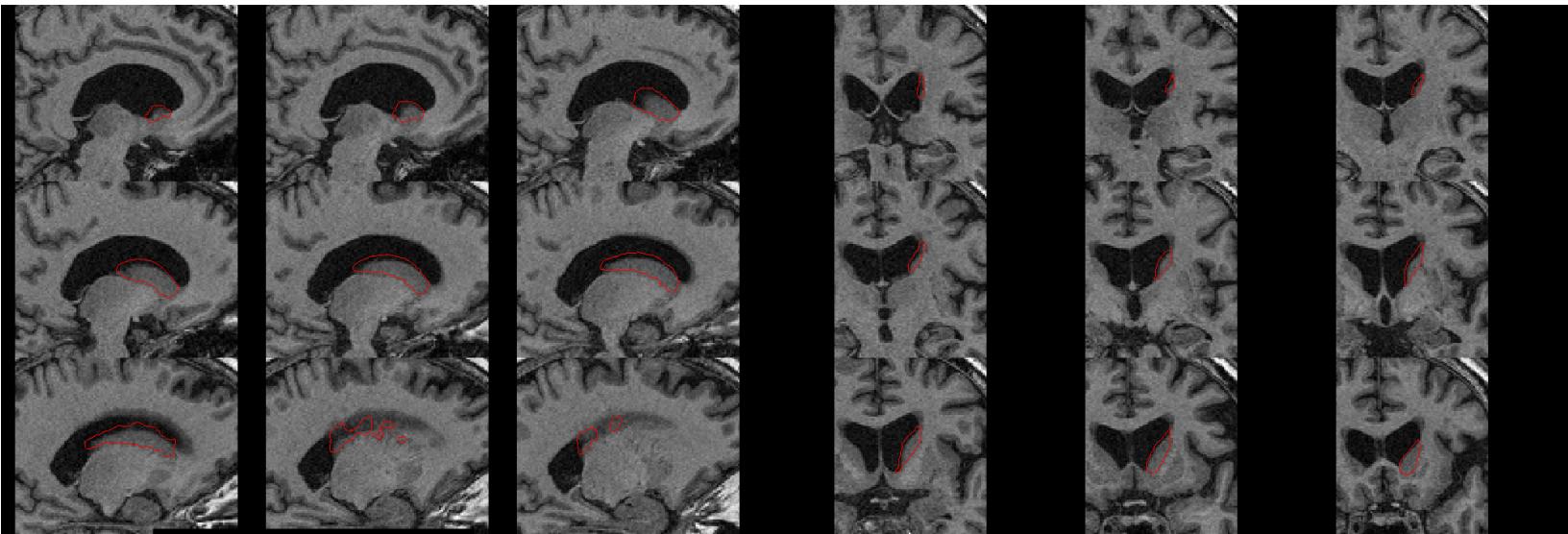
Rating: 2 (Moderate Pass) – Minor tail constriction (arrow) with some border overestimation, but generally reflects underlying anatomy.



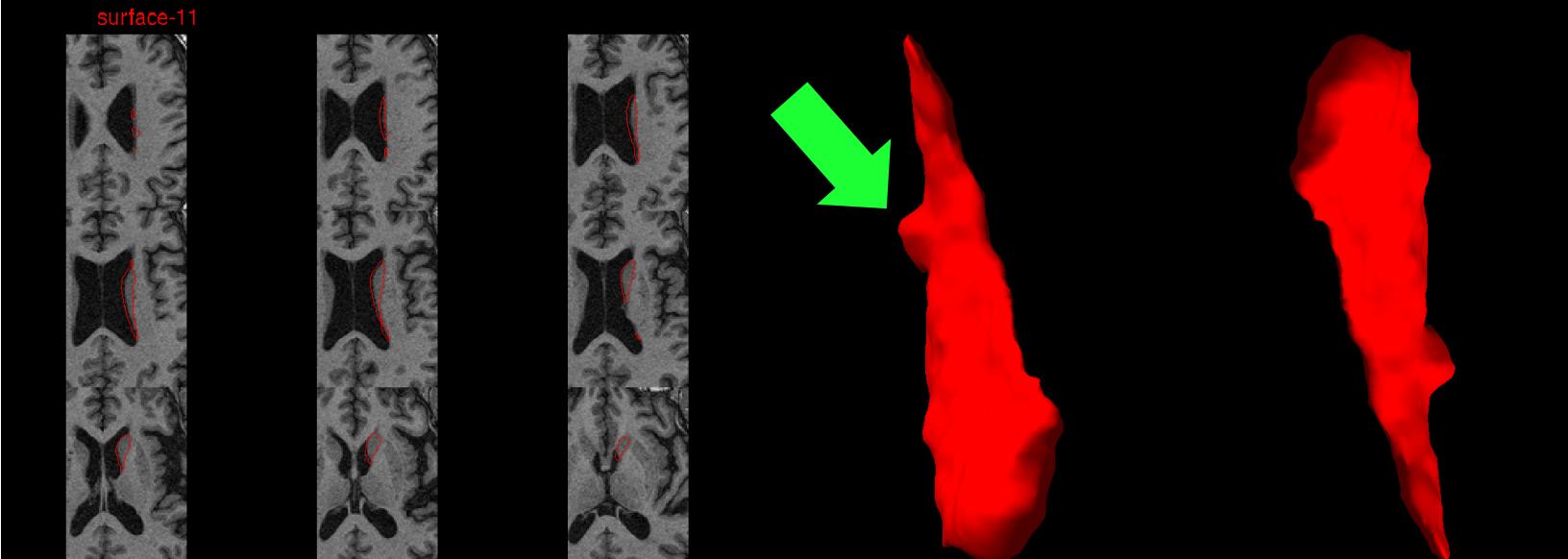
Z Score = 1.74: use



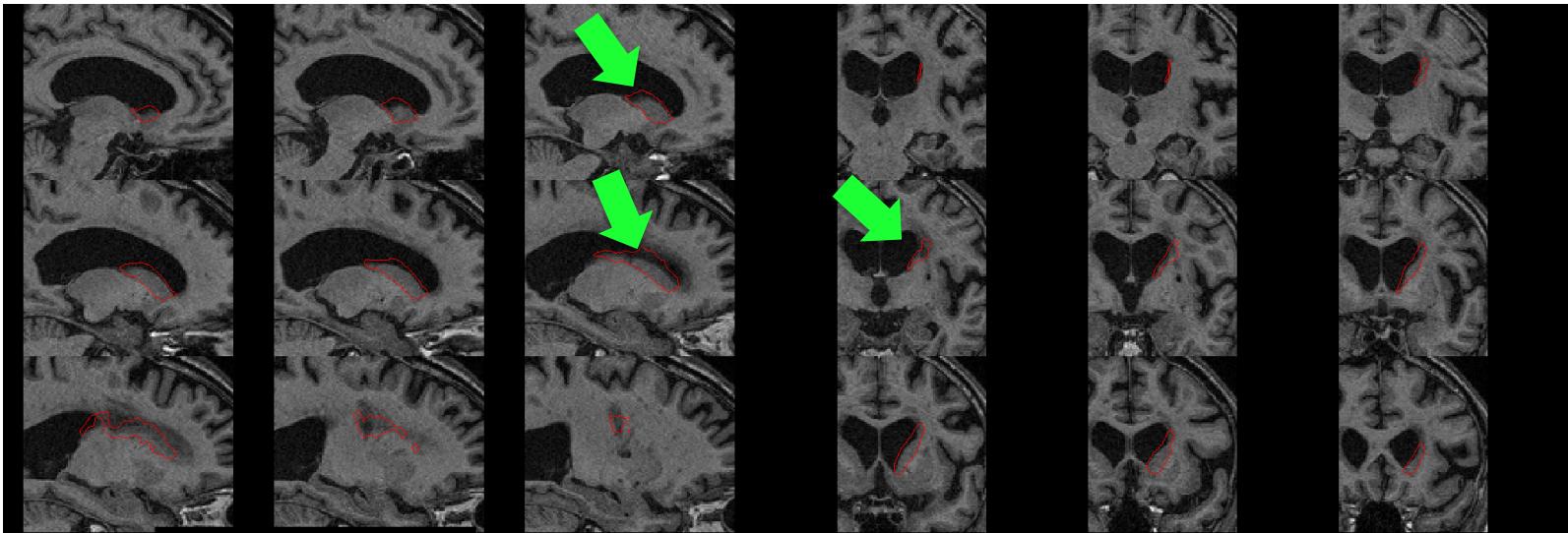
Rating: 2 (Moderate Pass) – Visually smaller compared to other subjects with some border overestimation (arrow), but generally reflects underlying anatomy.



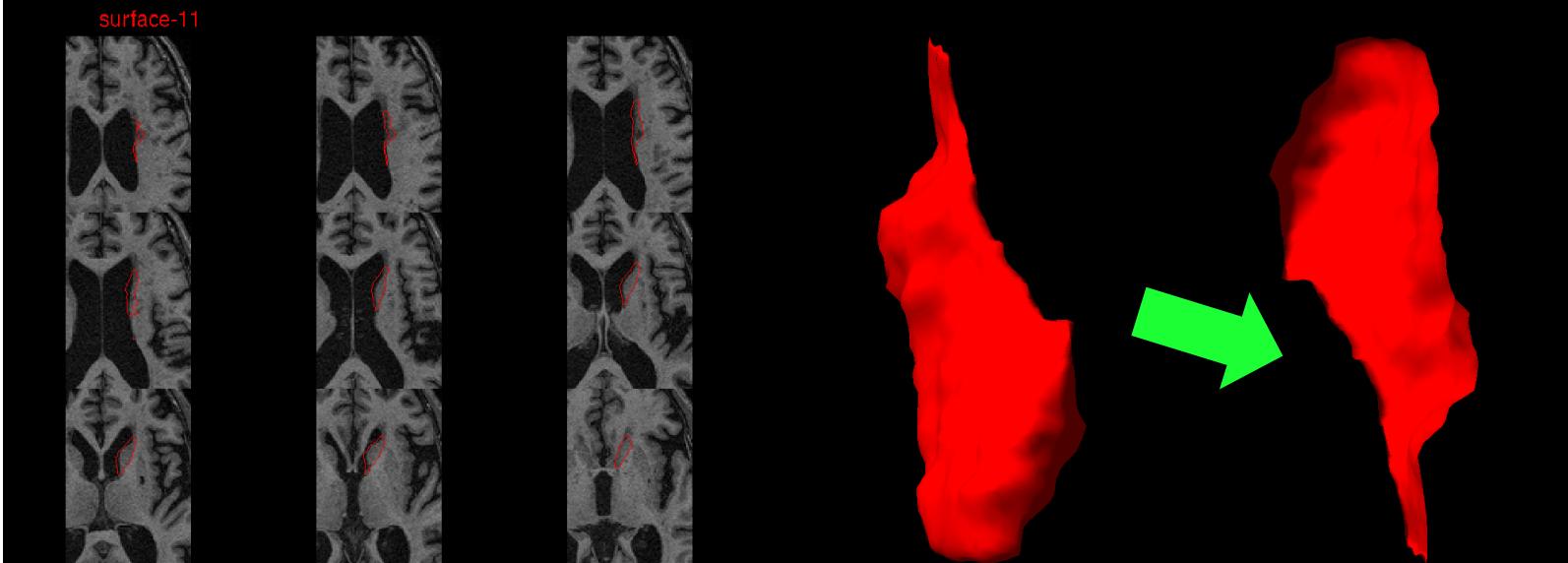
Z Score = 2.80: check



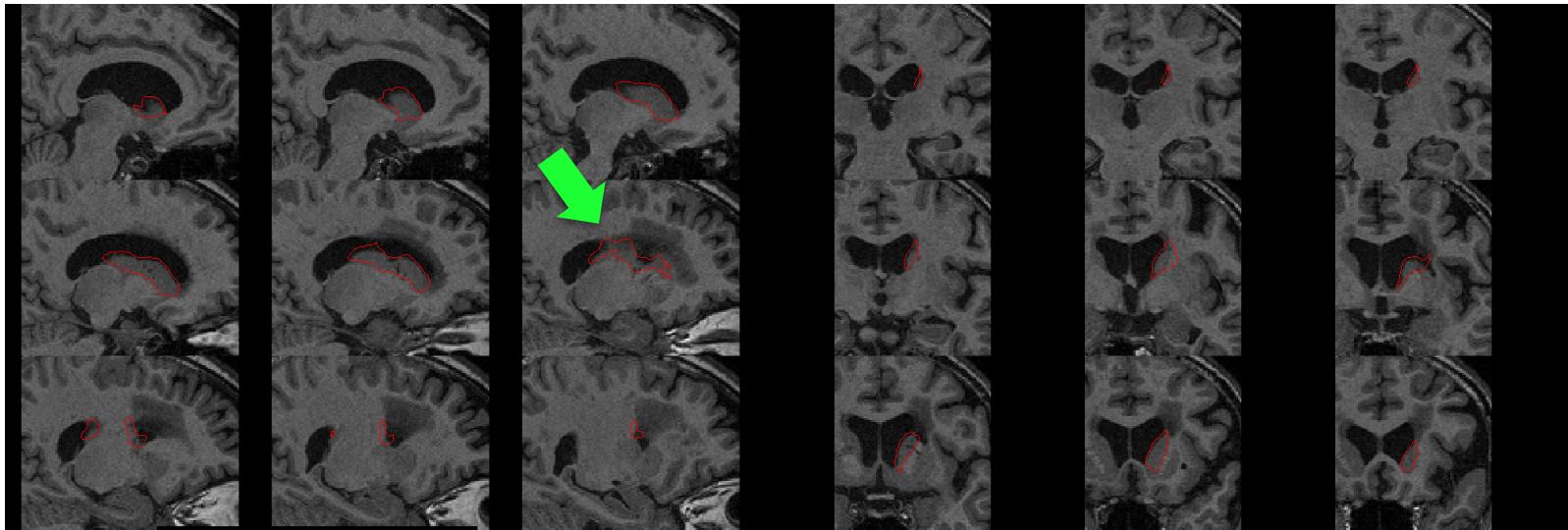
Rating: 1 (Fail) – Severe under/over estimation due to atrophy and pathology.



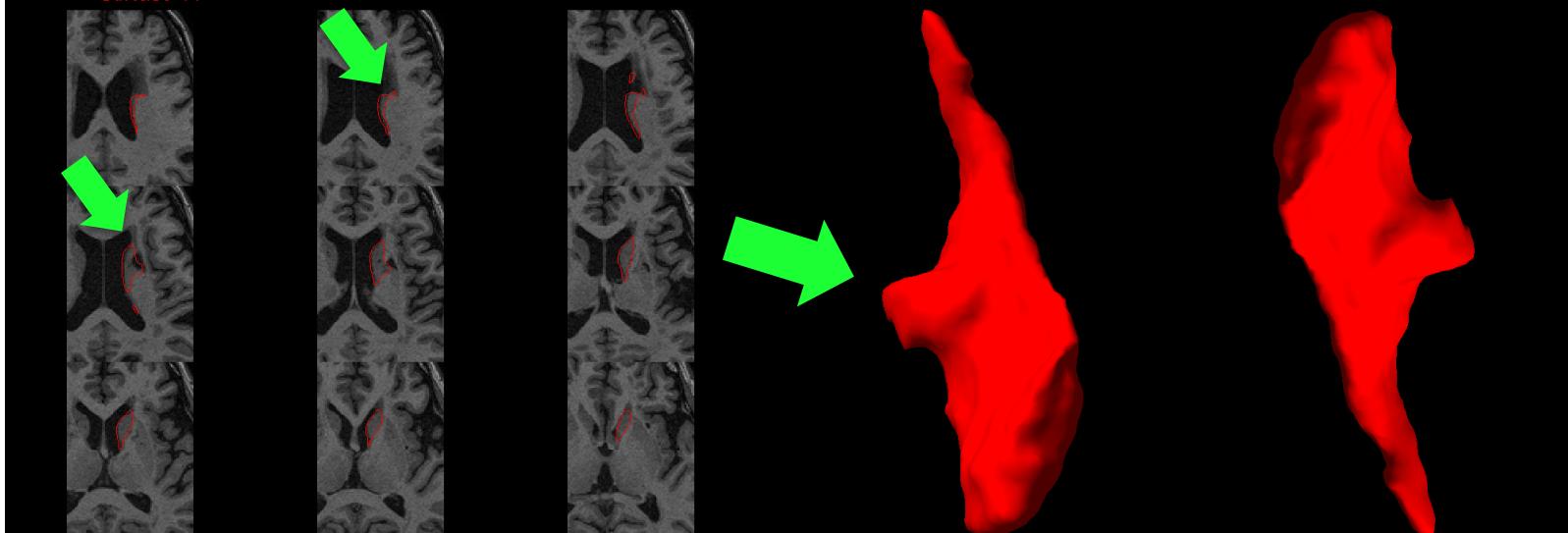
Z Score = 4.79: check



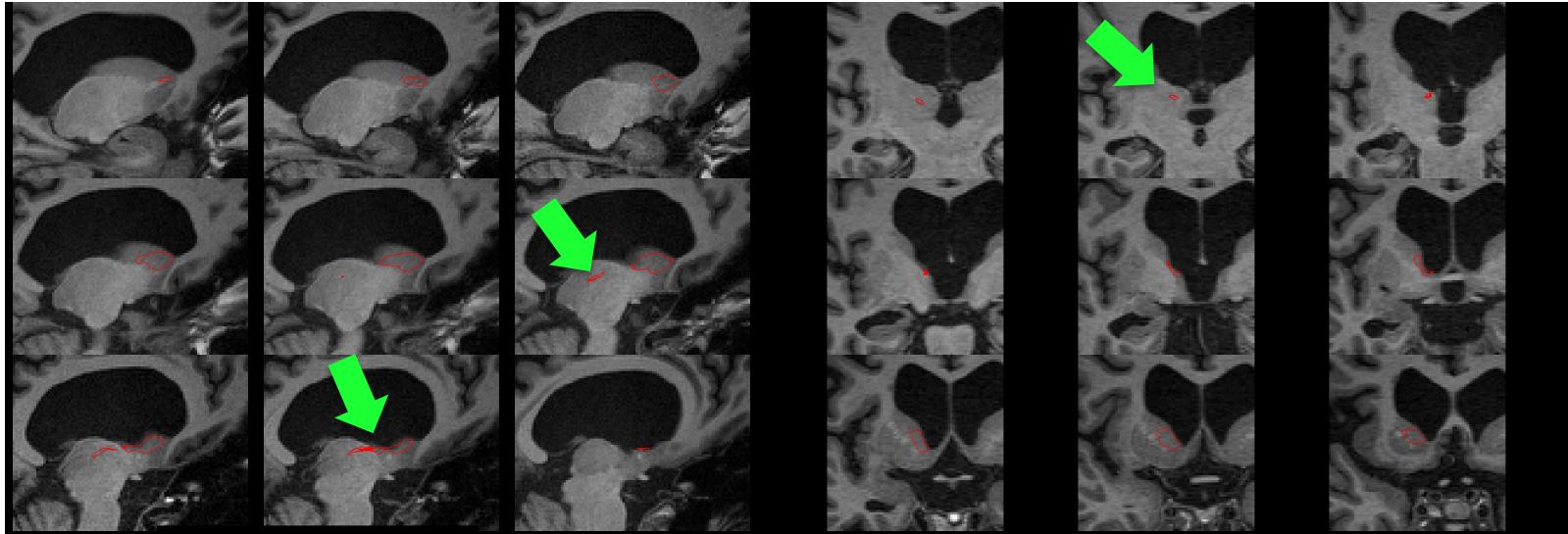
Rating: 1 (Fail) – Severe under/overestimation due to pathology.



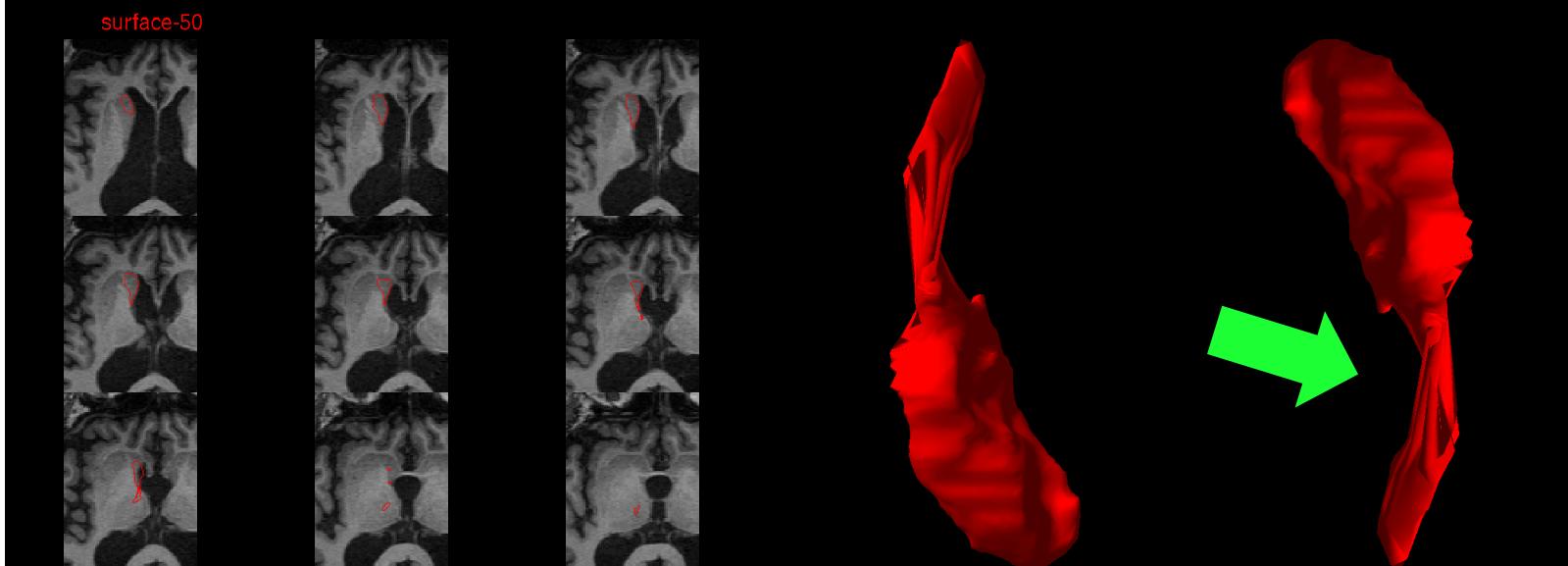
core = 5.44: check
Subject: 3777
surface-11



Rating: 1 (Fail) – Severe misclassification due to pathology.



Z Score = 8.24: check

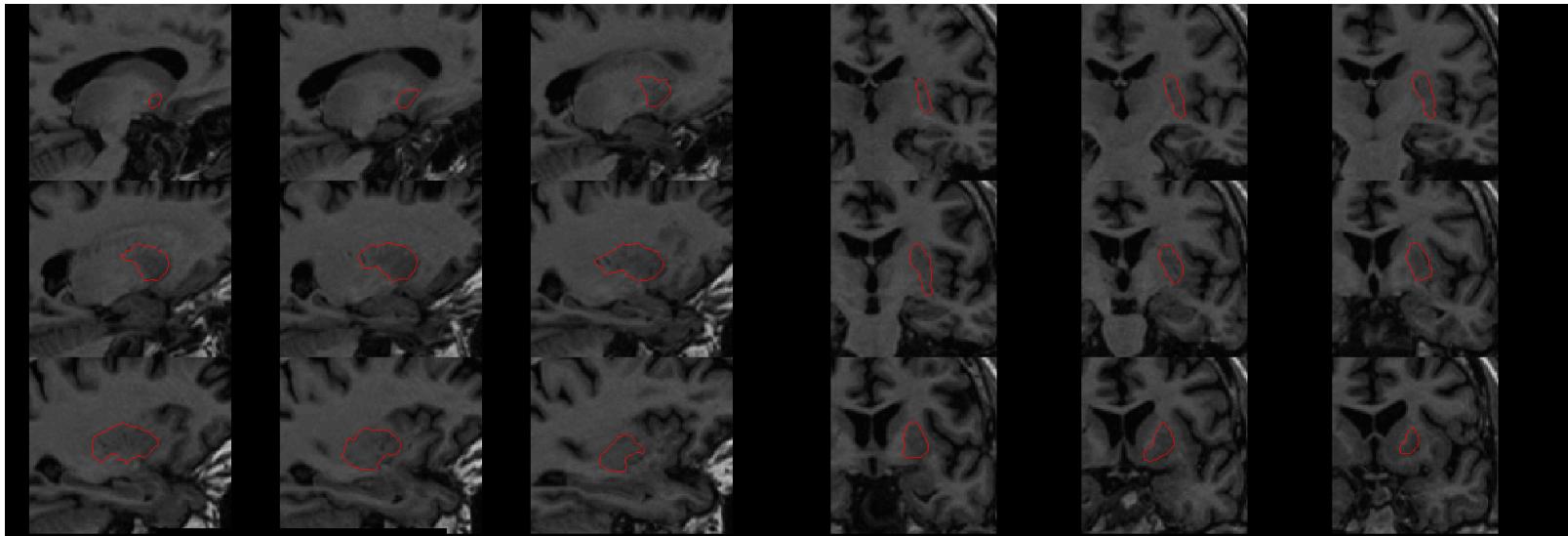


ROI 12/51

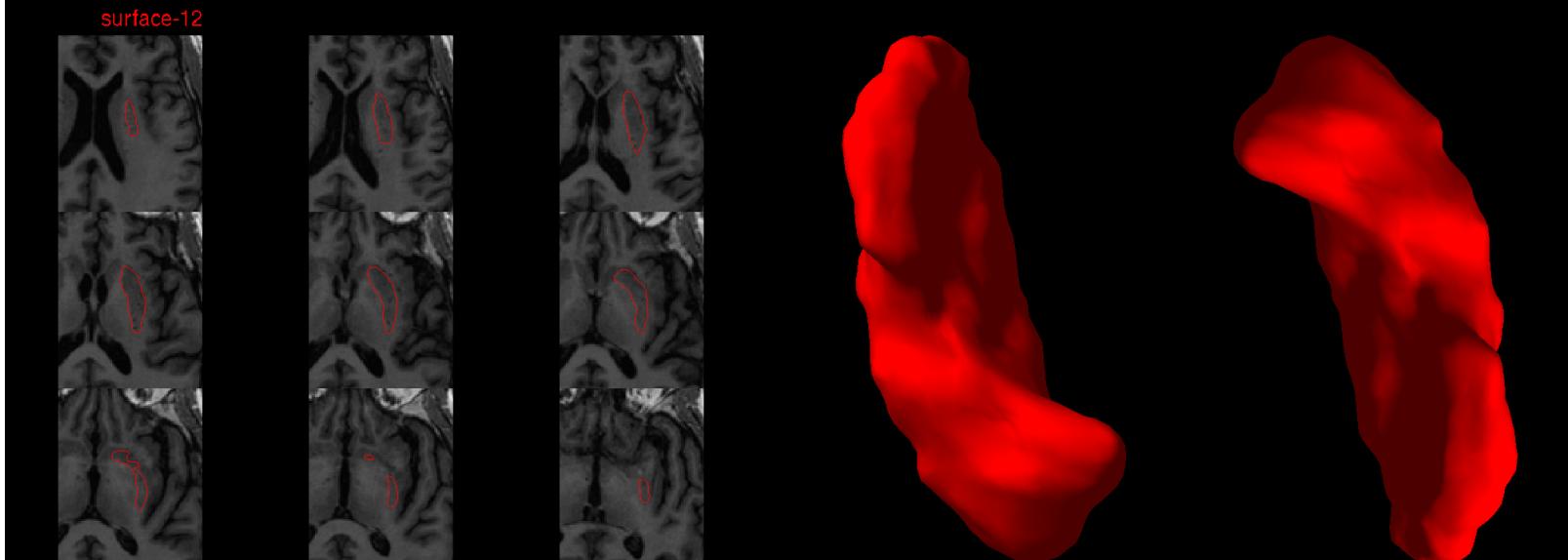
Left/Right Putamen

Overall: Some variability in the edge smoothness but few fails unless T1 image quality is poor.

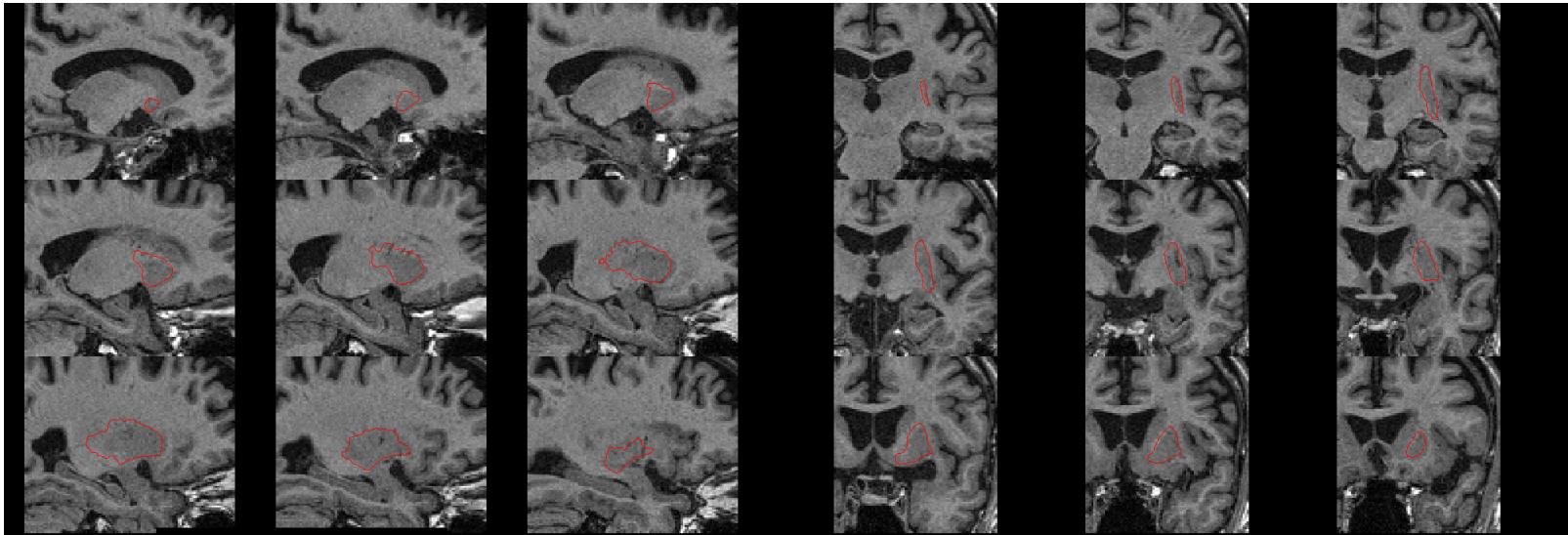
Rating: 3 (Pass)



Z Score = 1.63: use

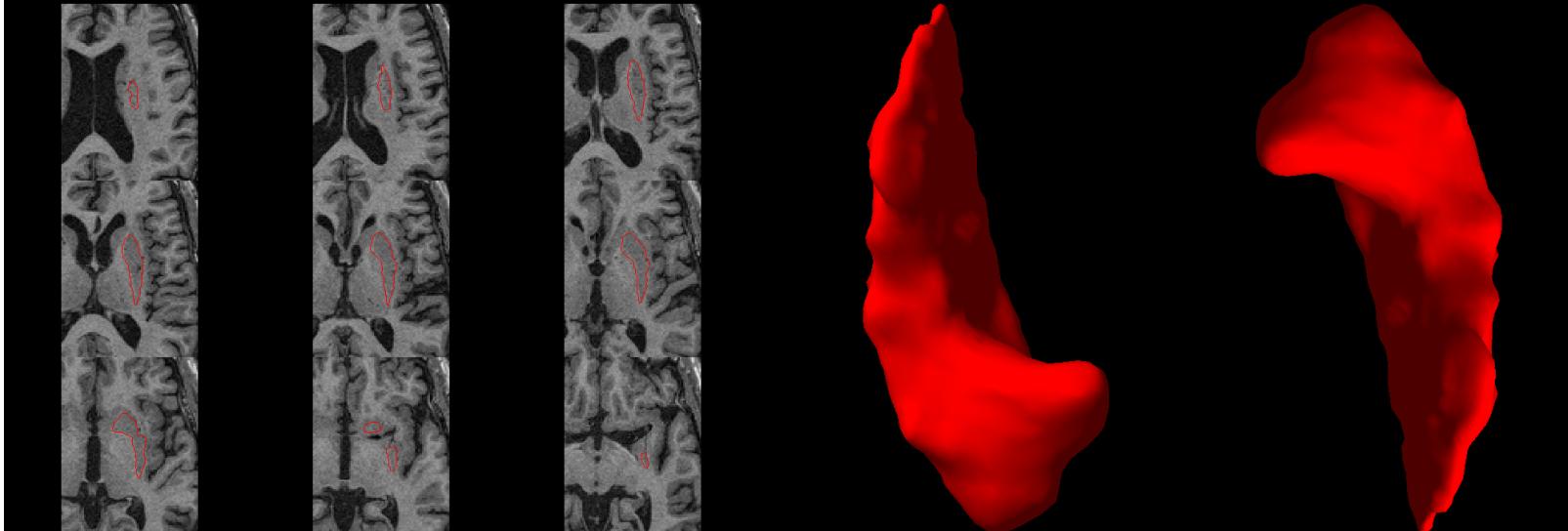


Rating: 3 (Pass)

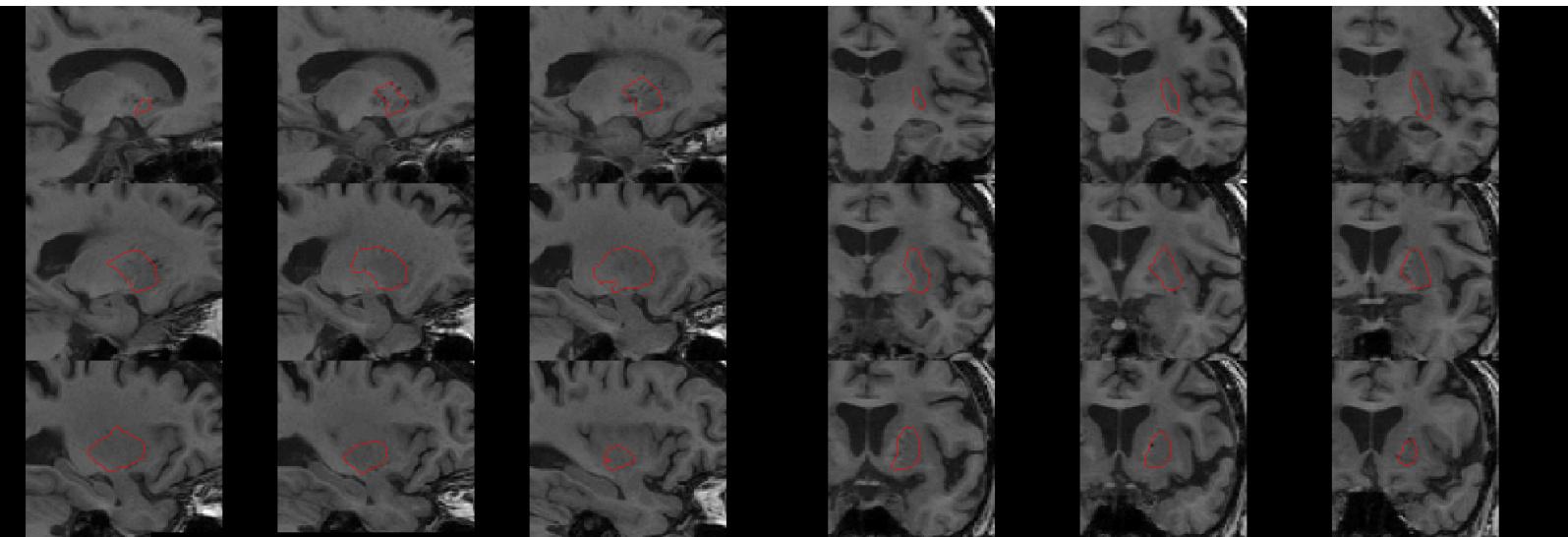


Z Score = 2.13: use

surface-12

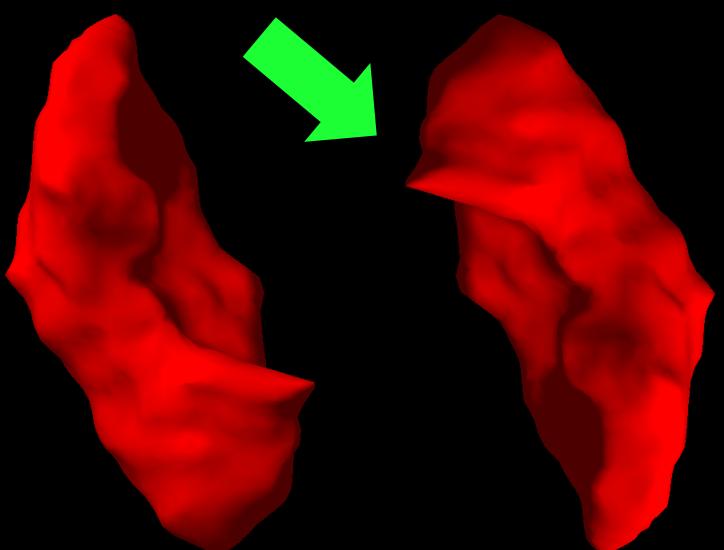
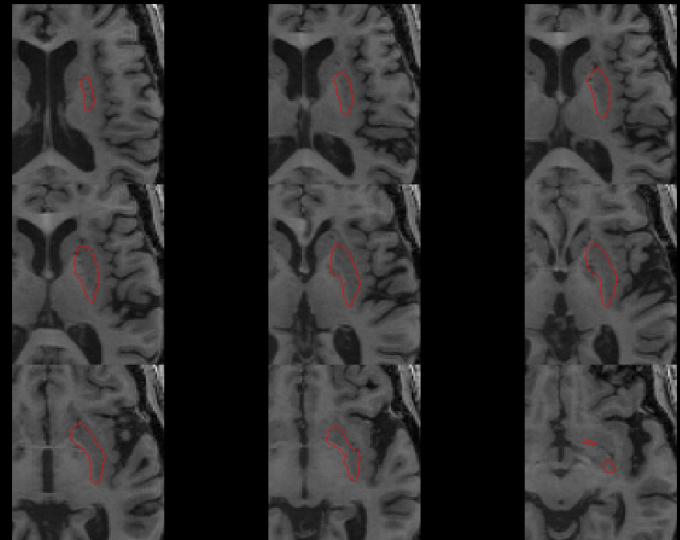


Rating: 2 (Moderate Pass) – Minor border irregularities (see arrow indicating spike) compared to other smoother subjects, but generally reflects underlying anatomy.

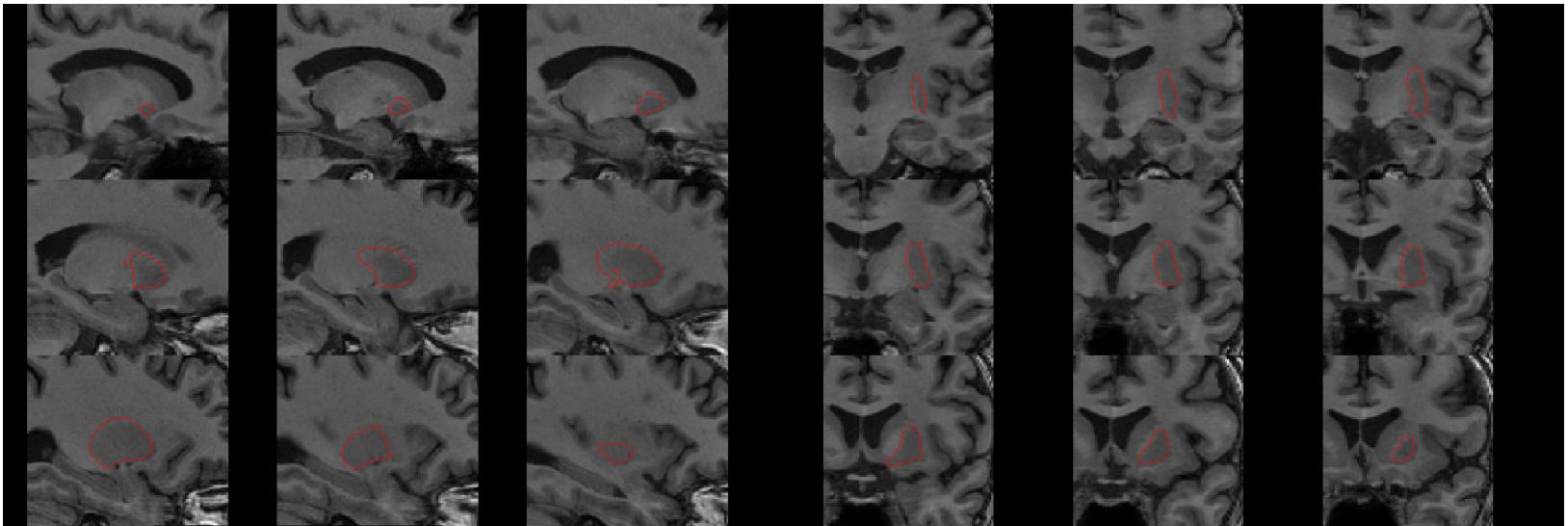


Z Score = 3.27; check

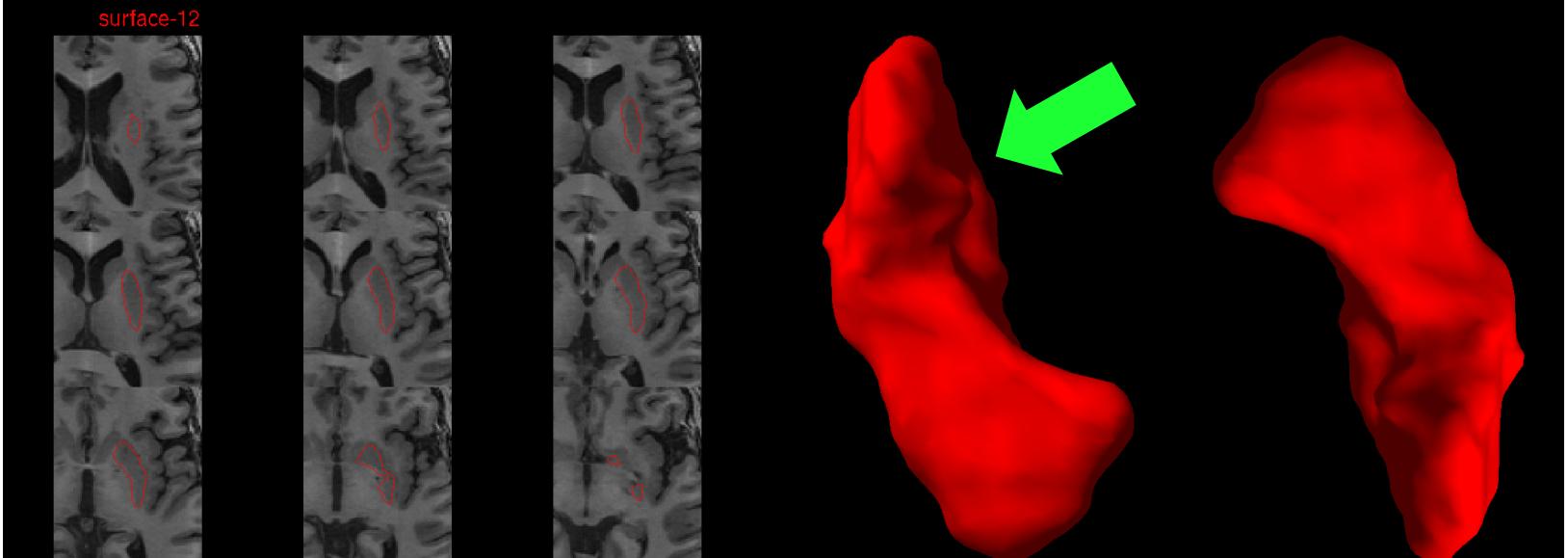
surface-12



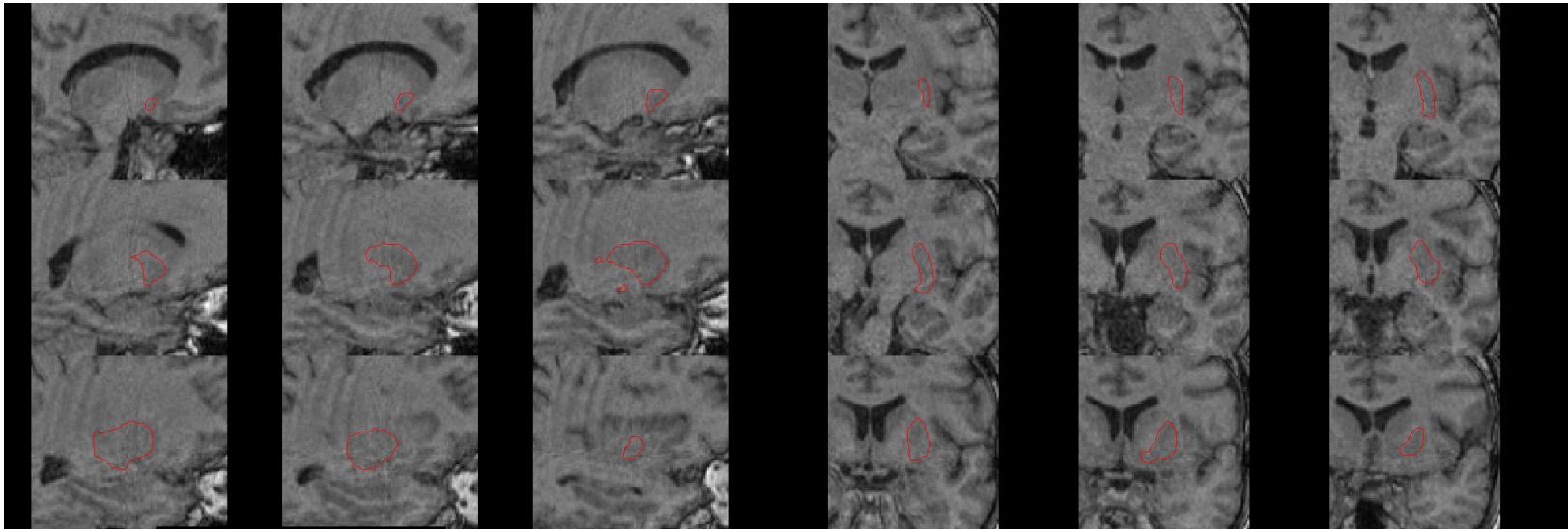
Rating: 2 (Moderate Pass) – Some posterior irregularities (arrow)
compared to other smoother subjects, but generally reflects underlying anatomy.



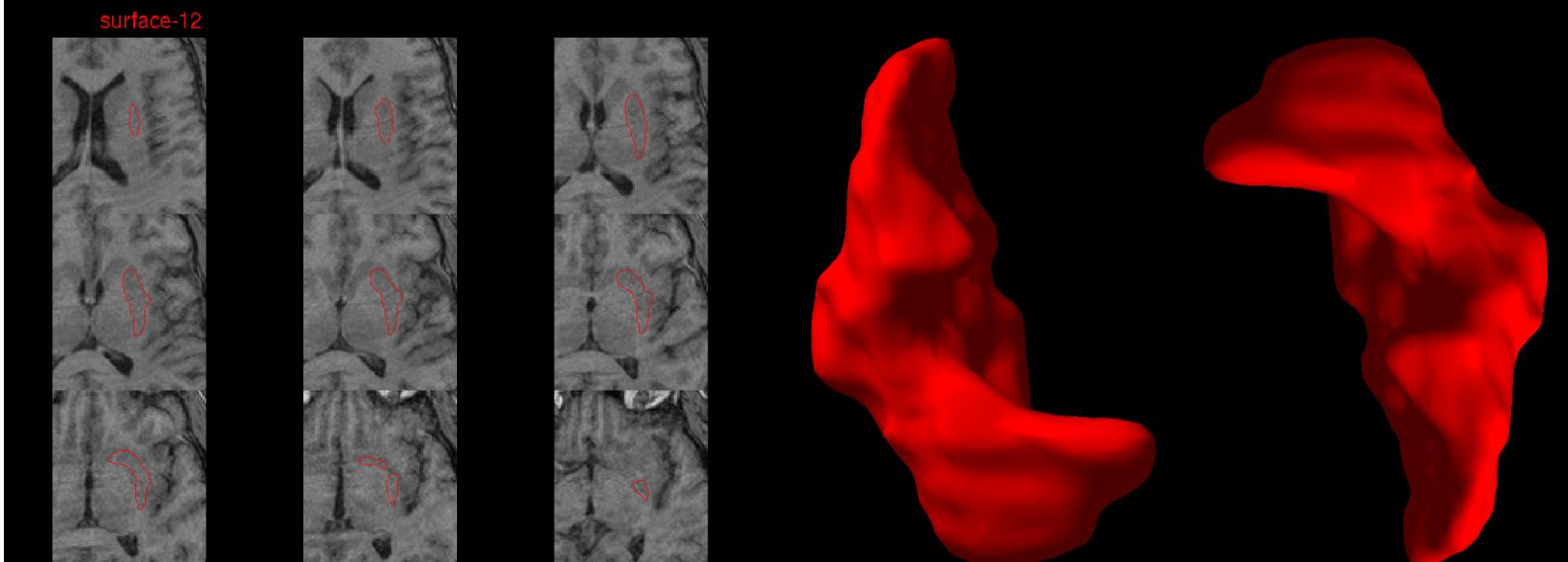
Z Score = 2.09: use



Rating: 1 (Fail) – Poor T1 quality leading to unreliable segmentation. Can't assess accuracy of shape borders.



Z Score = 1.89; use

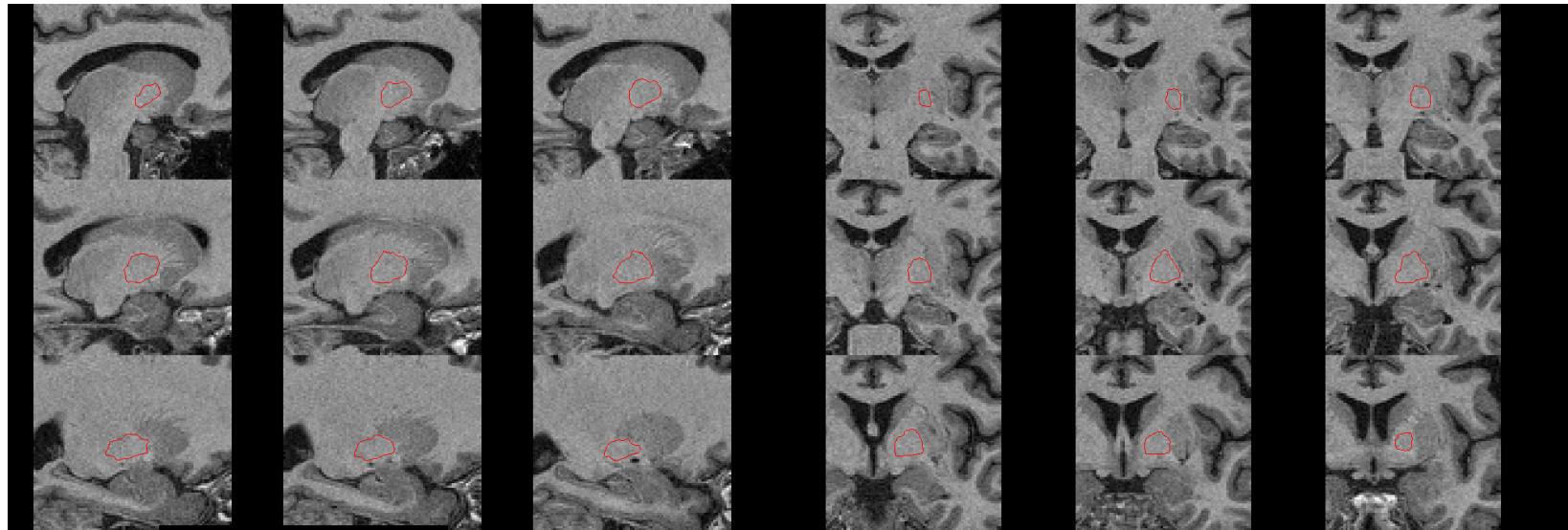


ROI 13/52

Left/Right Pallidum

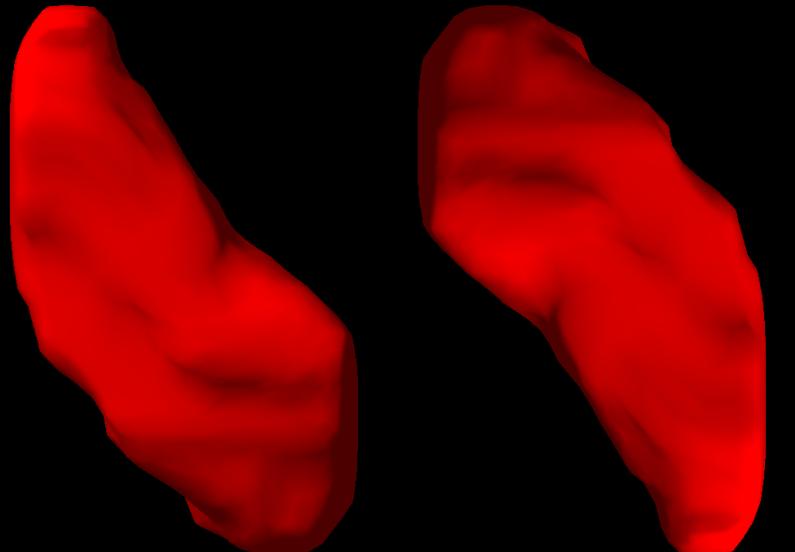
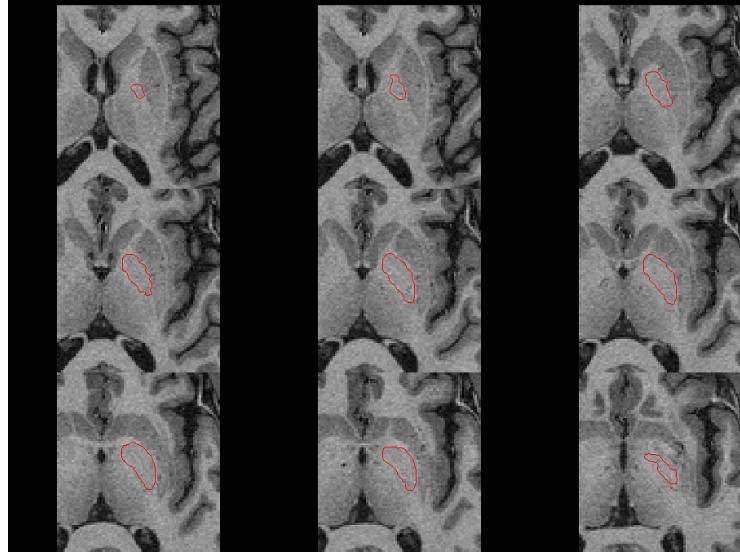
Overall: Some variability in the edge smoothness but few fails unless T1 image quality is poor.

Rating: 3 (Pass)

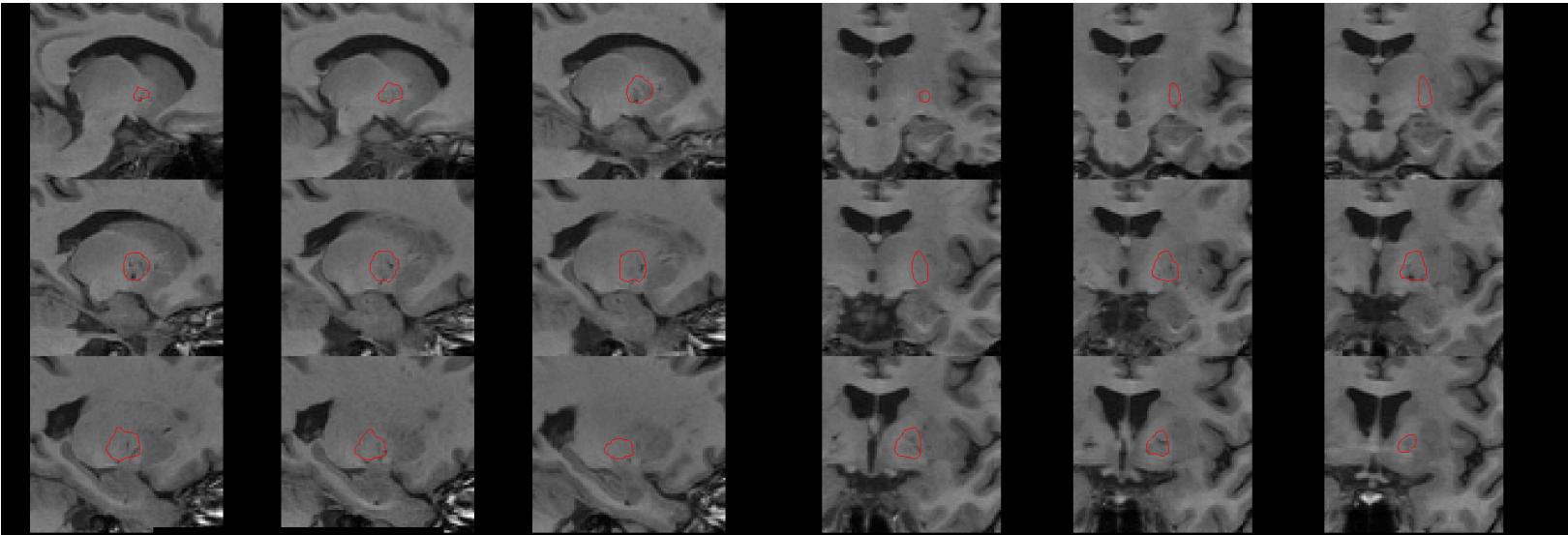


Z Score = 2.04: use

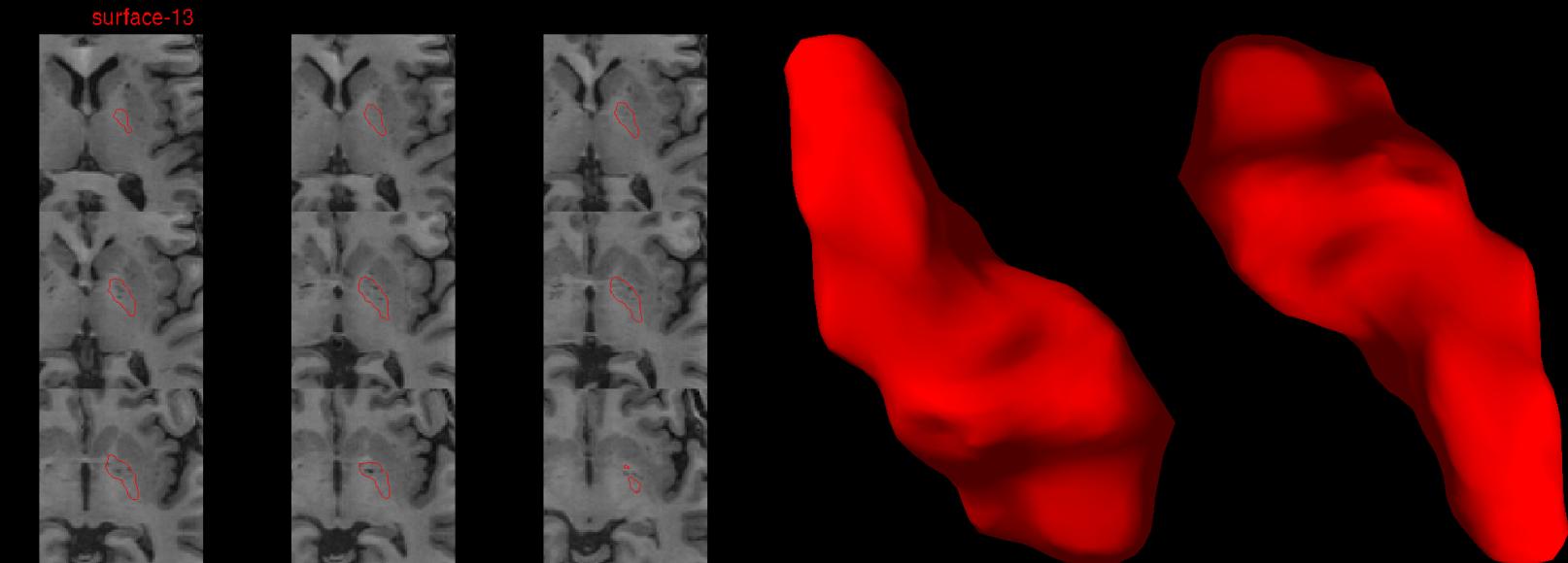
surface-13



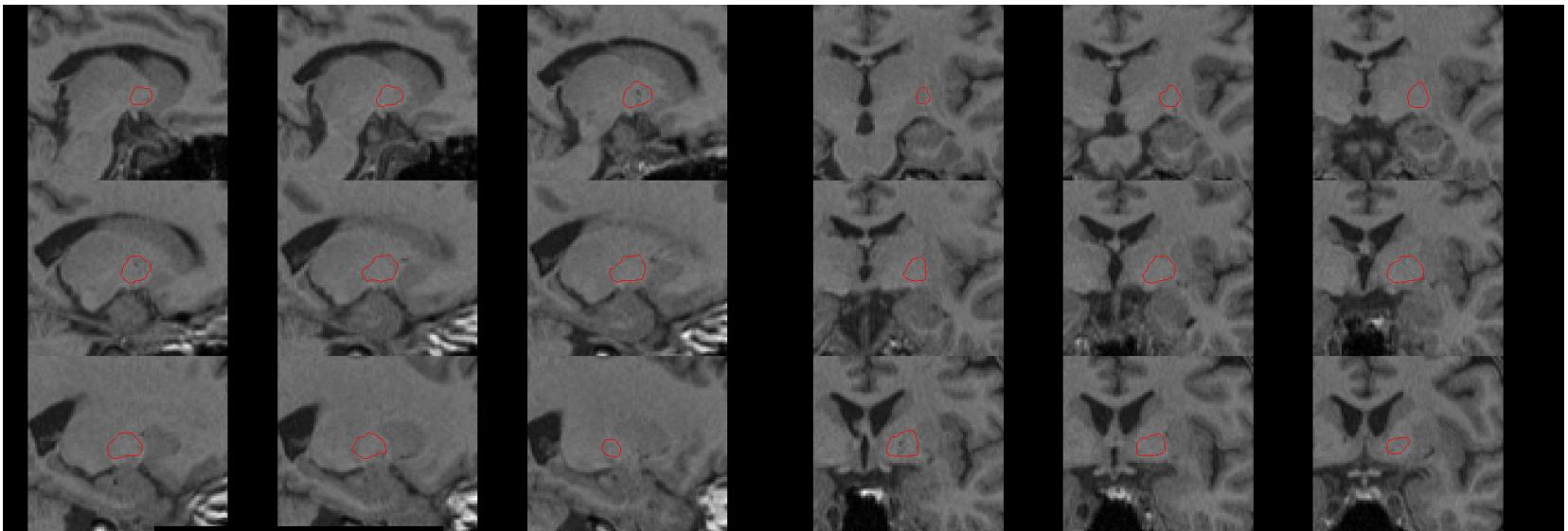
Rating: 2 (Moderate Pass) – Some border irregularities compared to smoother subjects, but generally reflects underlying anatomy.



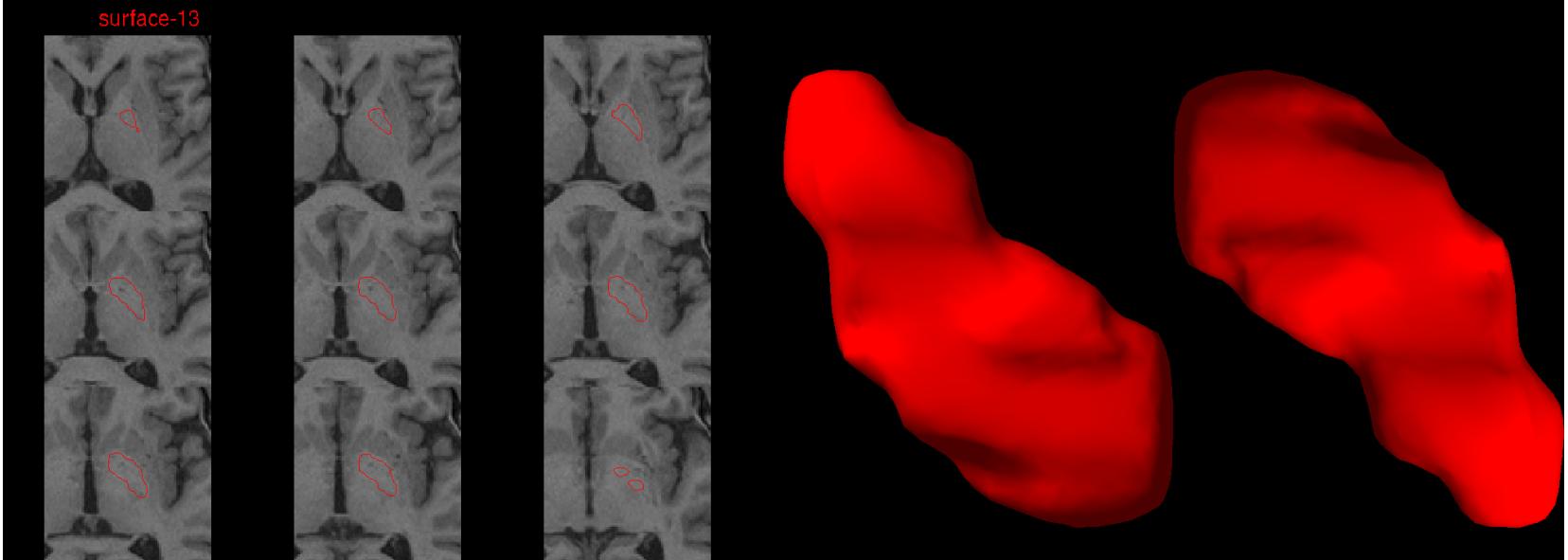
Z Score = 2.11: use



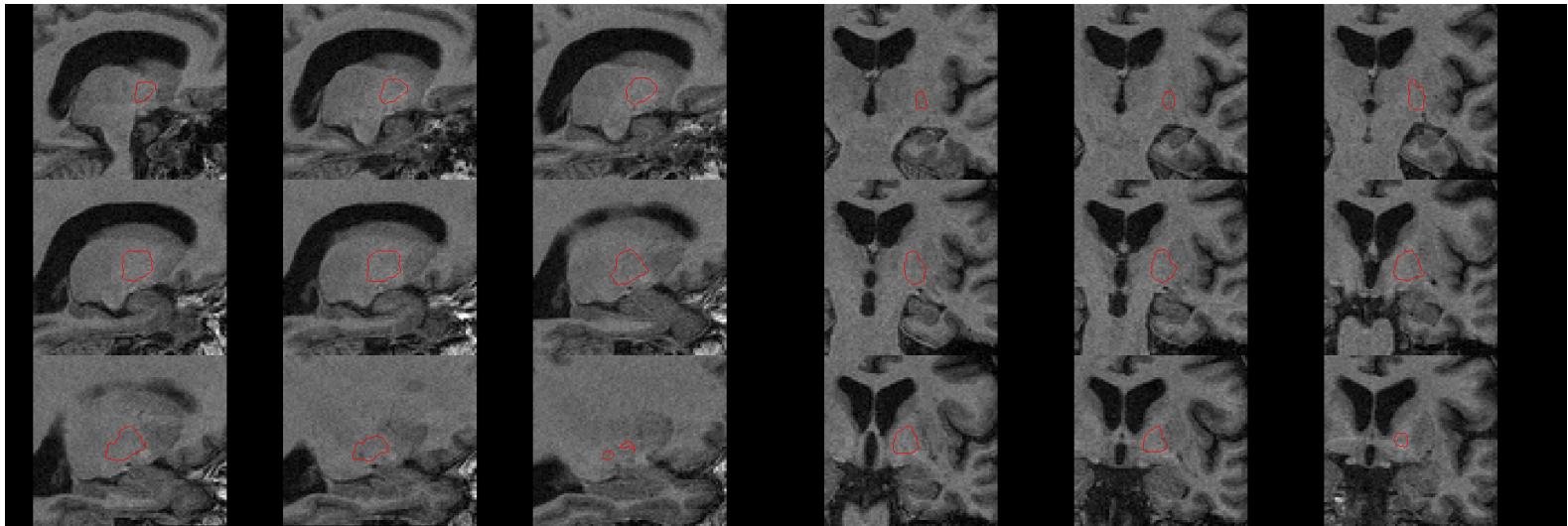
Rating: 2 (Moderate Pass) – Some border irregularities compared to smoother subjects, but generally reflects underlying anatomy.



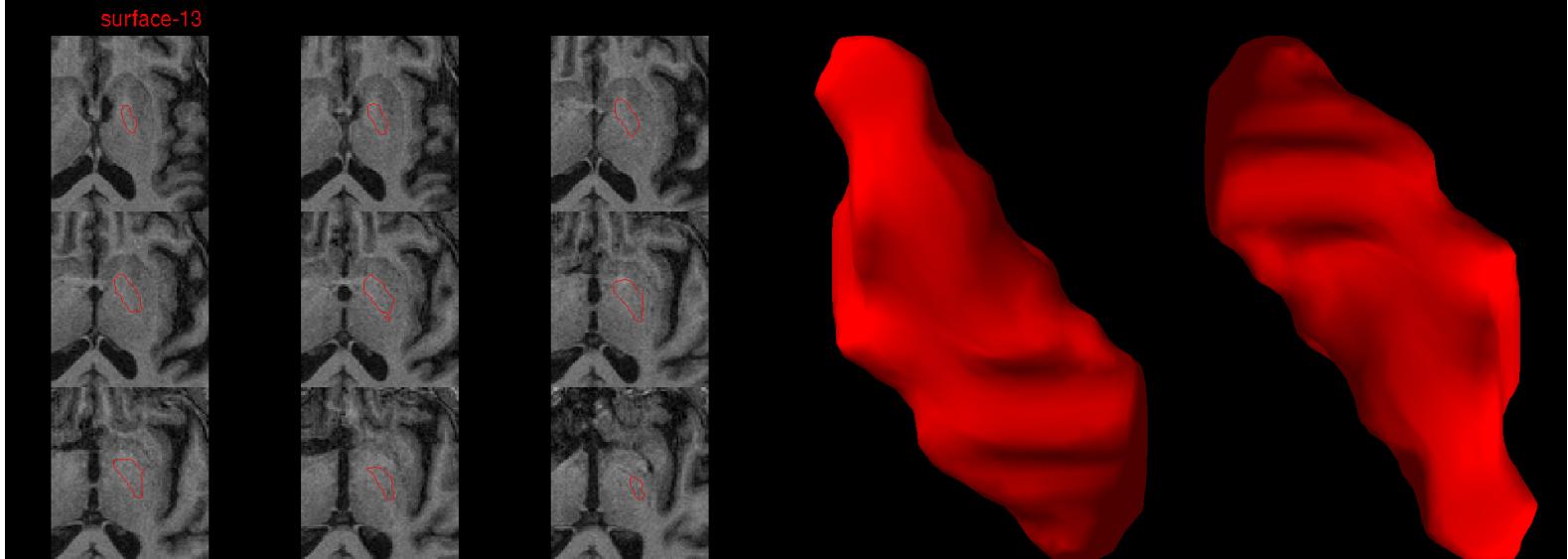
Z Score = 1.46; use



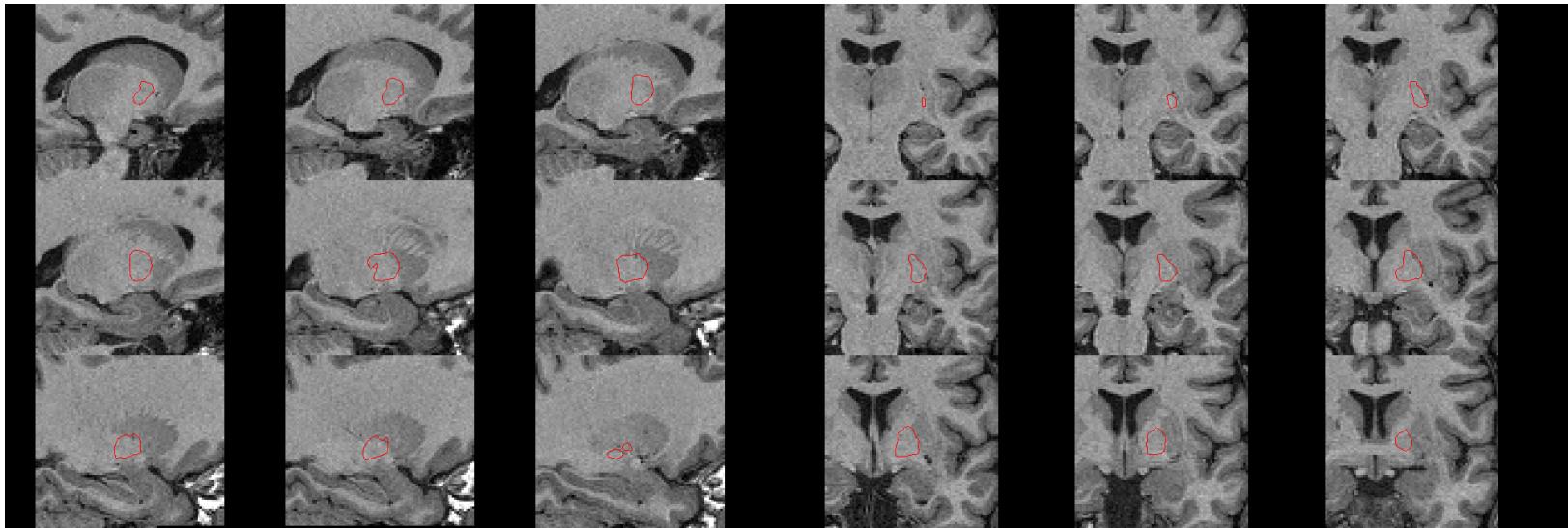
Rating: 2 (Moderate Pass) – Some border irregularities compared to majority of subjects, but generally reflects underlying anatomy given quality of T1 image.



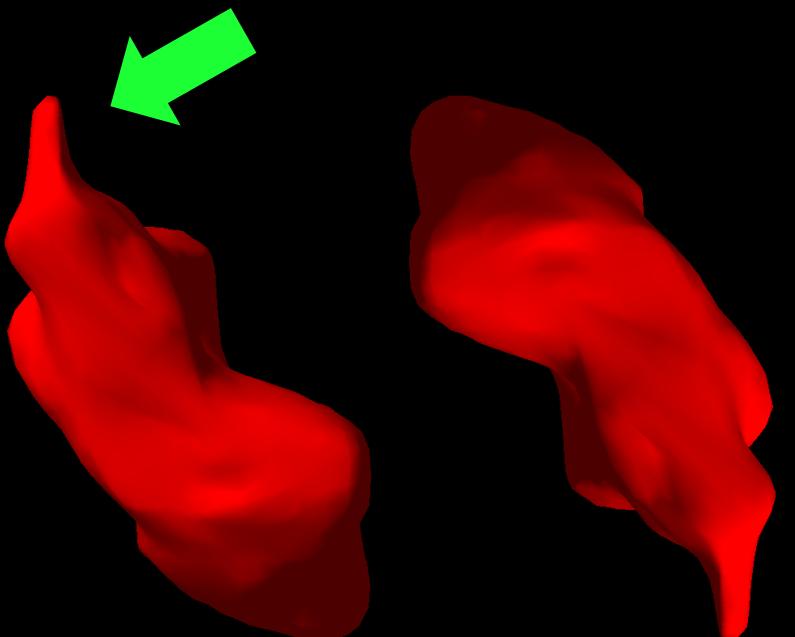
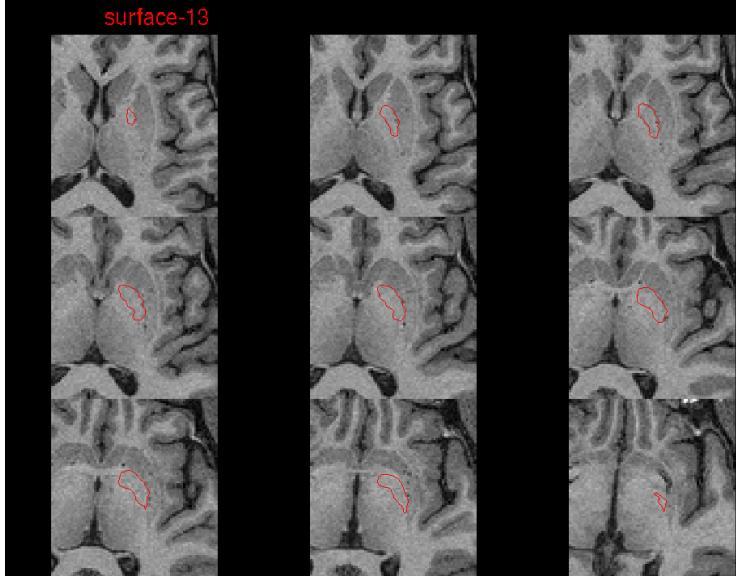
Z Score = 2.02: use



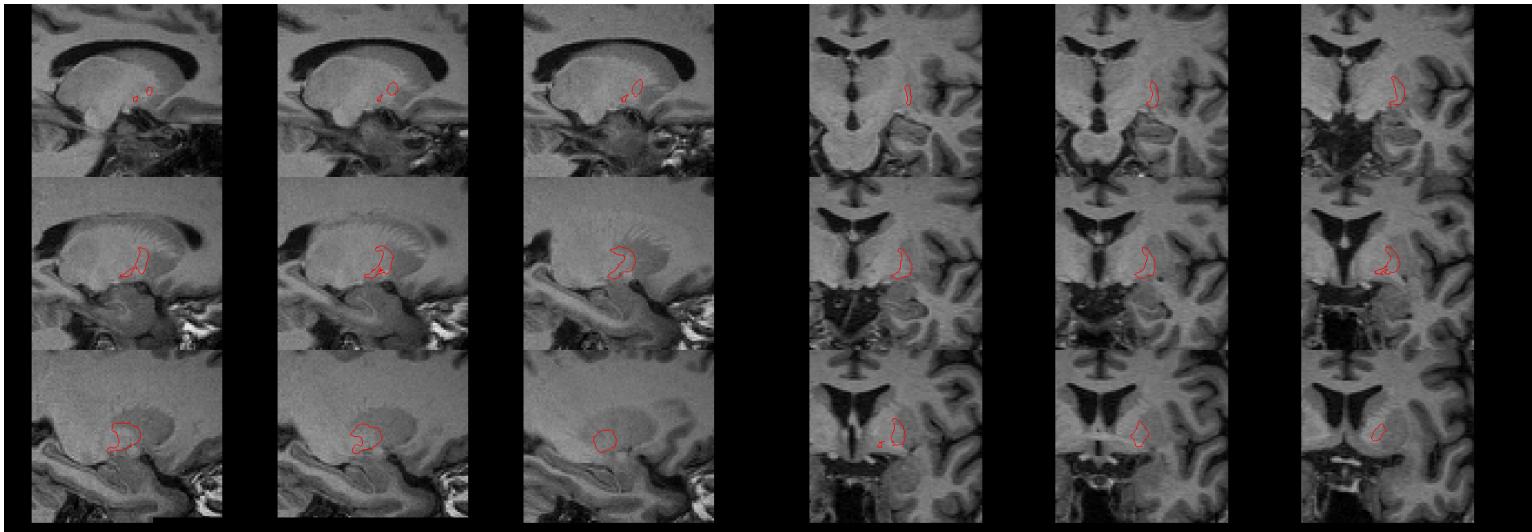
Rating: 1 (Fail) – Tail spike (arrow) that does not reflect underlying anatomy.



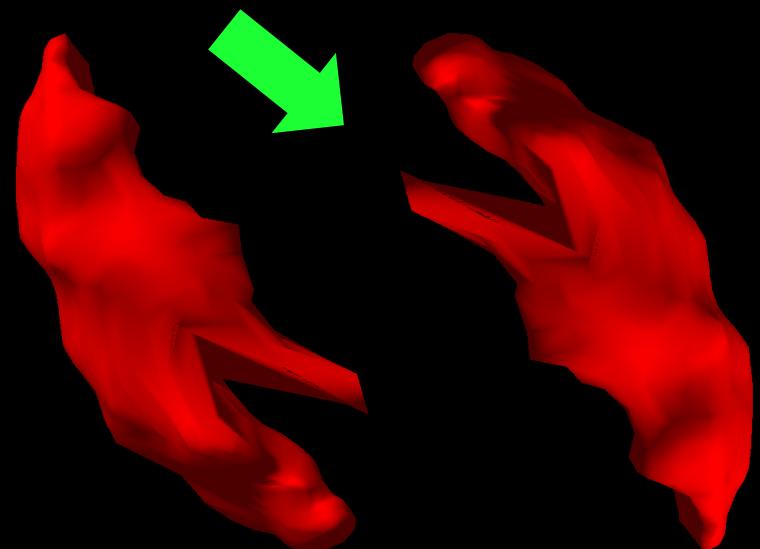
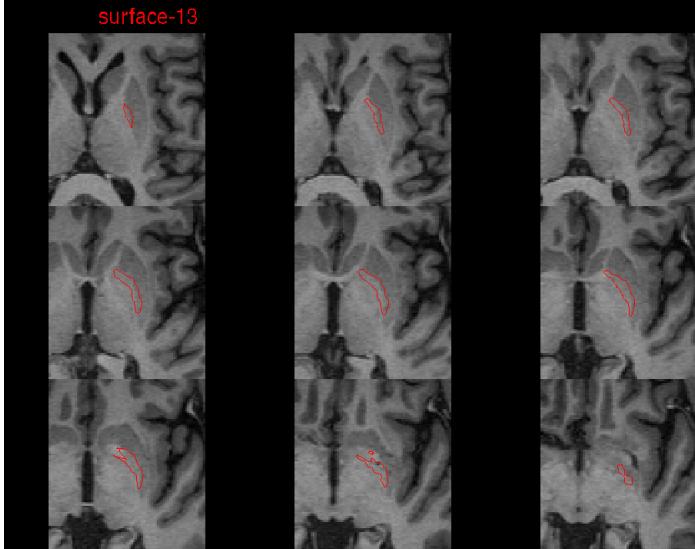
Z Score = 3.27: check



Rating: 1 (Fail) – Severe edge irregularity (arrow) that does not reflect underlying anatomy.



Z Score = 3.17: check

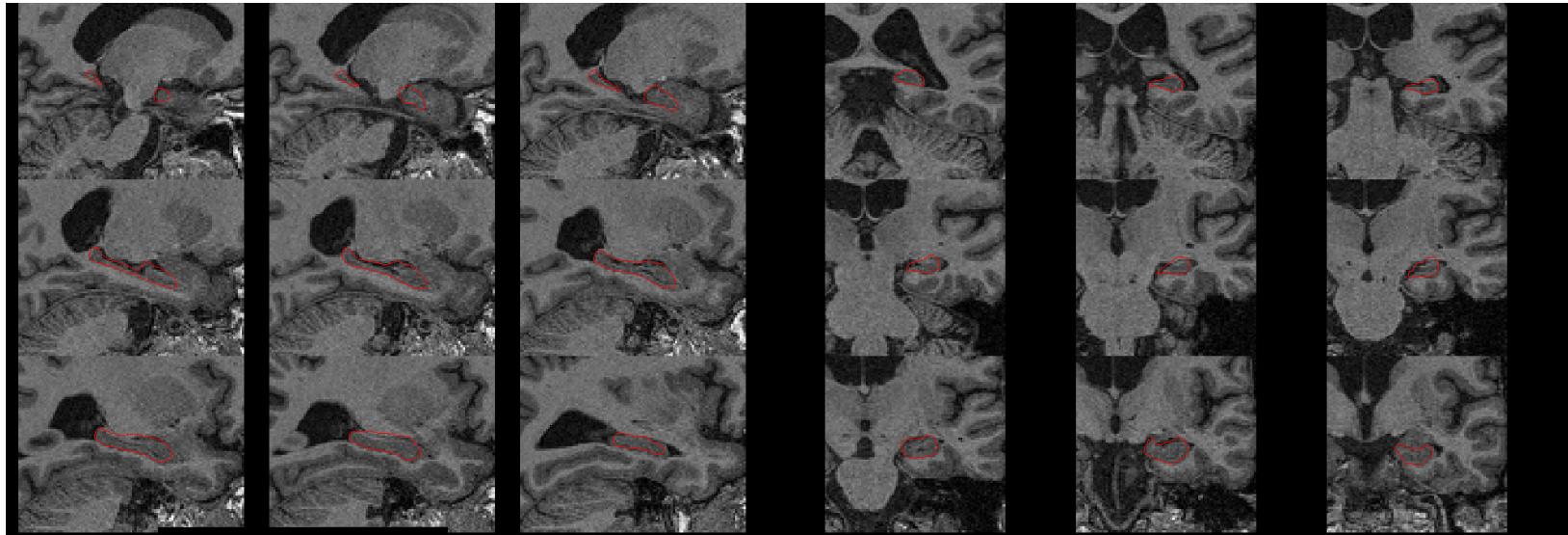


ROI 17/53

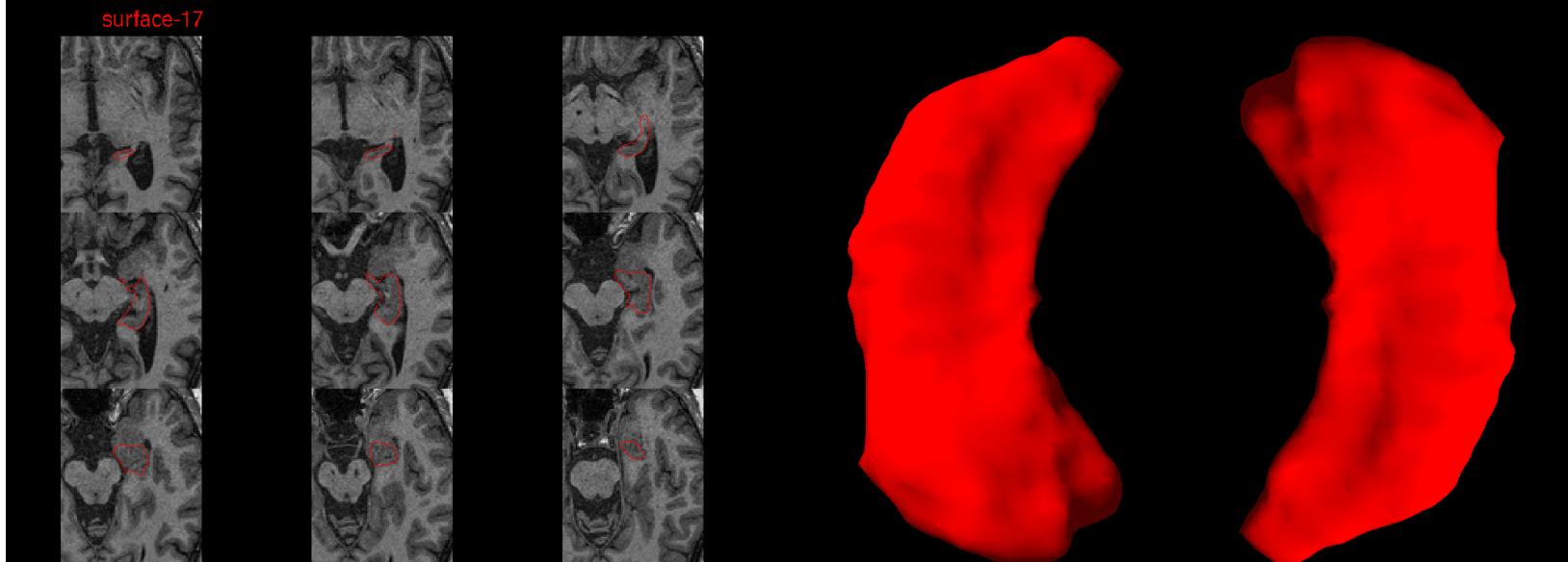
Left/Right Hippocampus

Overall: Some variability in the edge smoothness due to range of FreeSurfer/FSL segmentation quality.

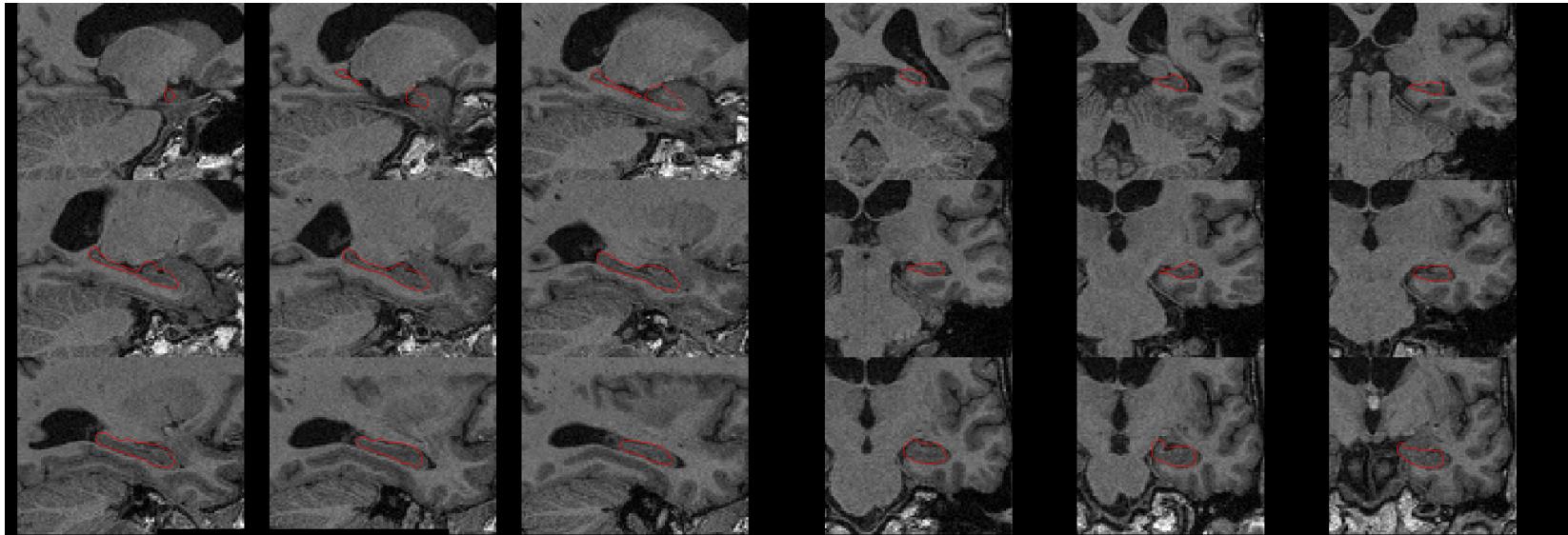
Rating: 3 (Pass)



Z Score = 1.47: use

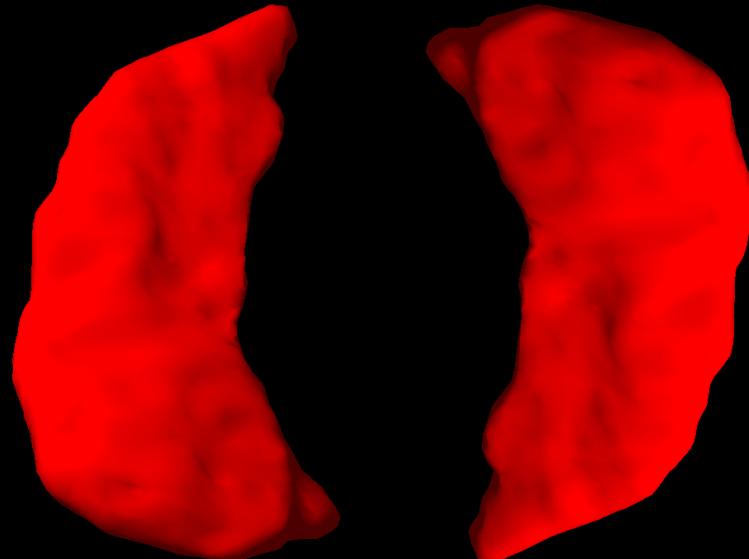
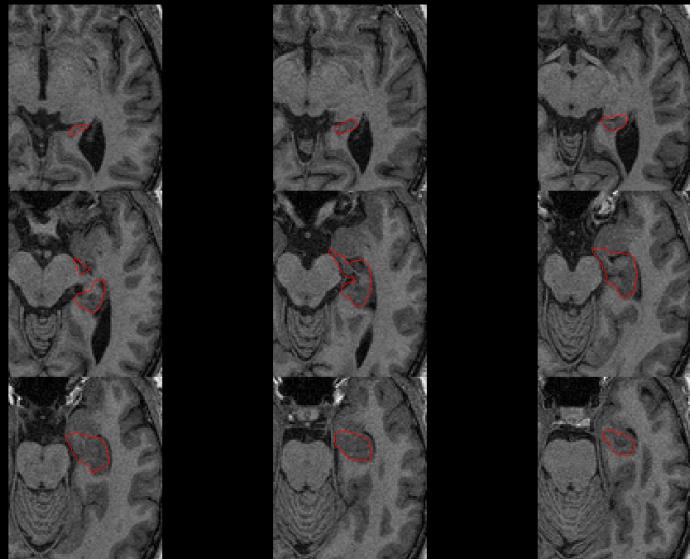


Rating: 3 (Pass)

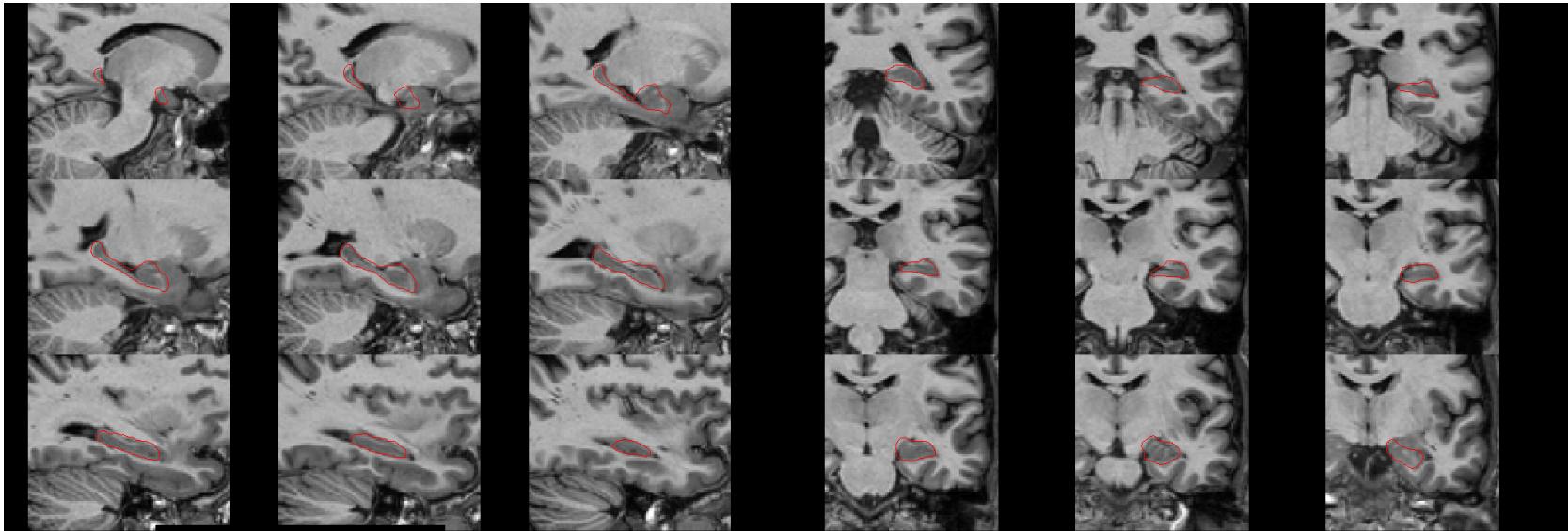


Z Score = 1.90; use

surface-17

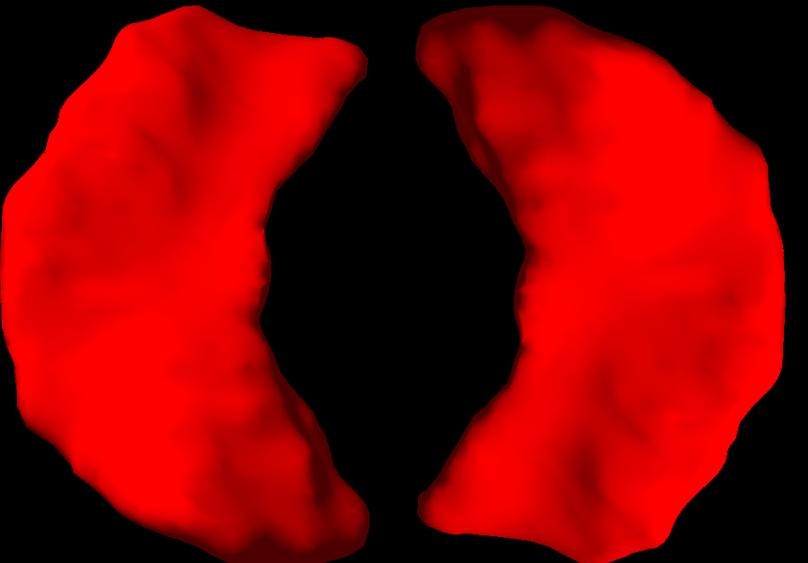
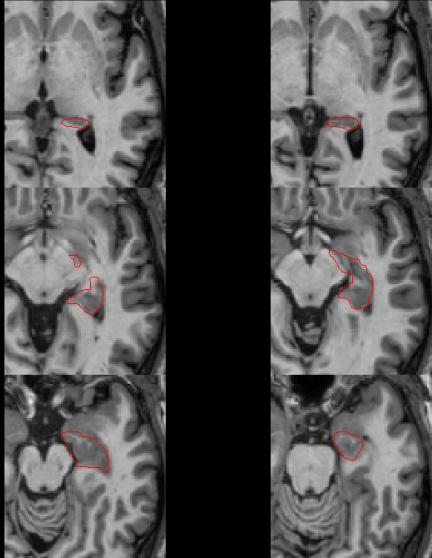


Rating: 3 (Pass)

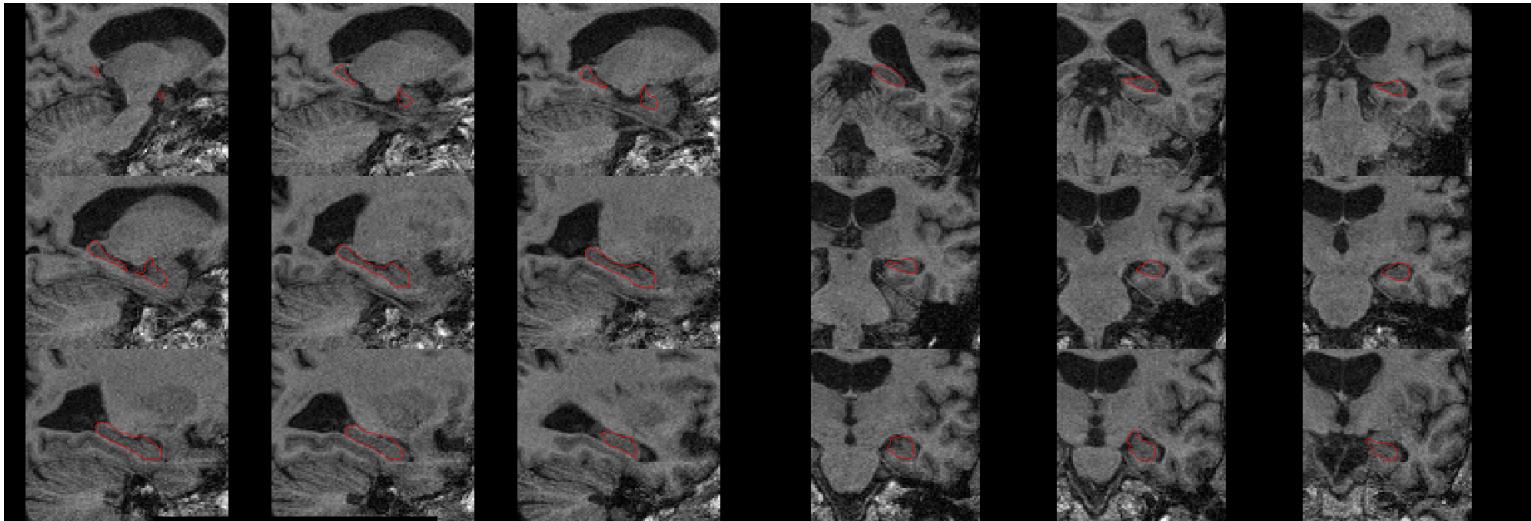


Z Score = 2.15: use

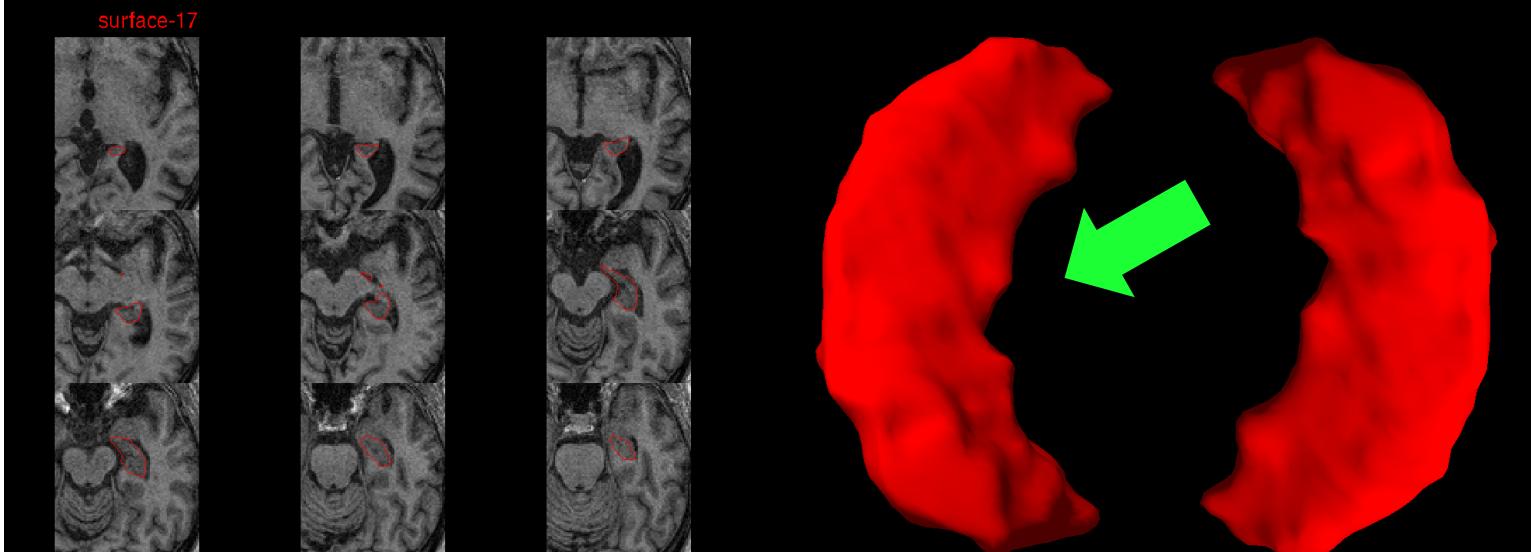
surface-17



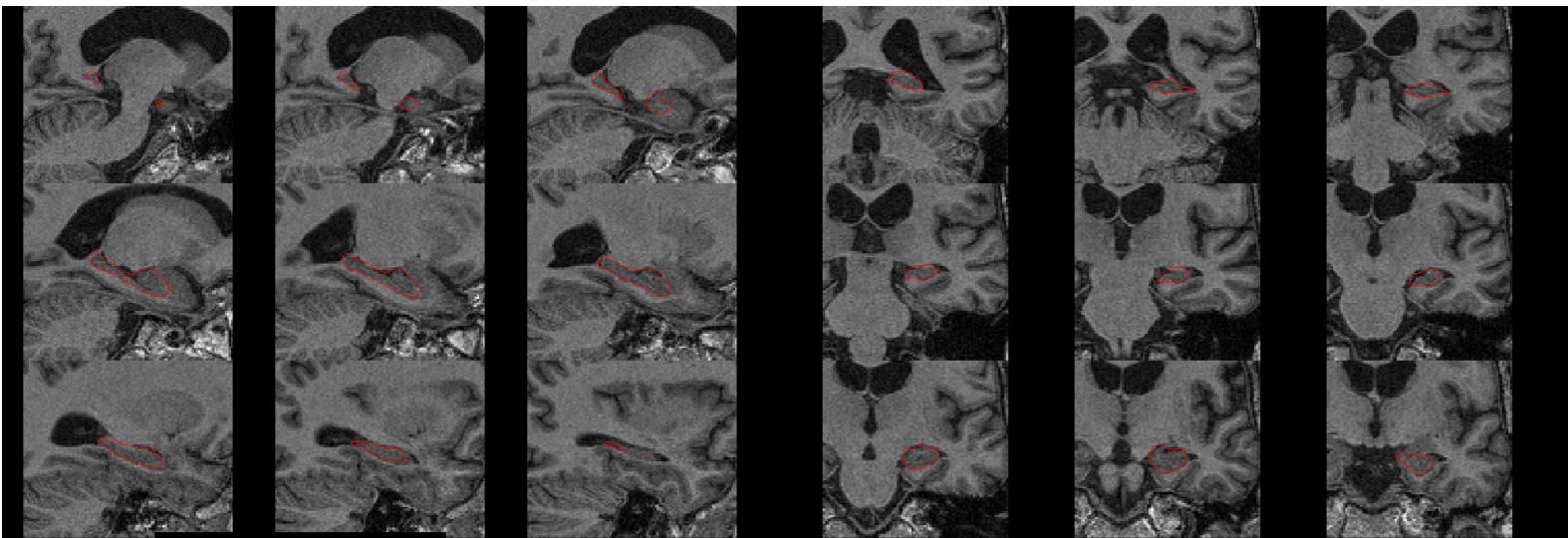
Rating: 2 (Moderate Pass) – Uneven medial edge (arrow), not severe enough to fail. Generally reflects underlying anatomy.



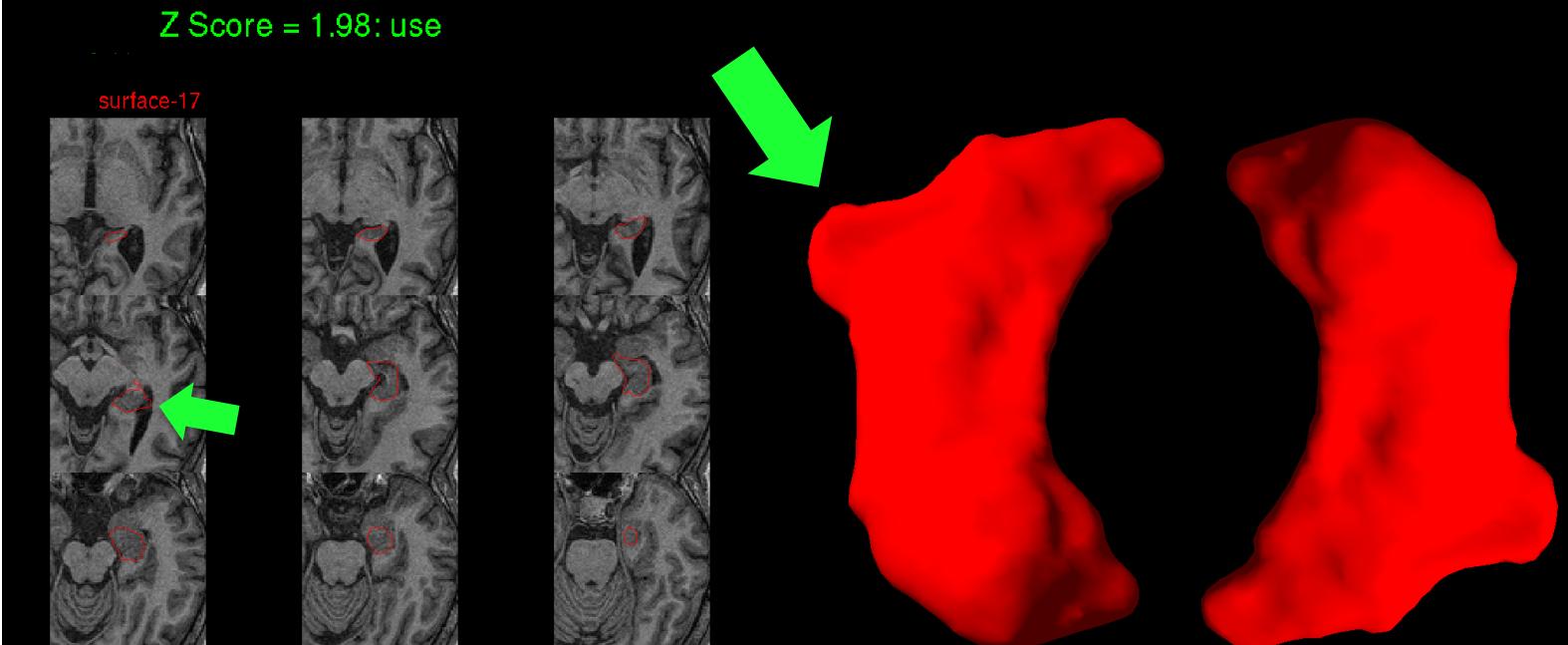
Z Score = 2.13: use



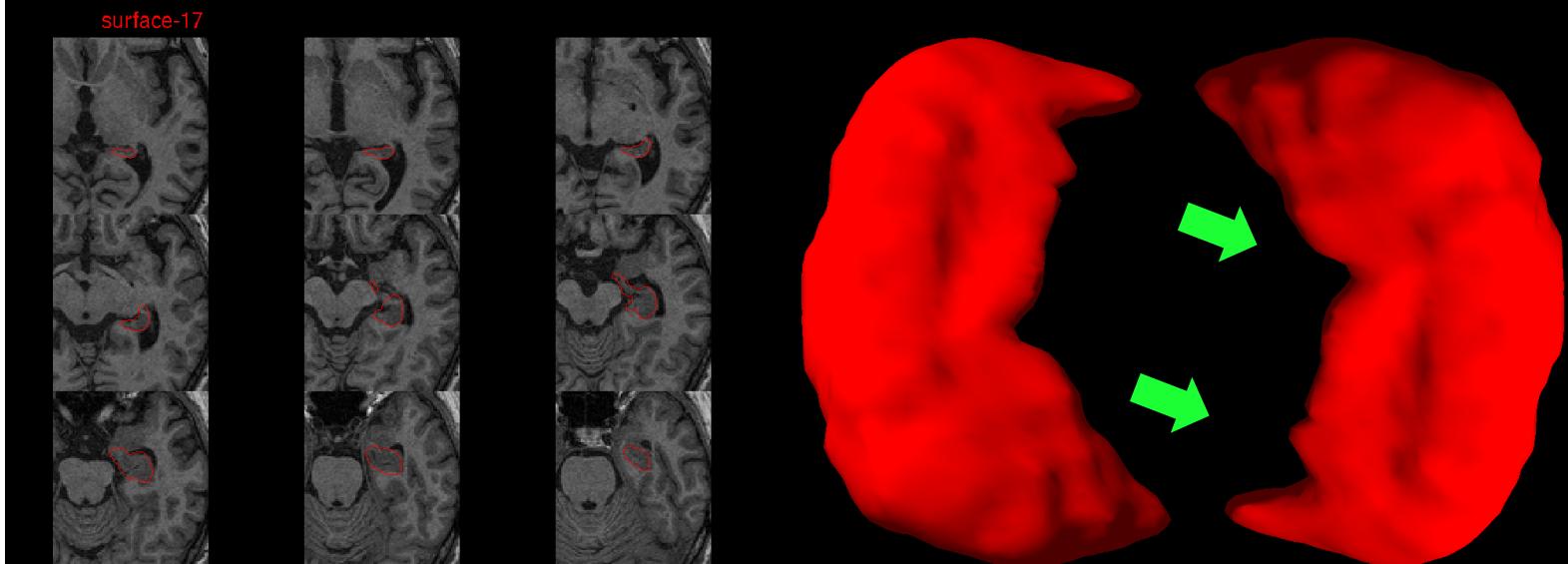
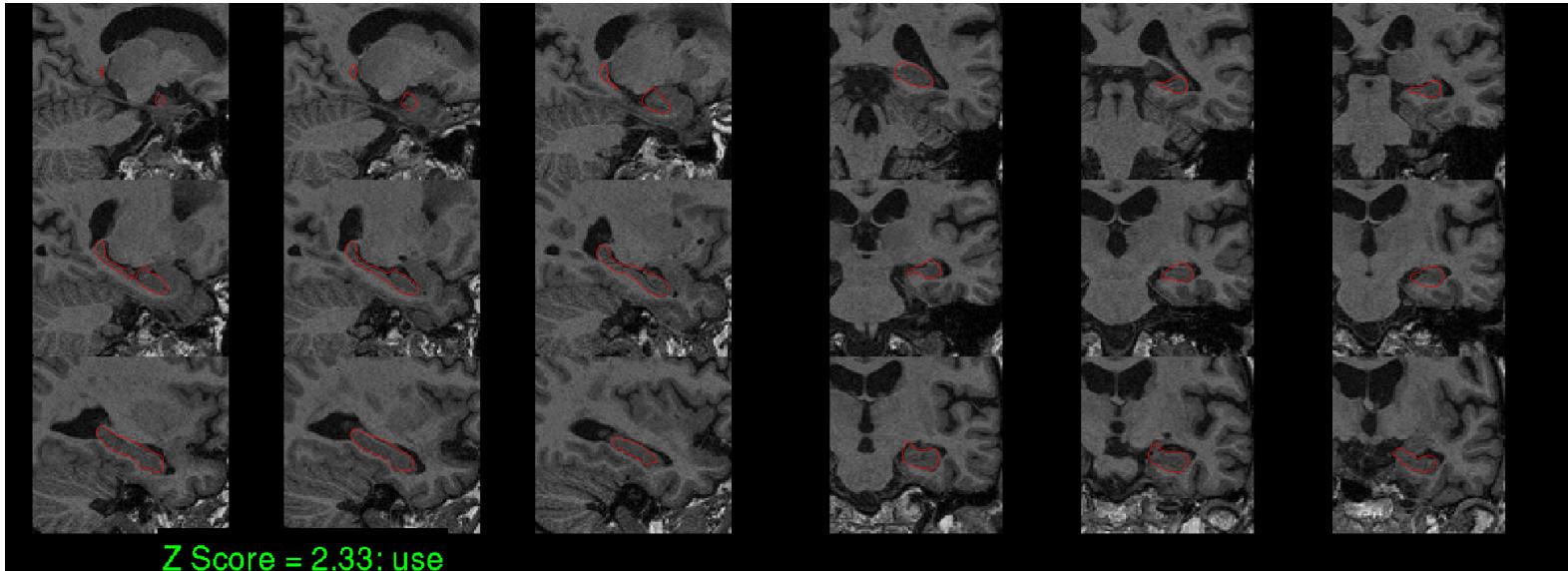
Rating: 2 (Moderate Pass) – Lateral overestimation (arrows), not severe enough to fail. Generally reflects underlying anatomy.



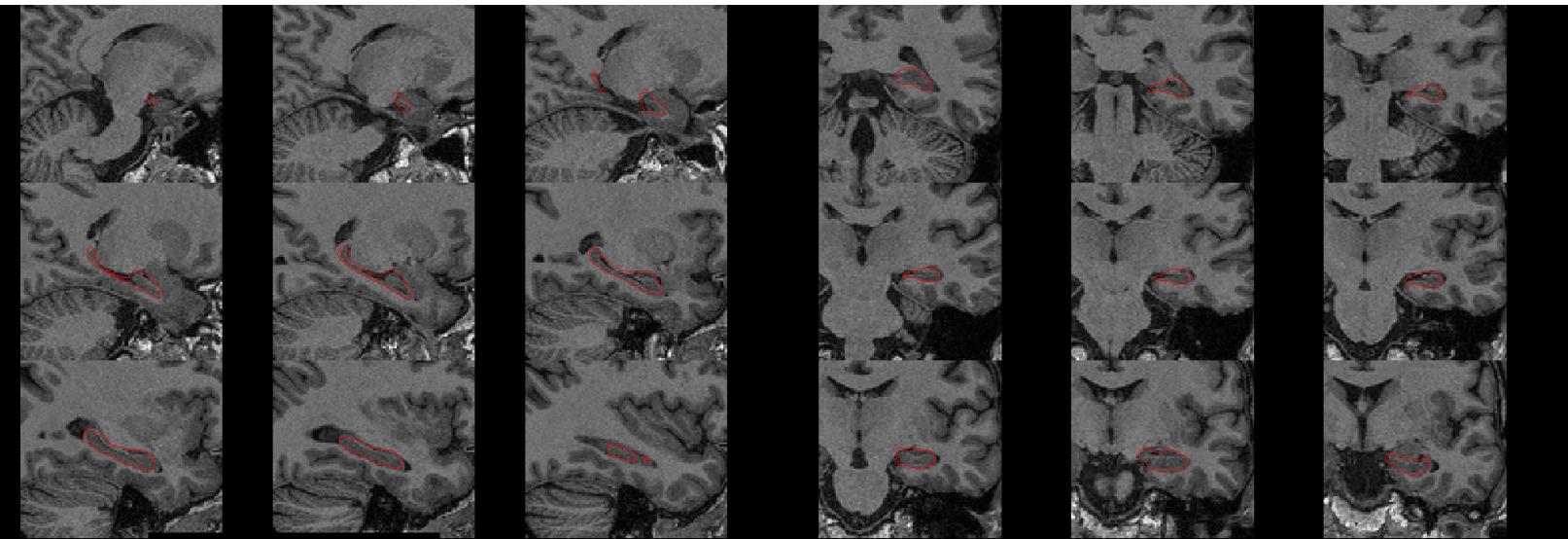
Z Score = 1.98: use



Rating: 2 (Moderate Pass) – Uneven medial edge and tail spike (arrow), not severe enough to fail. Generally reflects underlying anatomy.

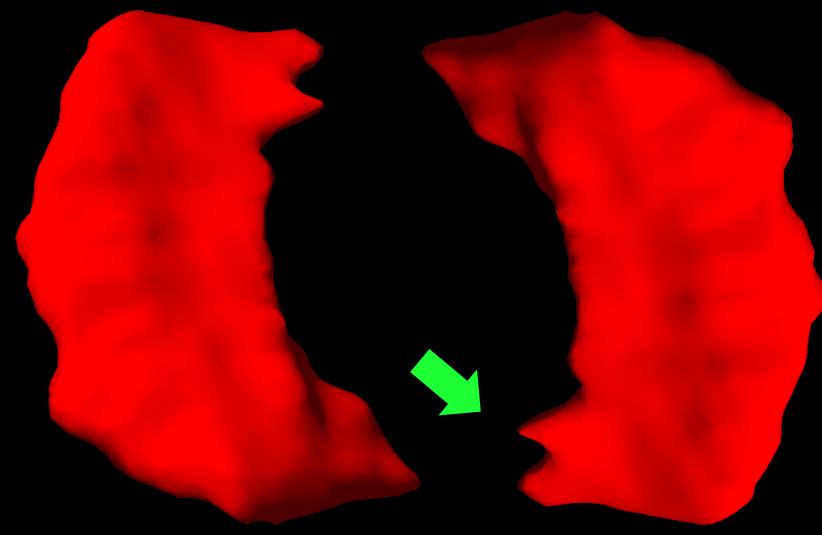
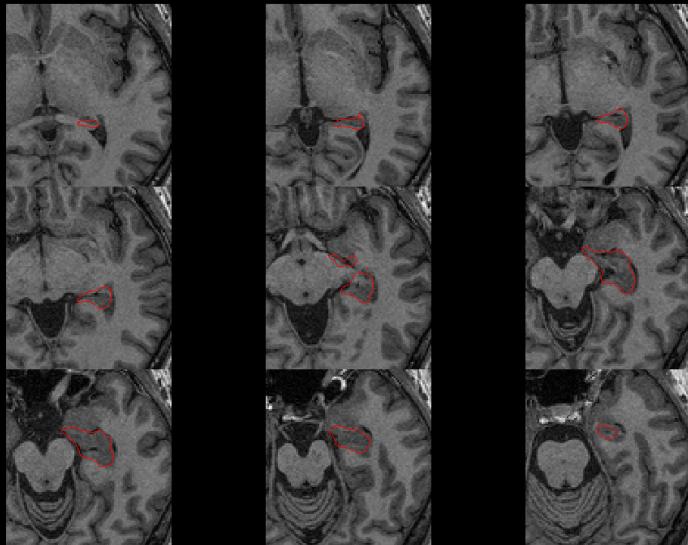


Rating: 2 (Moderate Pass) – Forked tail spike (arrow), not severe enough to fail. Generally reflects underlying anatomy.

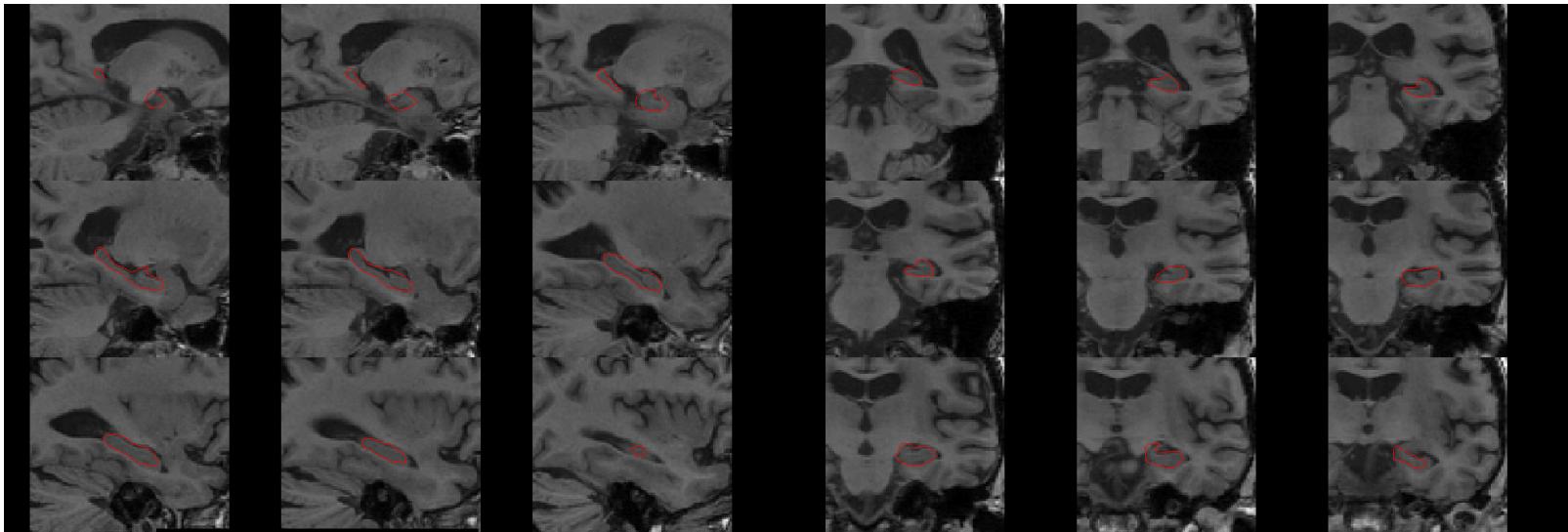


Z Score = 1.80: use

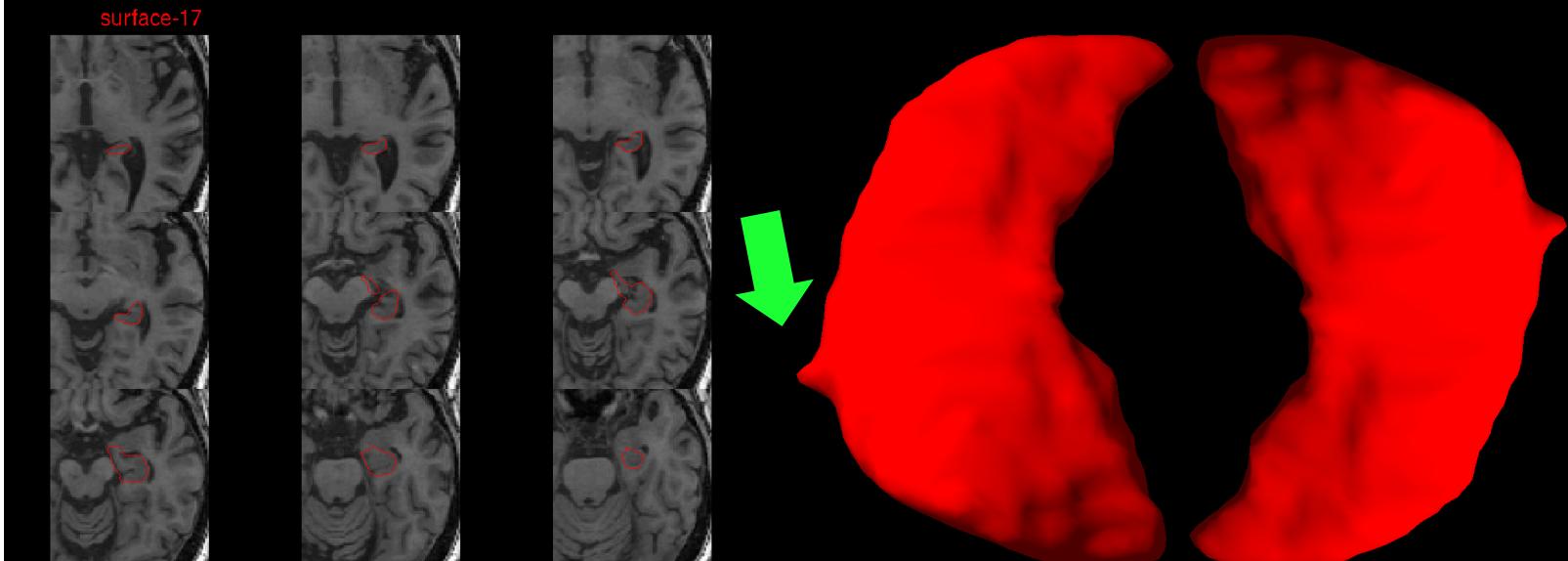
surface-17



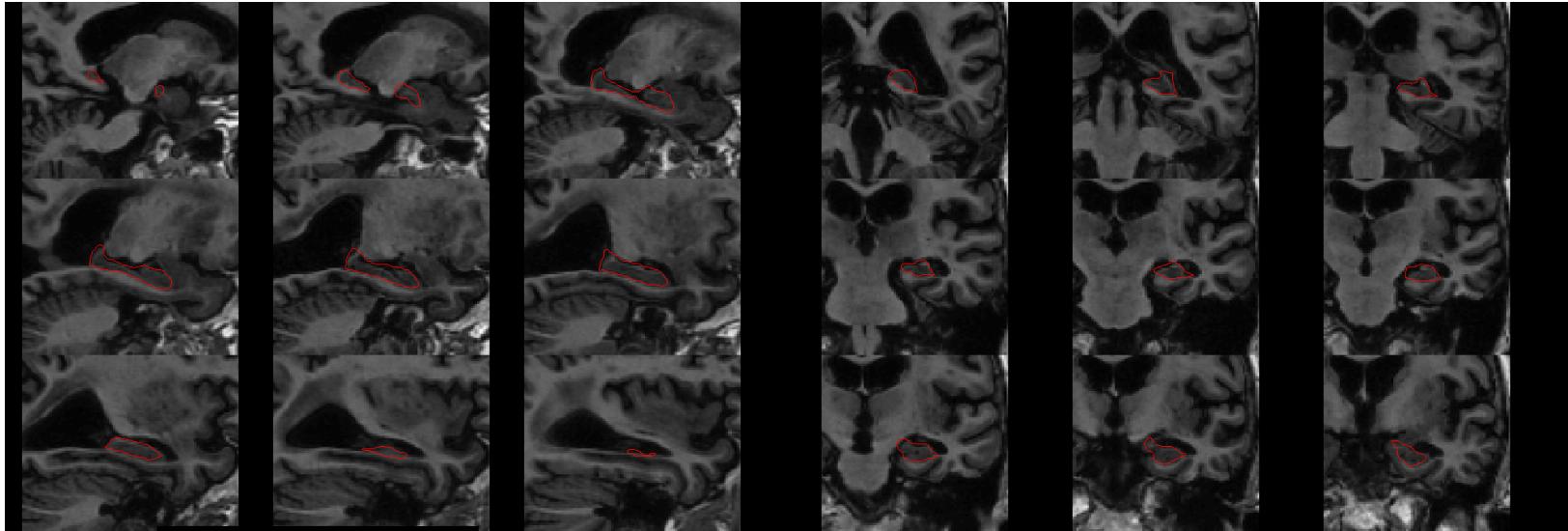
Rating: 2 (Moderate Pass) – Minor lateral edge spike (arrow), not severe enough to fail. Generally reflects underlying anatomy.



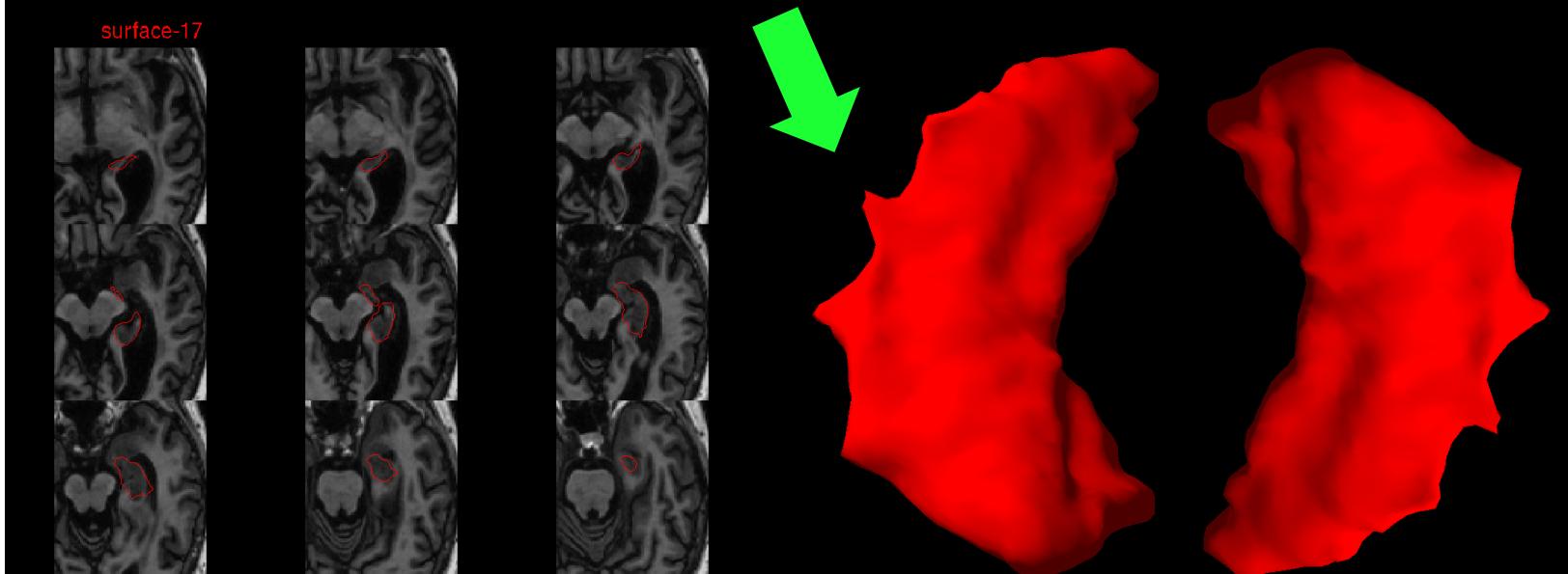
Z Score = 2.54: check



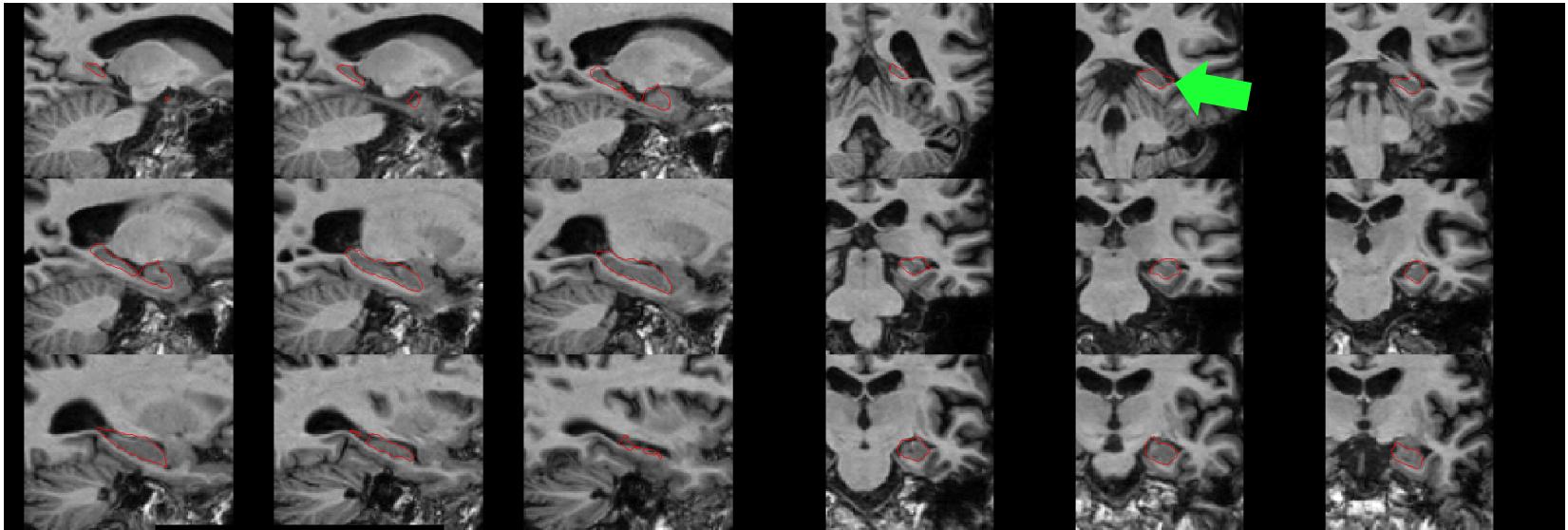
Rating: 1 (Fail) – Severe spiking along lateral edge representing under/overestimation by FreeSurfer/FSL segmentation.



Z Score = 3.01: check

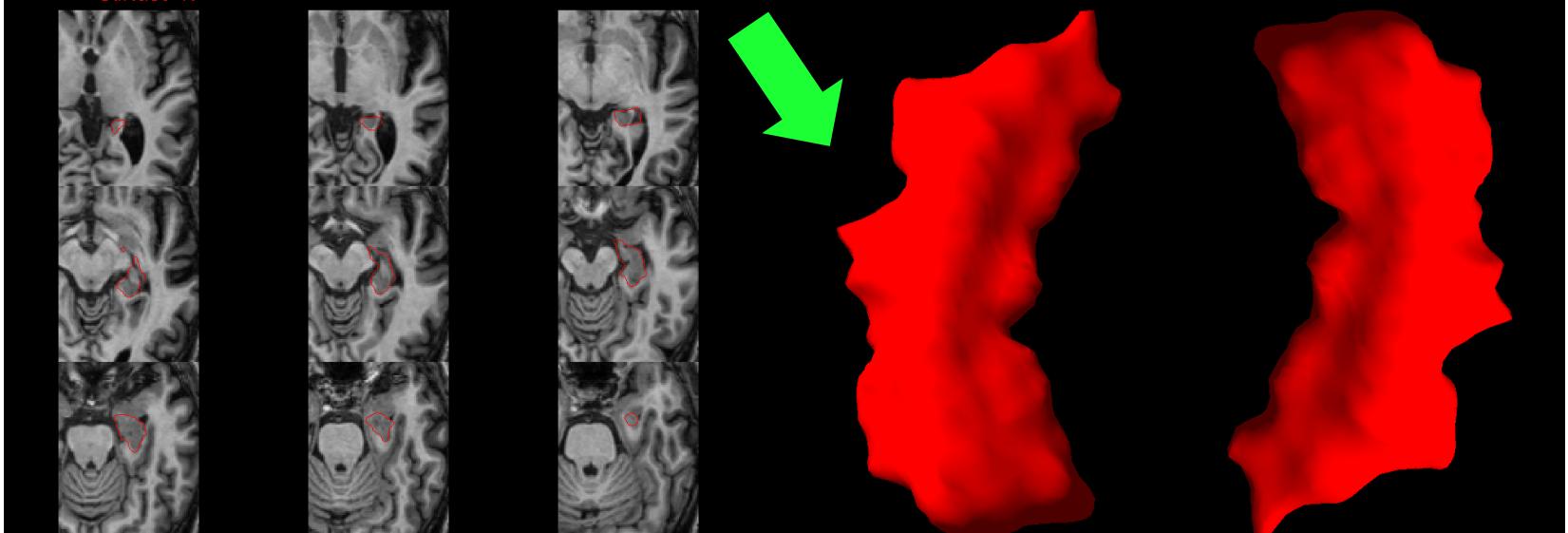


Rating: 1 (Fail) – Severe spiking along lateral edge (arrows) representing under/overestimation by FreeSurfer/FSL segmentation.

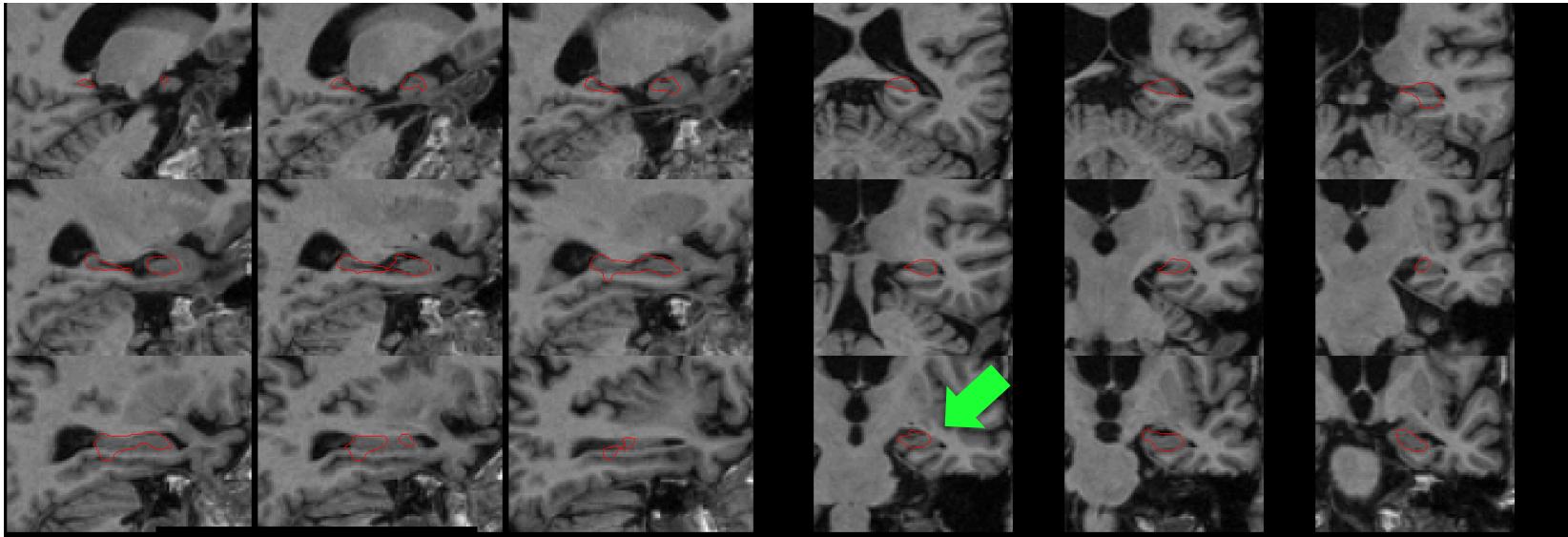


Z Score = 2.49: use

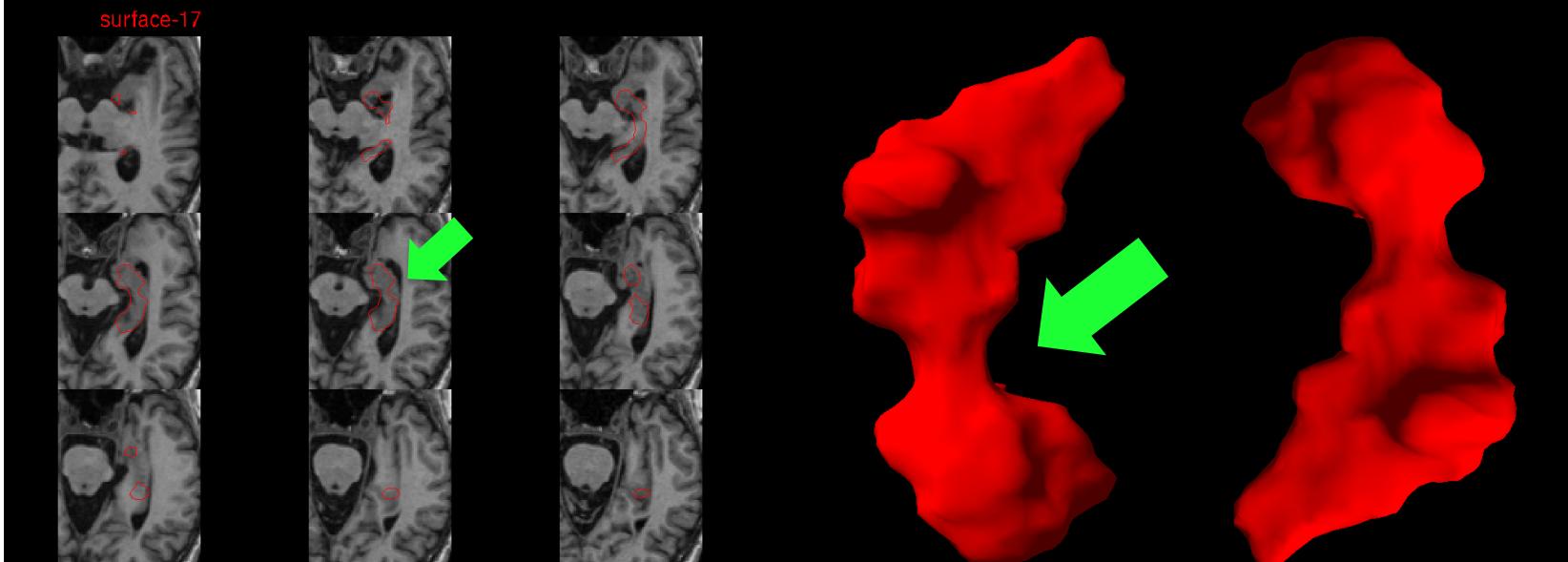
surface-17



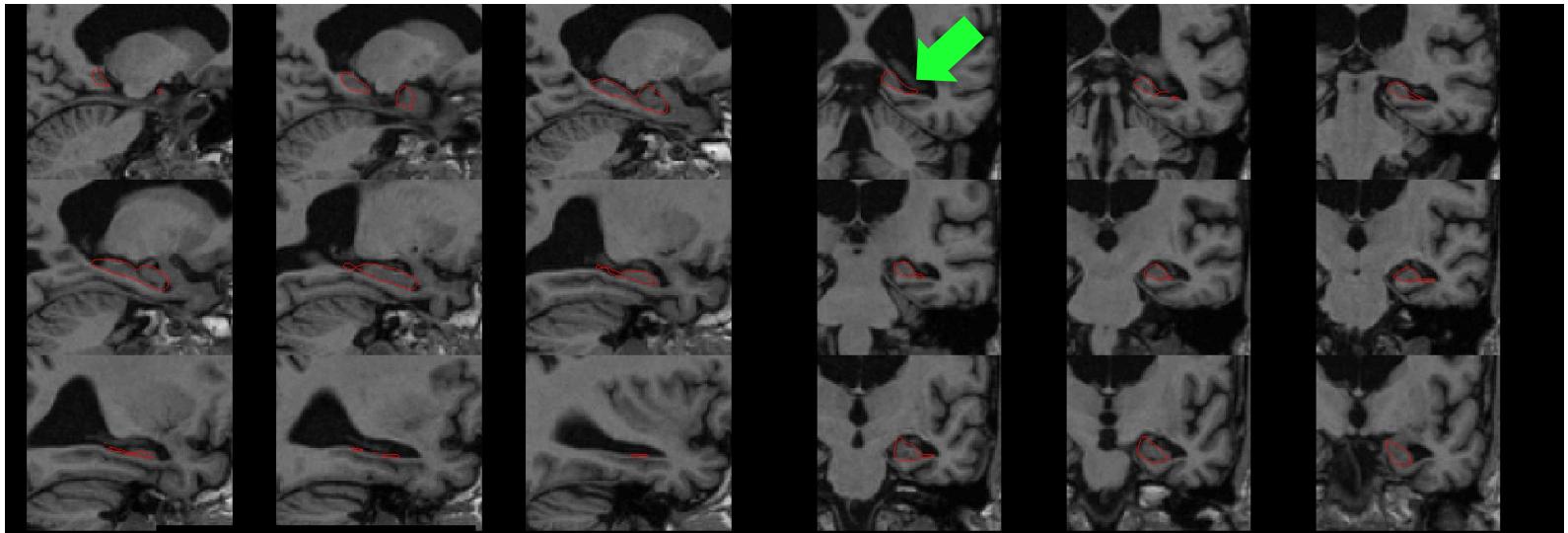
Rating: 1 (Fail) – Severe over/underestimation.



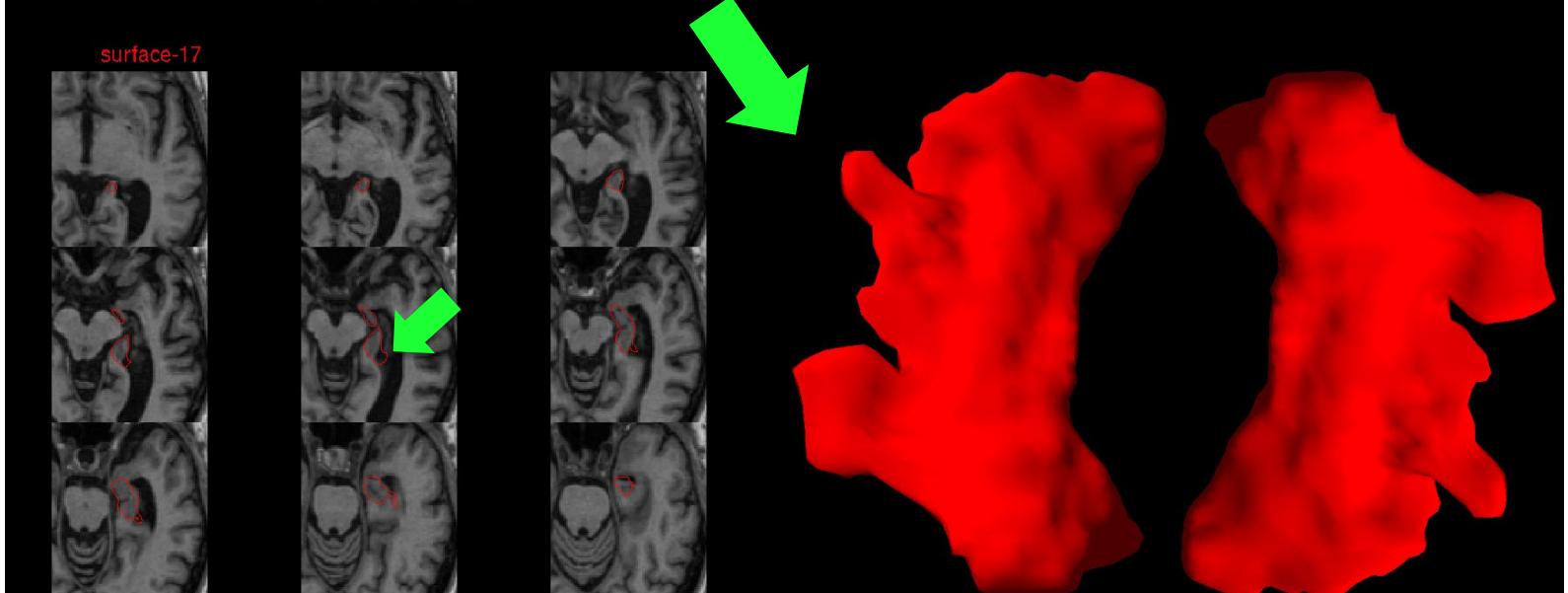
Z Score = 4.11: check



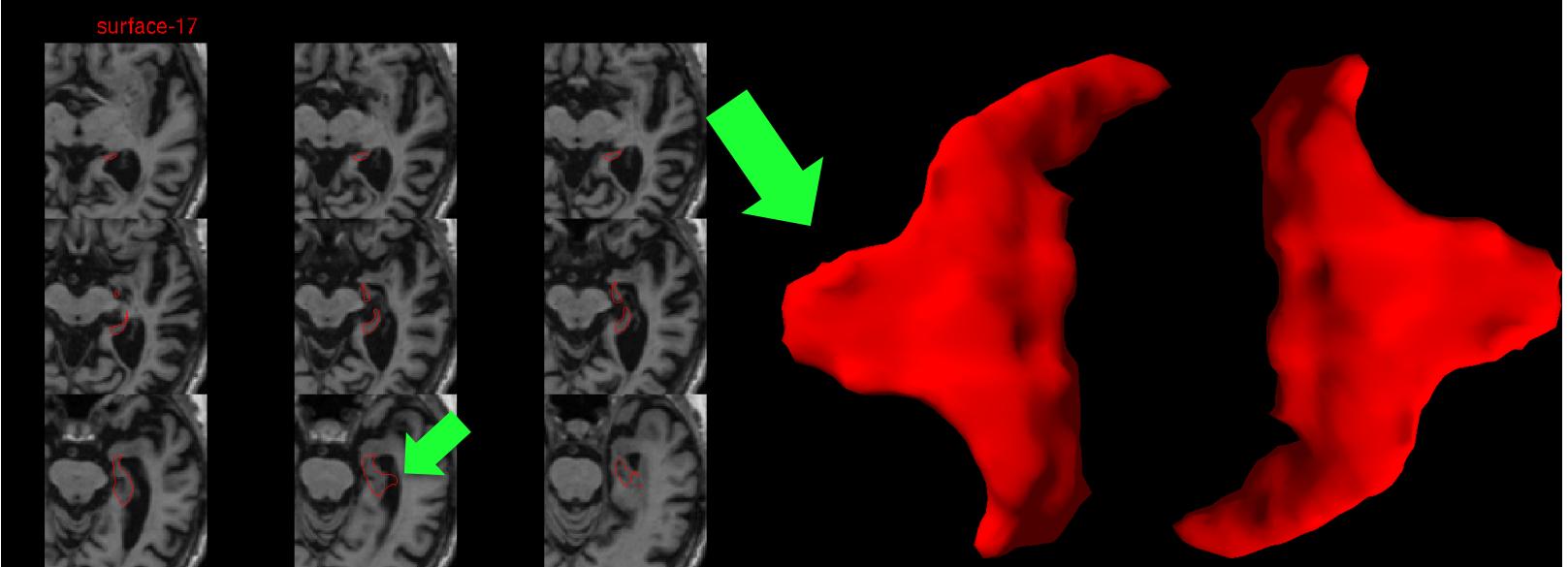
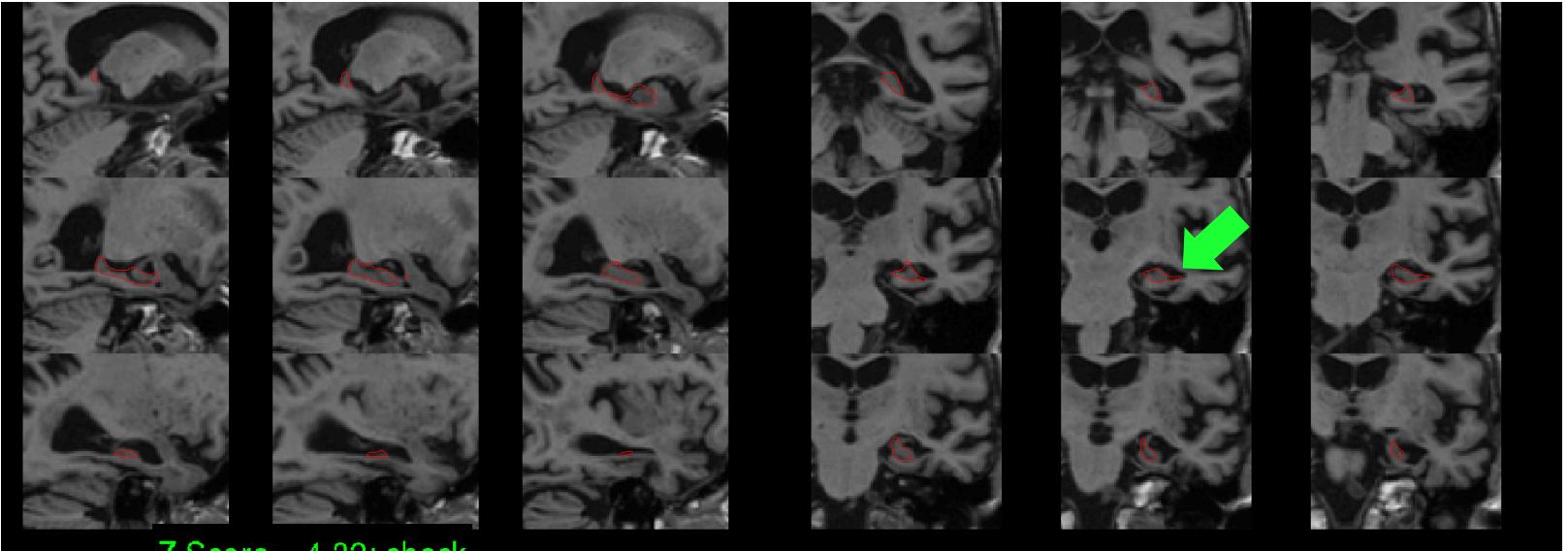
Rating: 1 (Fail) – Severe overestimation.



Z Score = 3.79: check



Rating: 1 (Fail) – Severe over/underestimation.

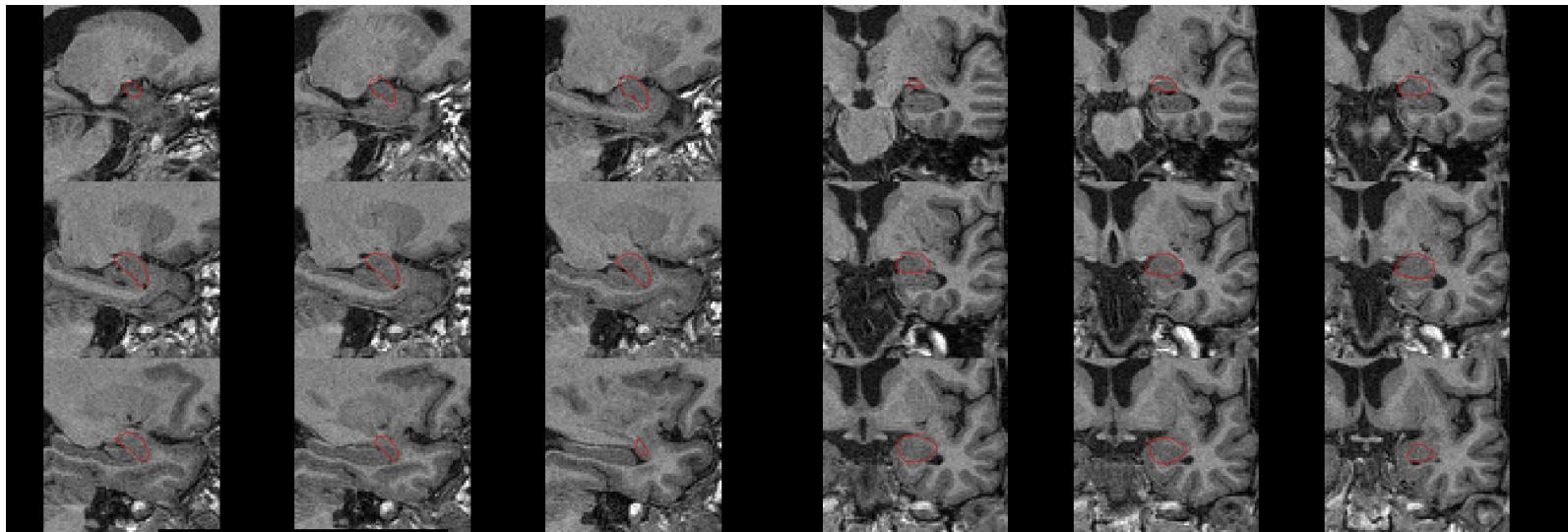


ROI 18/54

Left/Right Amygdala

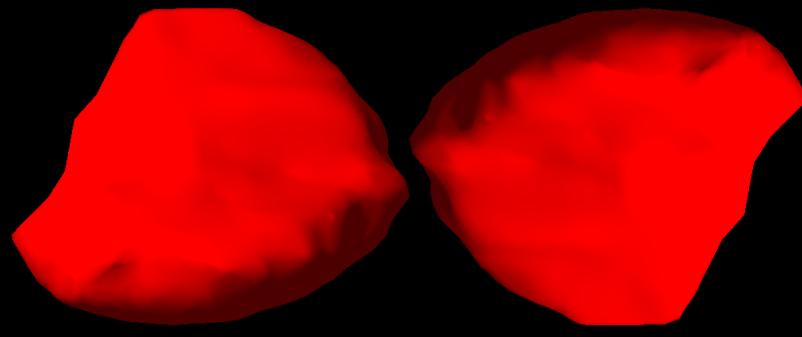
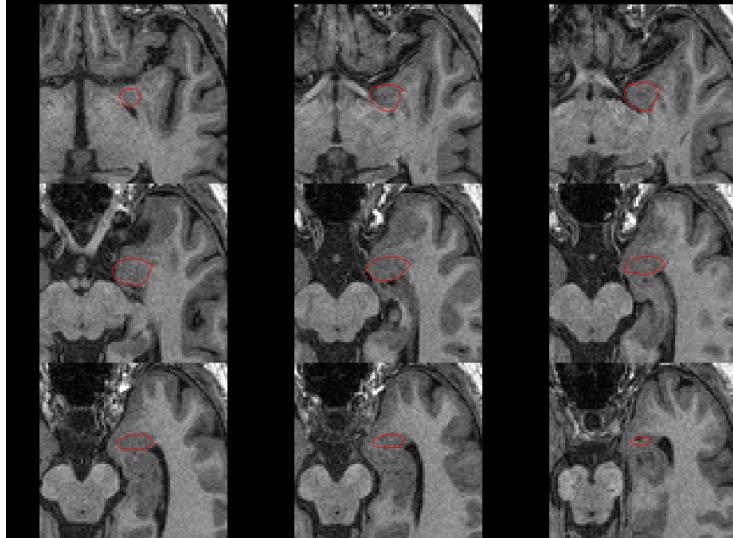
Overall: Some variability in the edge smoothness due to range of FreeSurfer/FSL segmentation quality.

Rating: 3 (Pass)

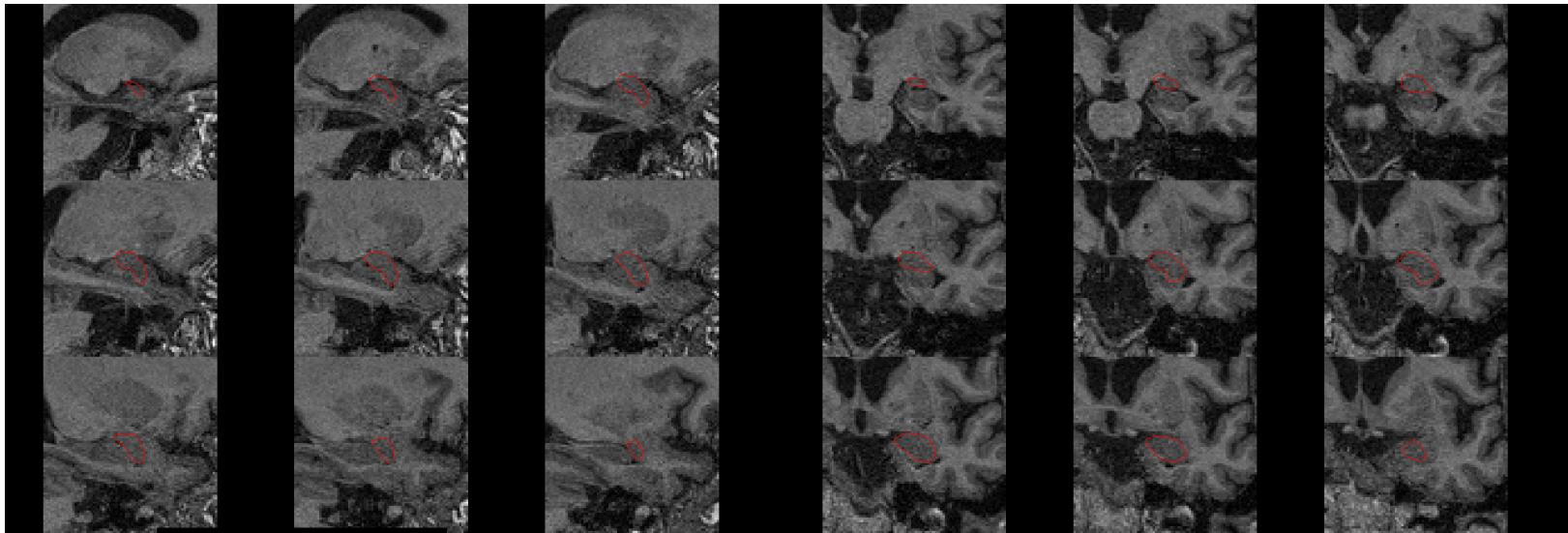


Z Score = 1.62: use

surface-18

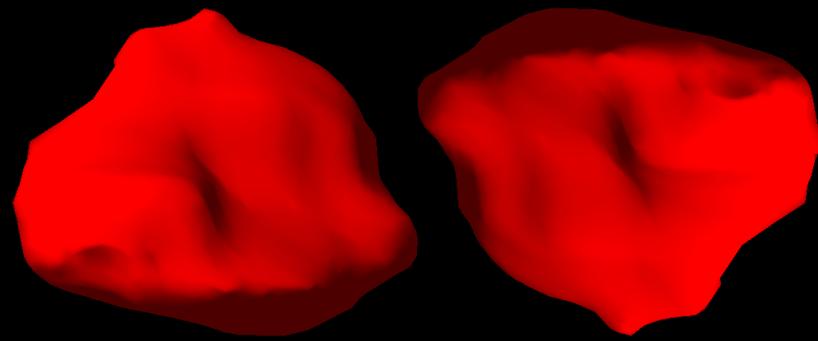
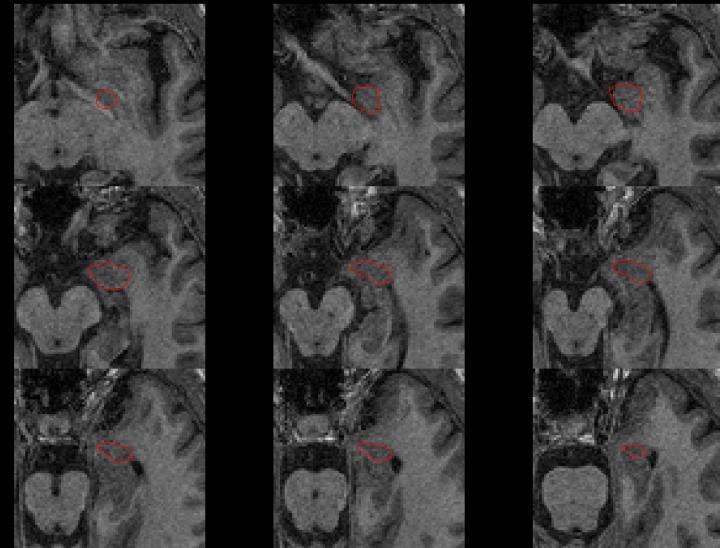


Rating: 3 (Pass)

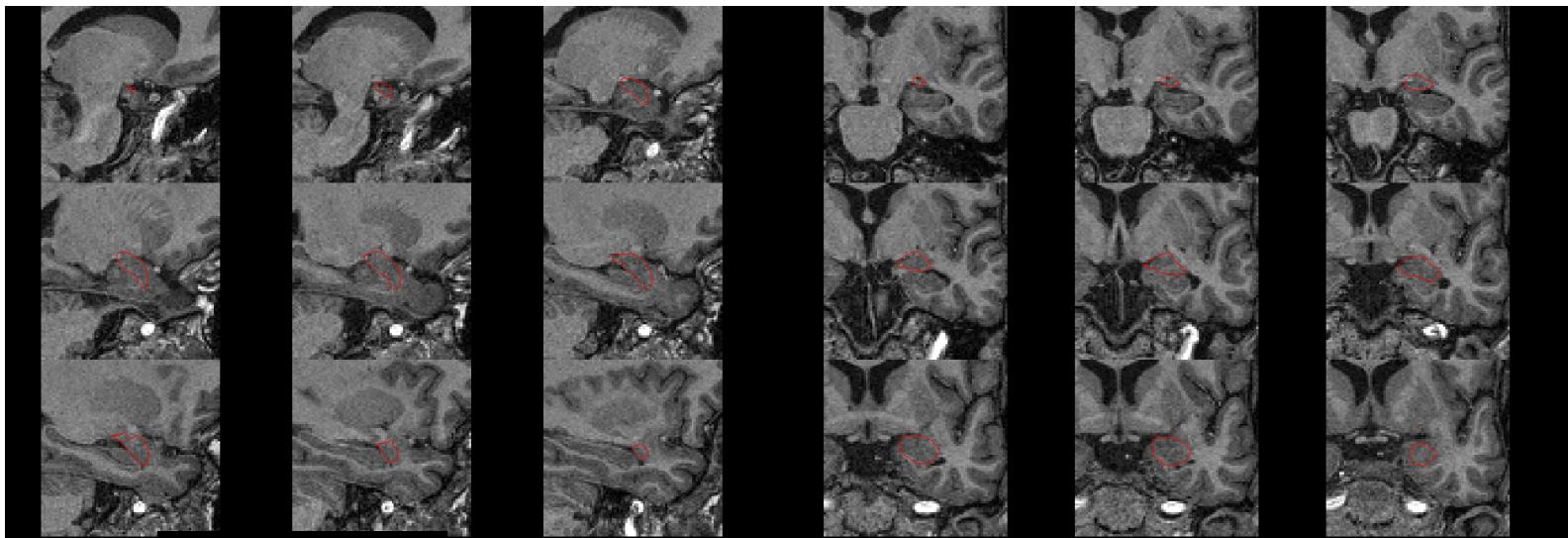


Z Score = 1.66: use

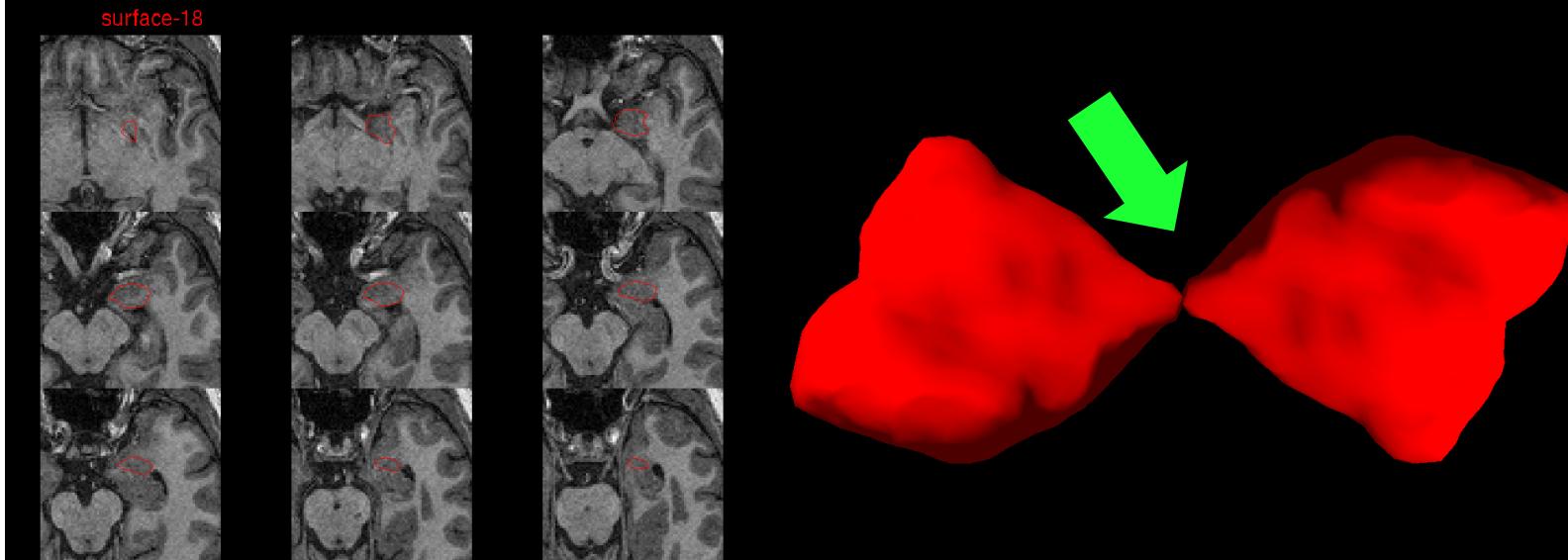
surface-18



Rating: 2 (Moderate Pass) – Minor spike (arrow), not severe enough to fail. Generally reflects underlying anatomy.

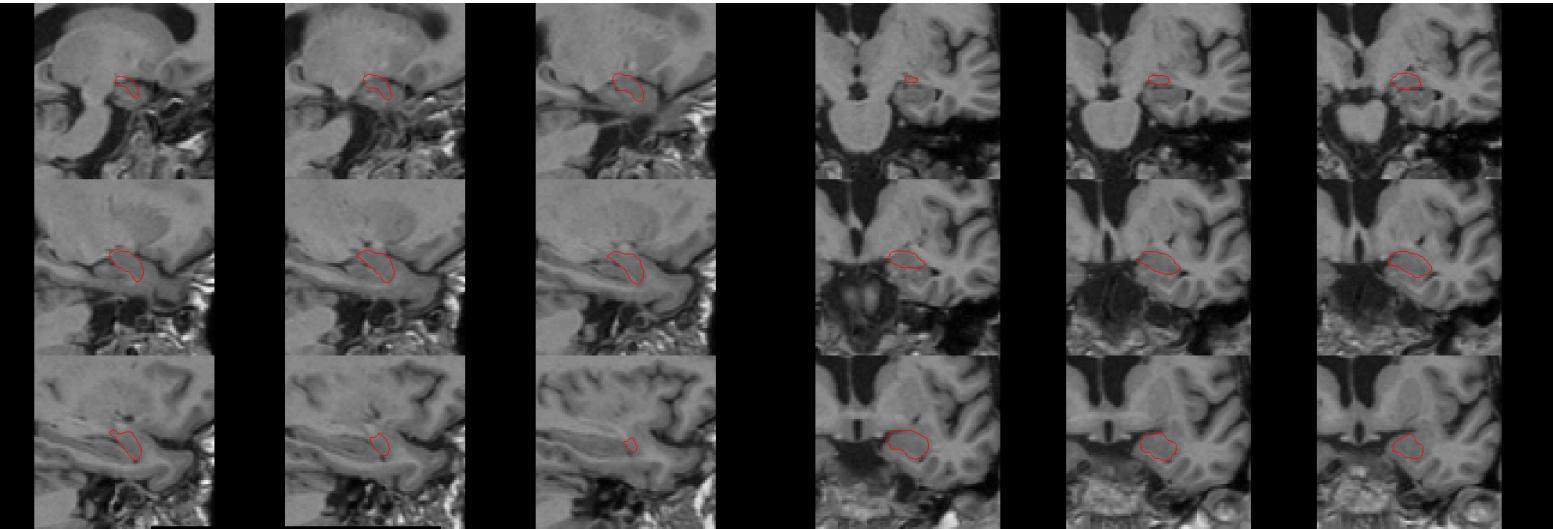


Z Score = 1.85: use



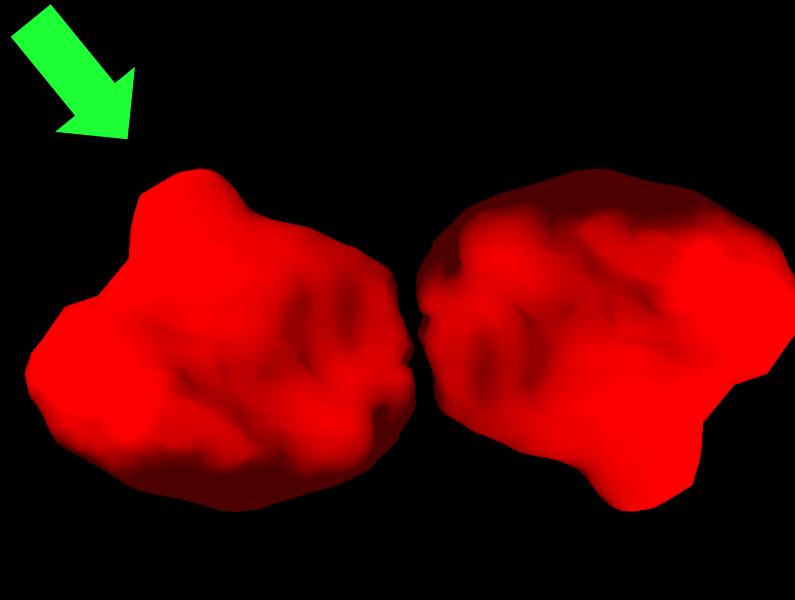
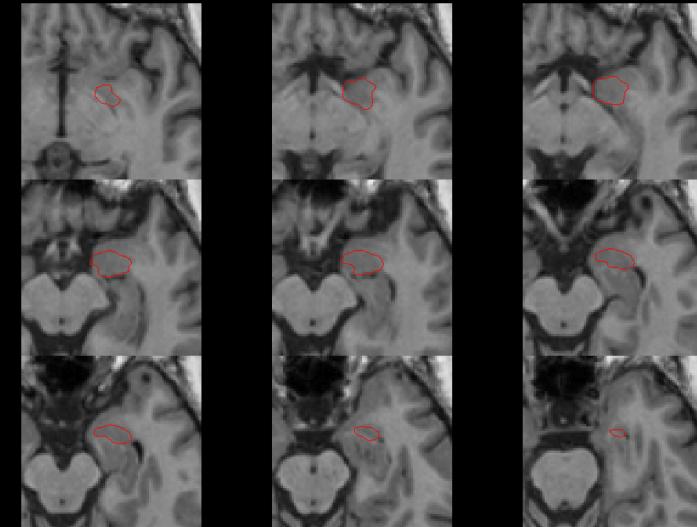
surface-18

Rating: 2 (Moderate Pass) – Minor edge irregularity (arrow), not severe enough to fail. Generally reflects underlying anatomy.

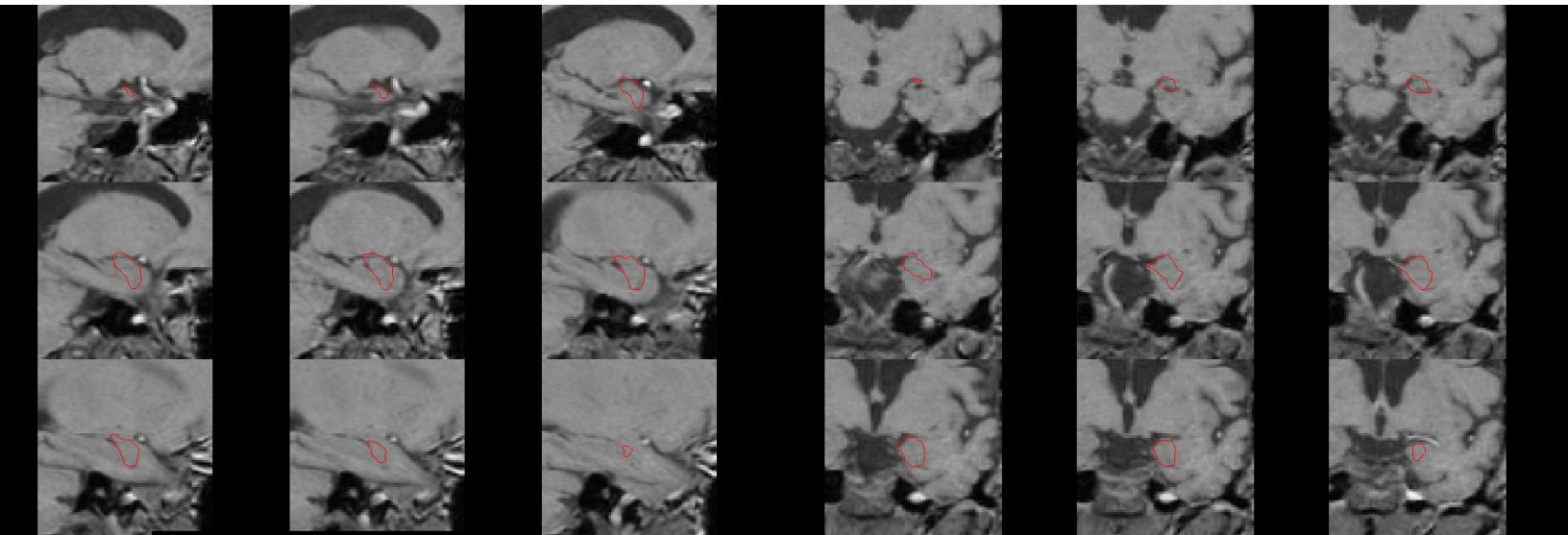


Z Score = 1.68: use

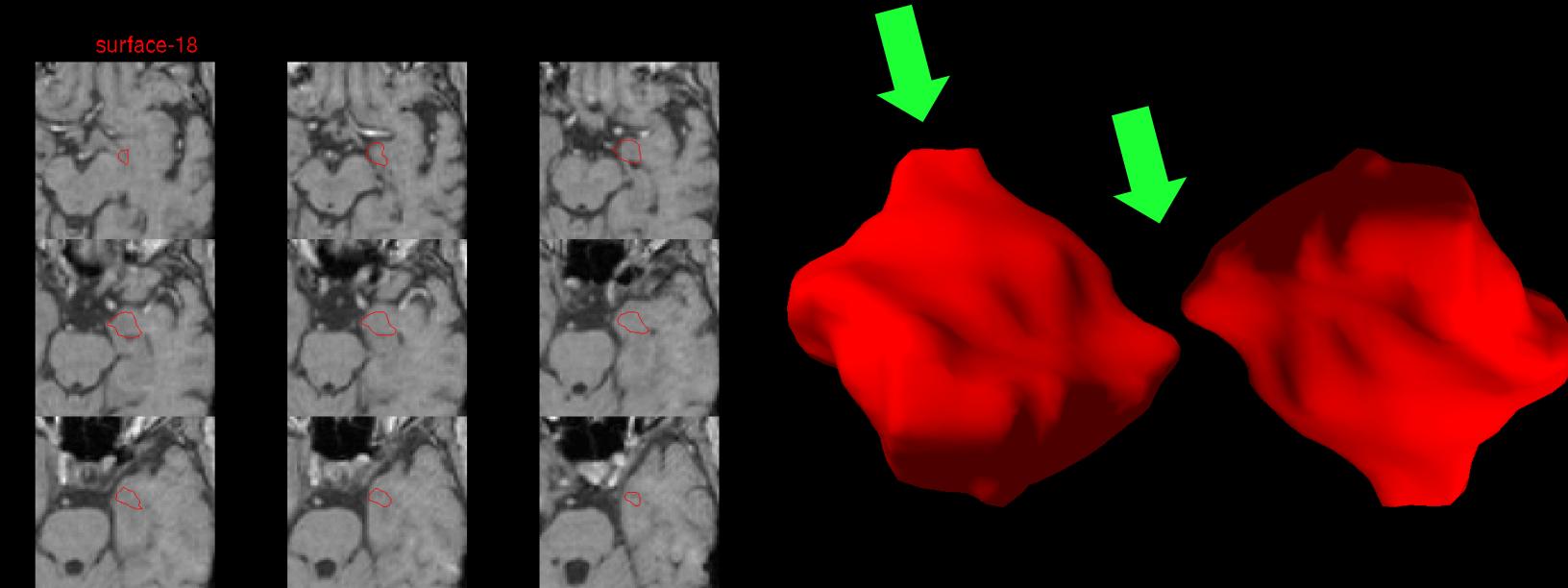
surface-18



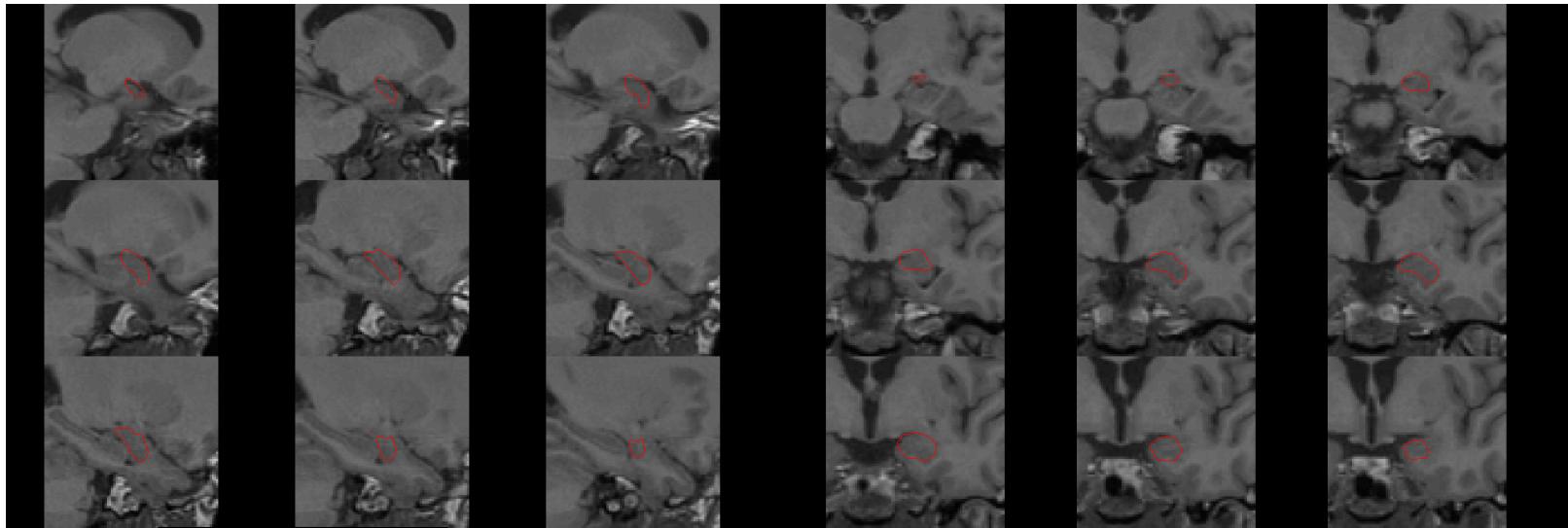
Rating: 2 (Moderate Pass) – Minor edge irregularity (arrows), not severe enough to fail. Generally reflects underlying anatomy.



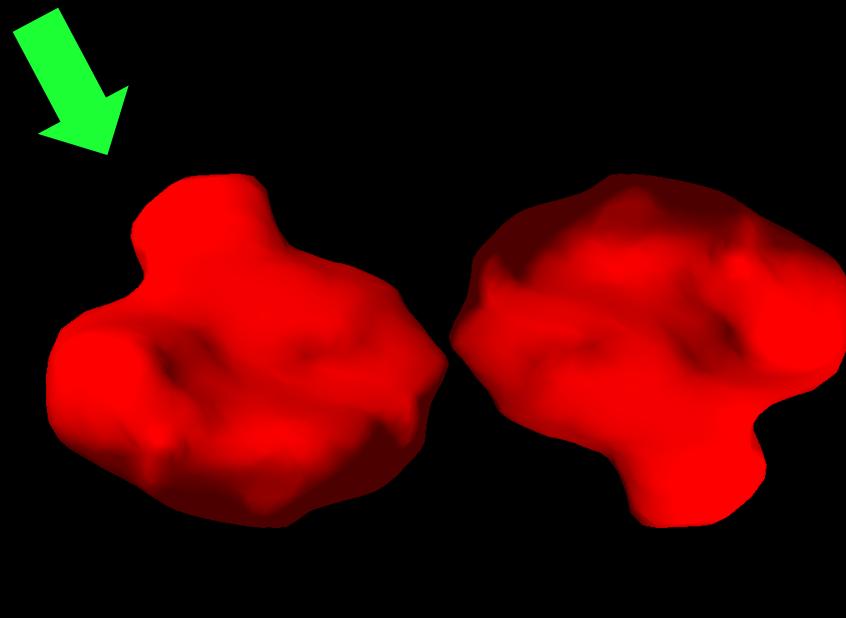
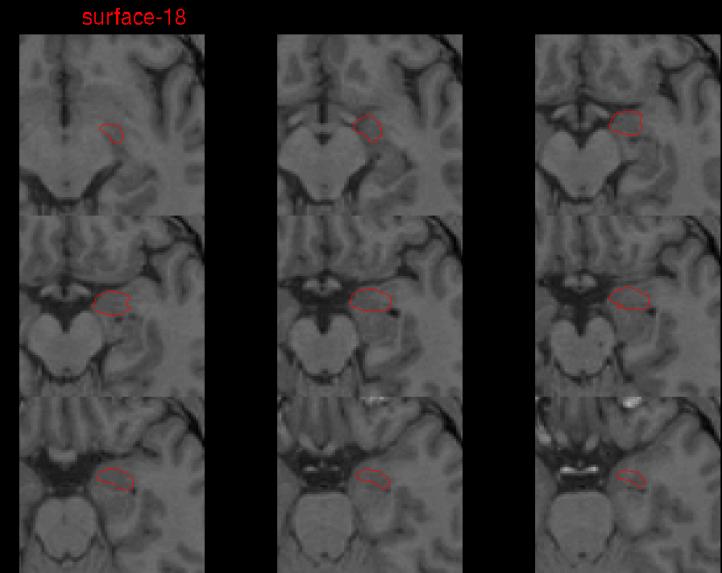
Z Score = 3.05: check



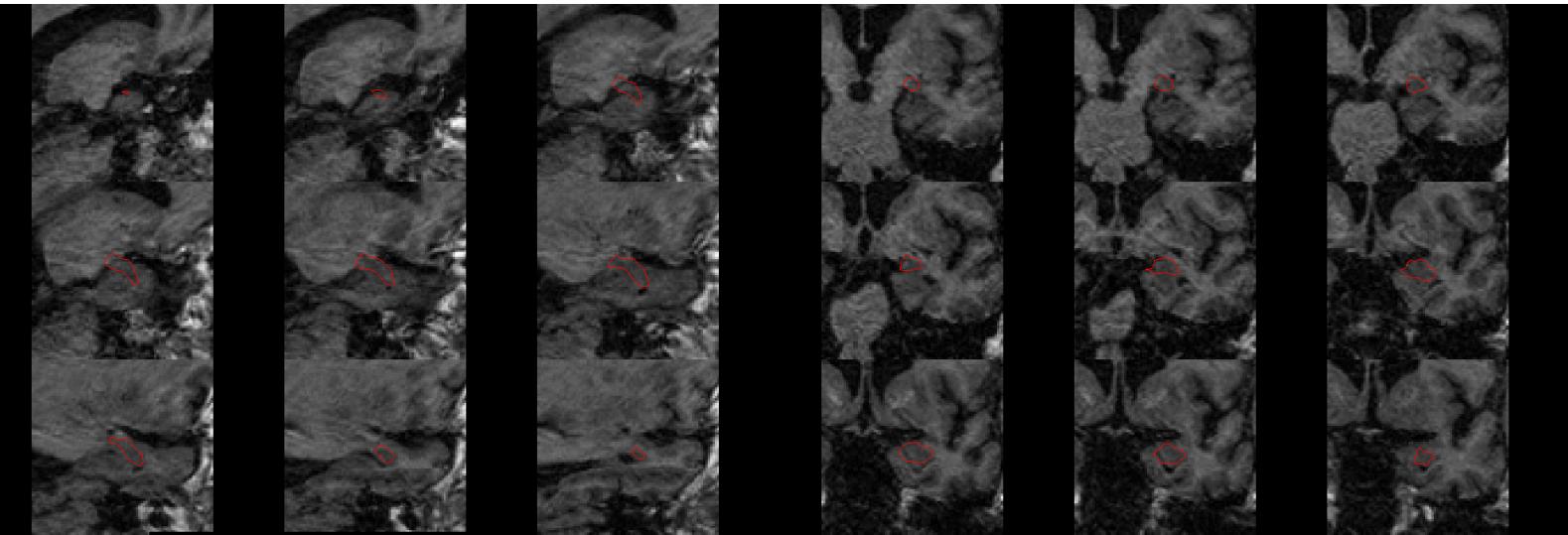
Rating: 2 (Moderate Pass) – Minor edge irregularity (arrow), not severe enough to fail. Generally reflects underlying anatomy.



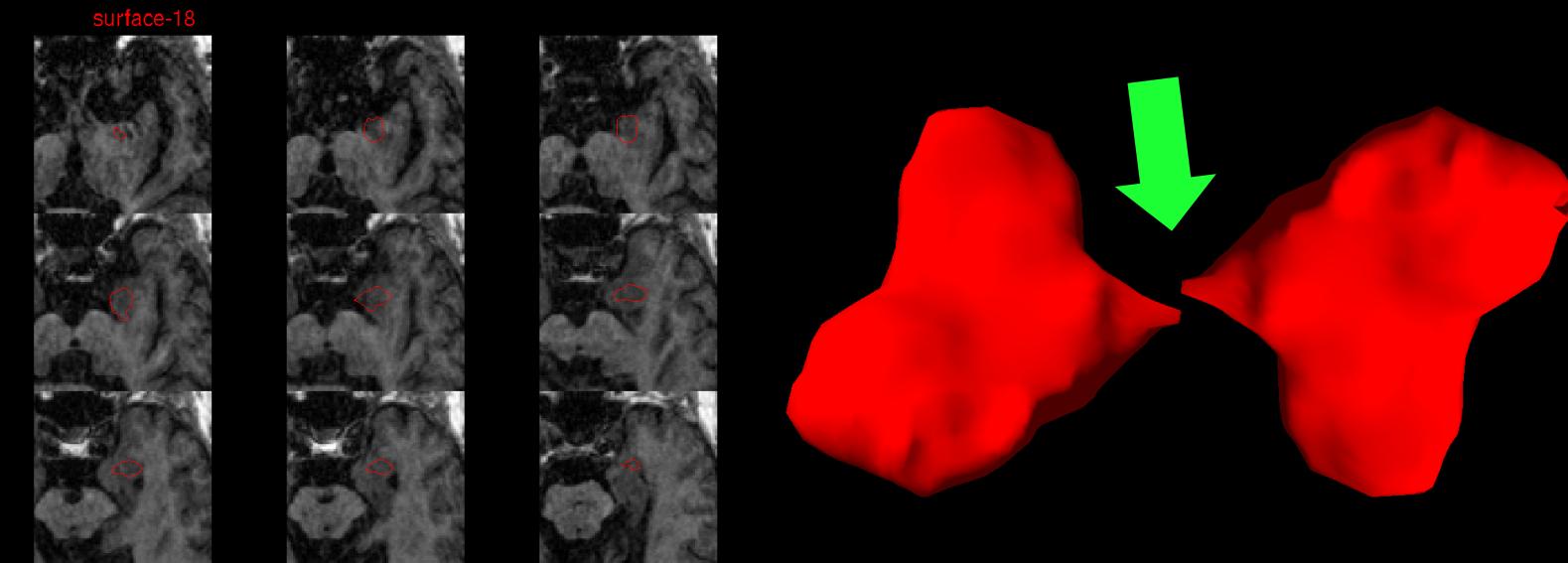
Z Score = 1.60: use



Rating: 1 (Fail) – Severe spike and edge irregularity (arrow) due to poor quality T1 scan.



Z Score = 4.29: check

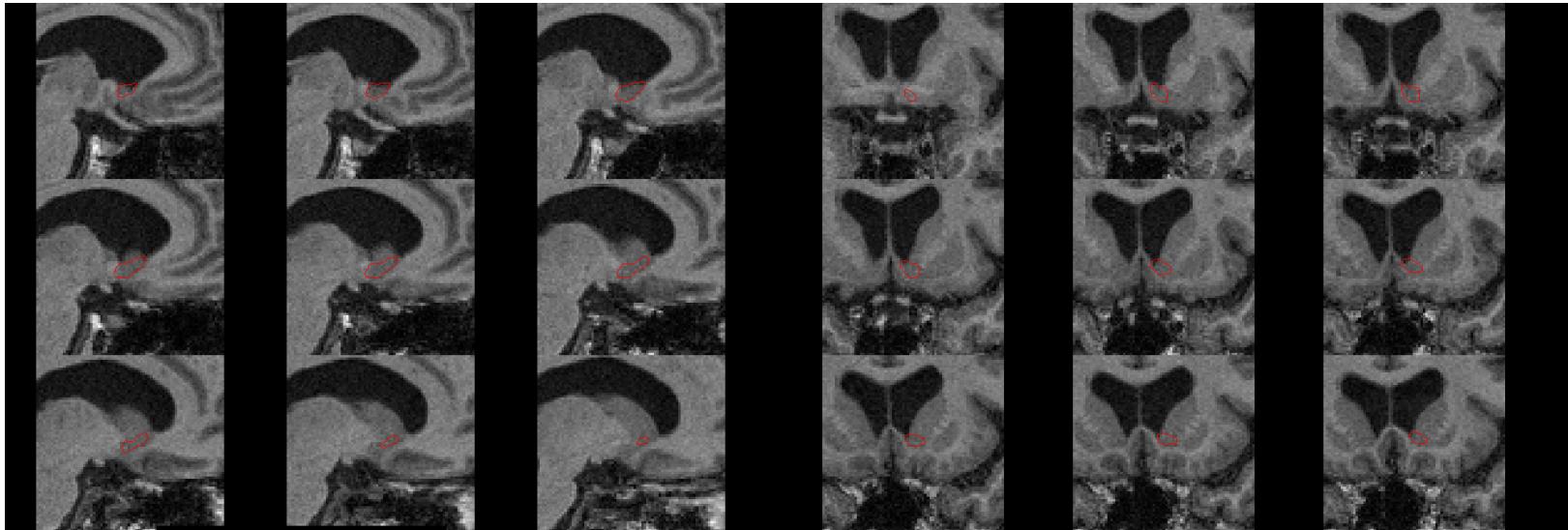


ROI 26/58

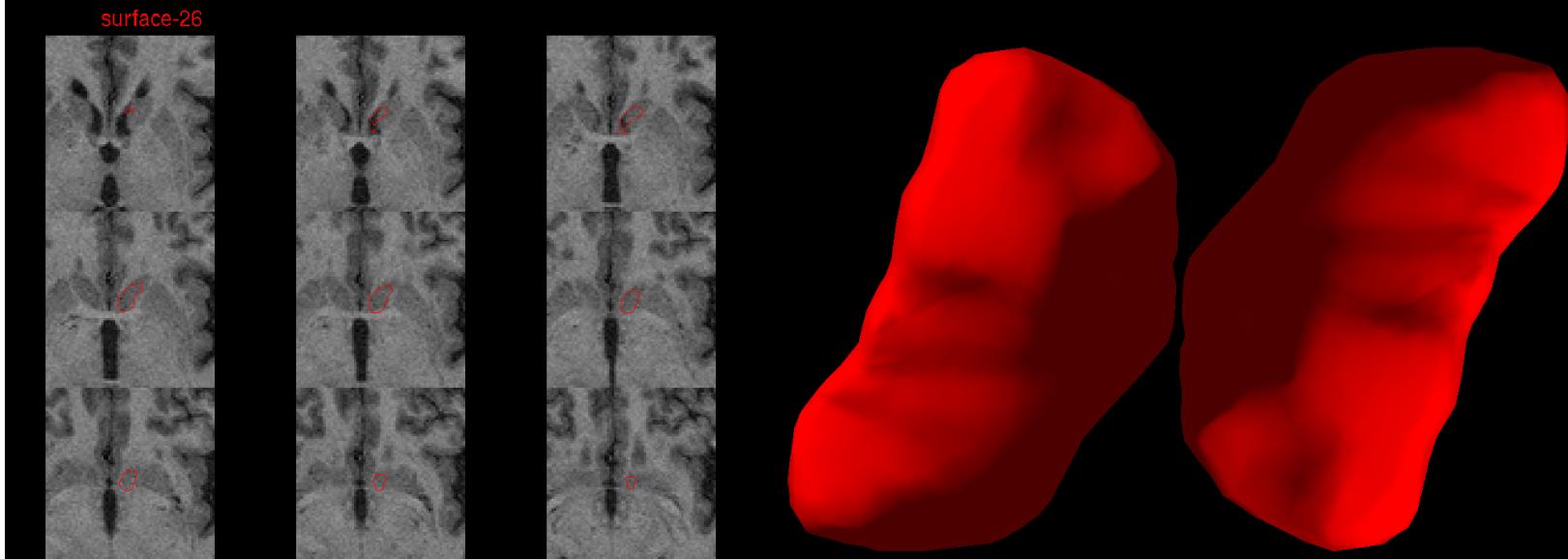
Left/Right Accumbens

Overall: Some variability in the edge smoothness due to range of FreeSurfer/FSL segmentation quality.

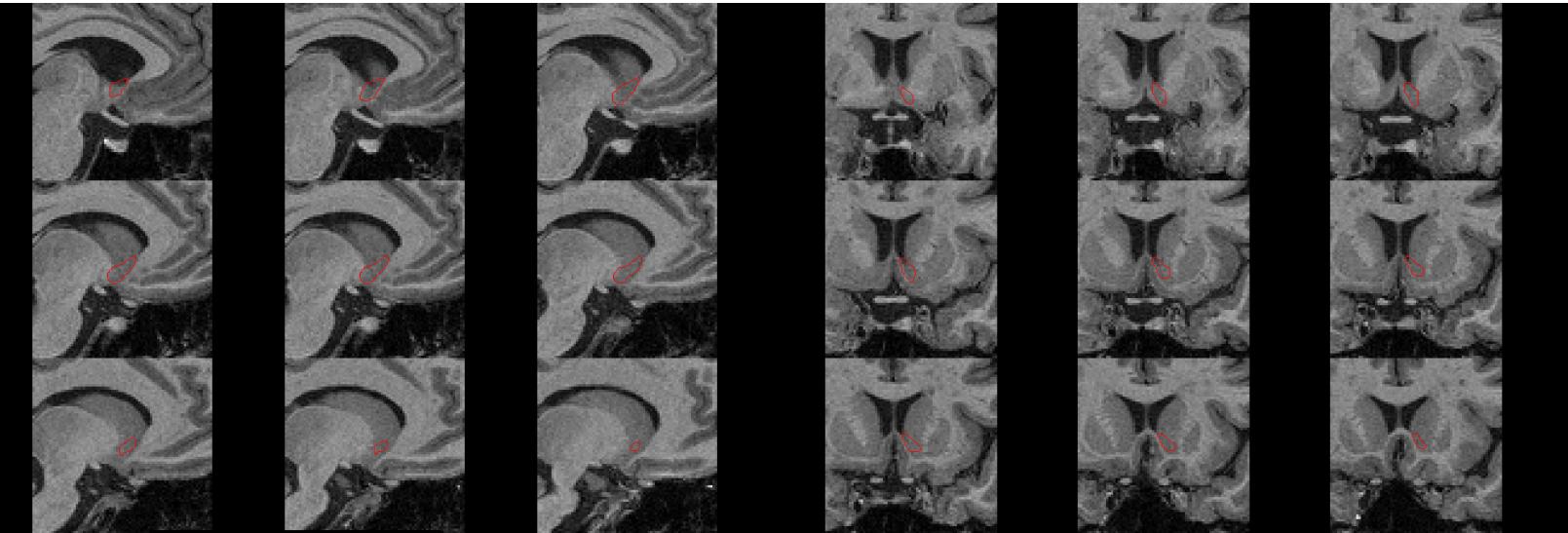
Rating: 3 (Pass)



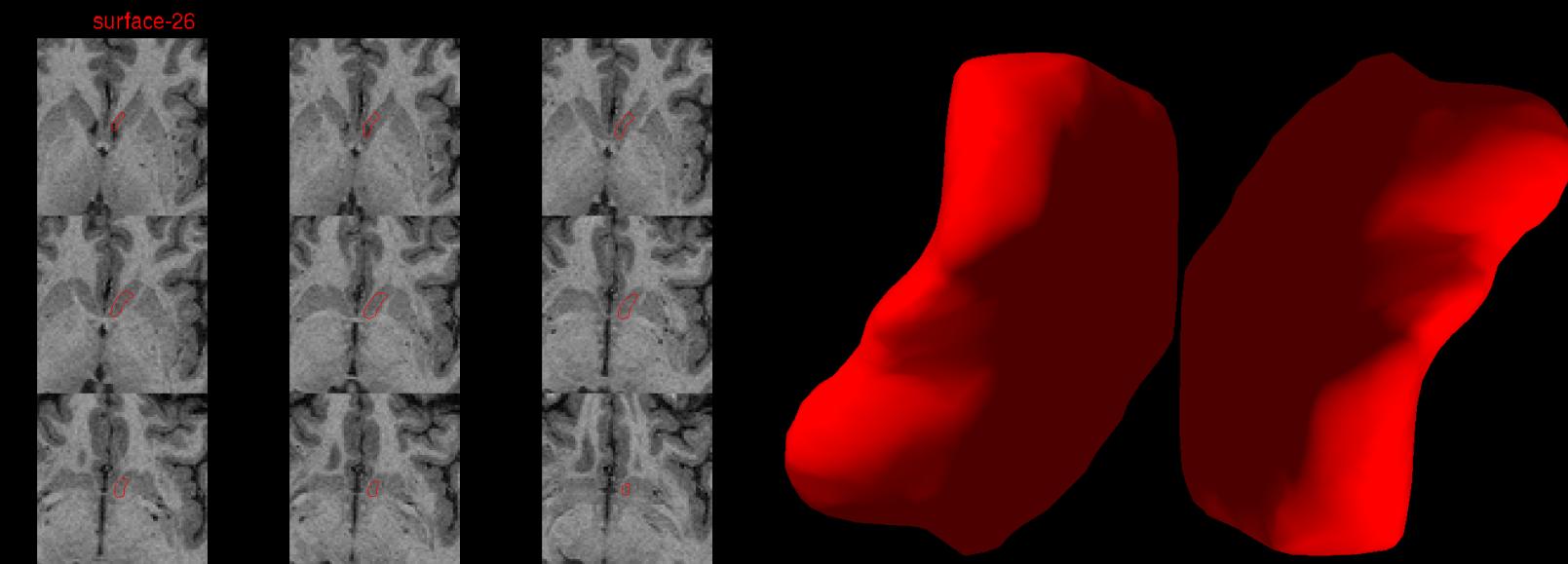
Z Score = 1.56: use



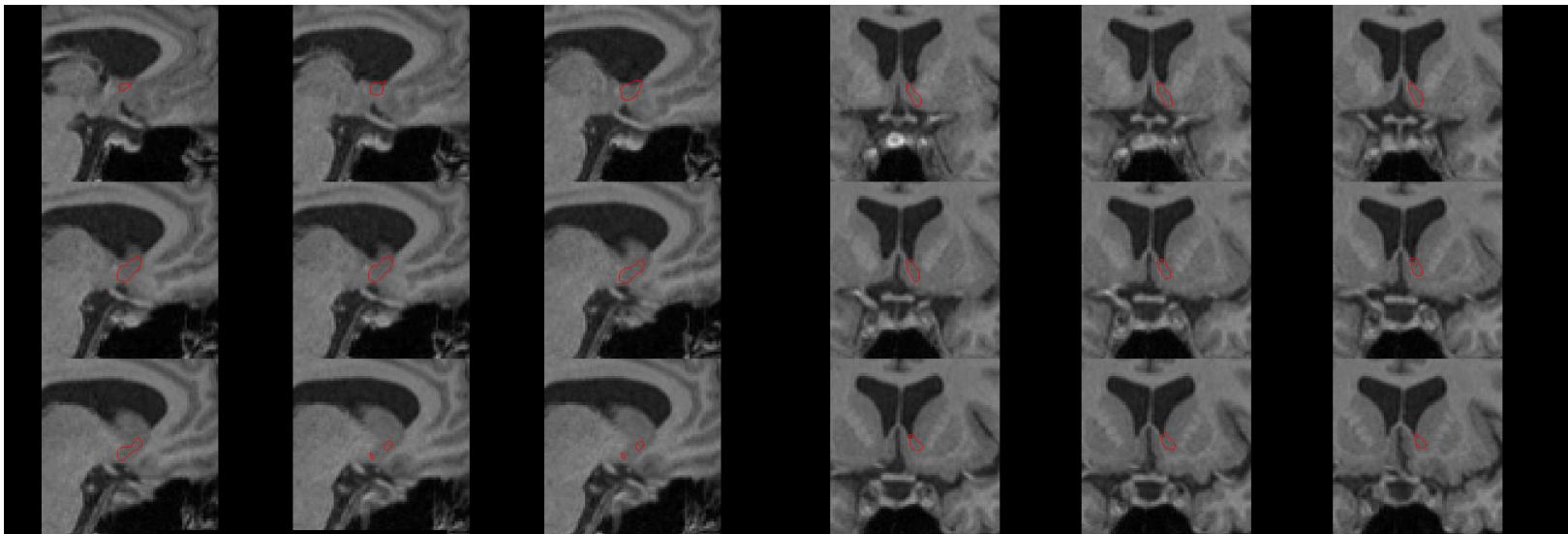
Rating: 3 (Pass)



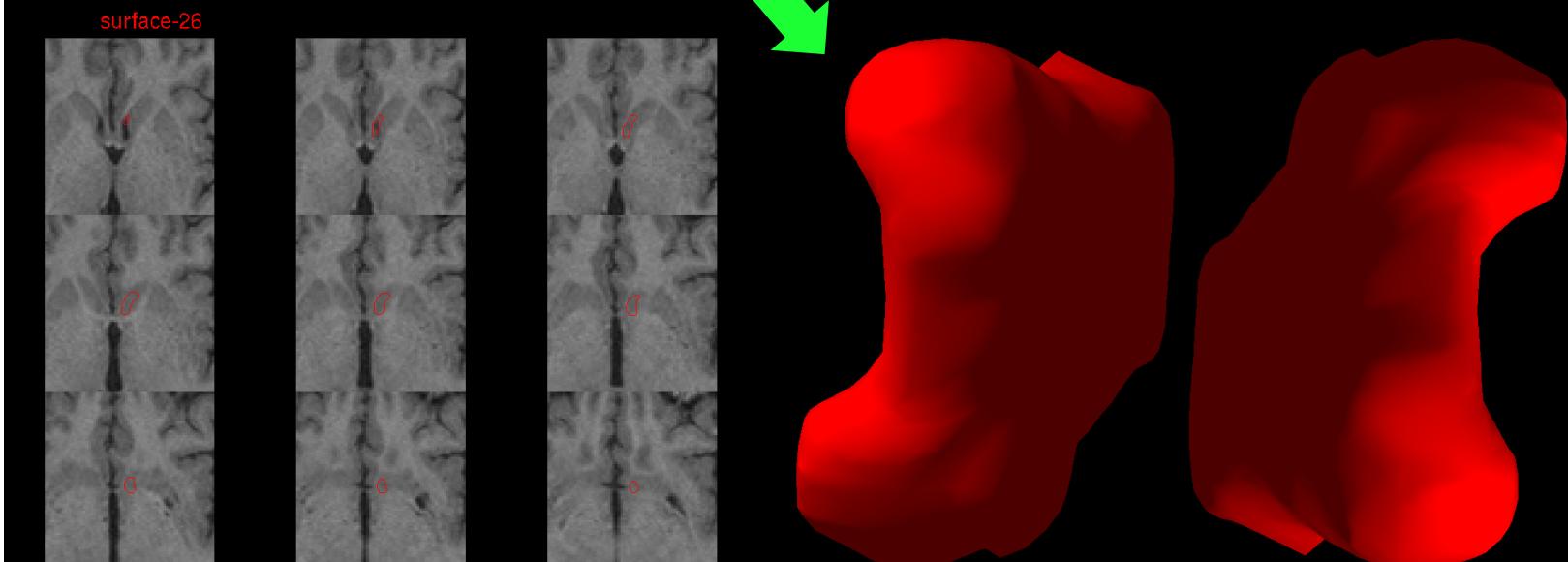
Z Score = 0.85: use



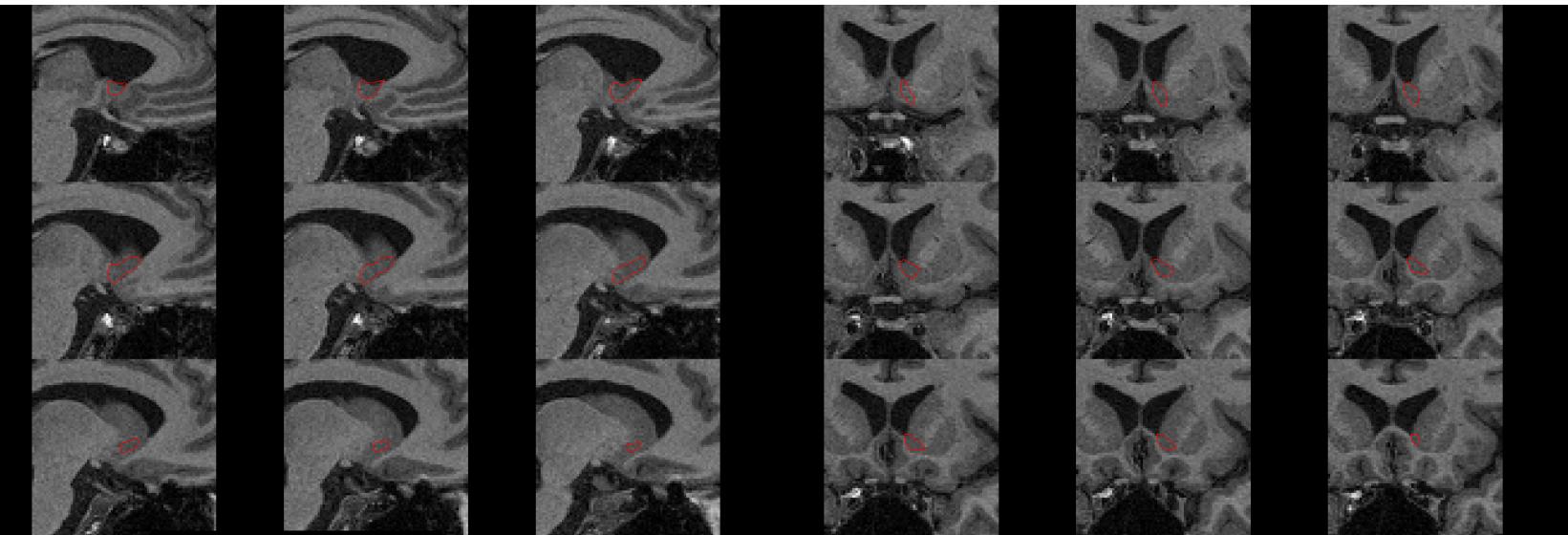
Rating: 2 (Moderate Pass) – Minor edge irregularity (arrow), not severe enough to fail. Generally reflects underlying anatomy.



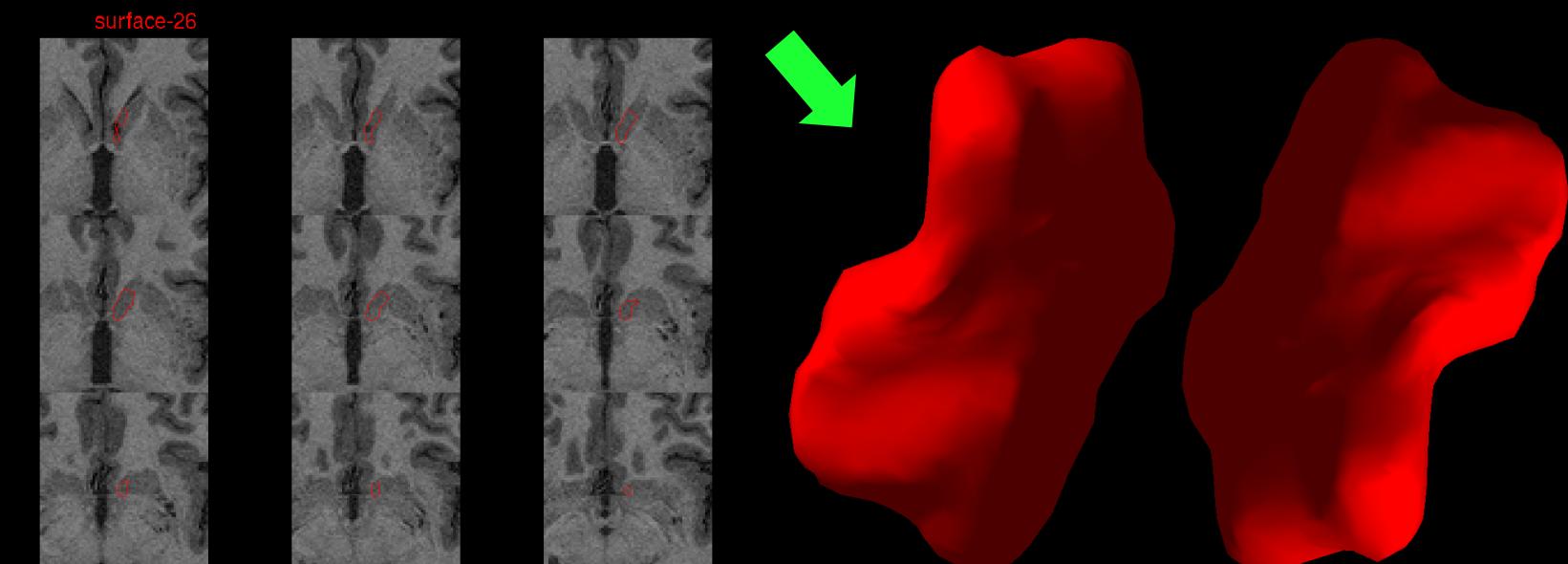
Z Score = 1.68: use



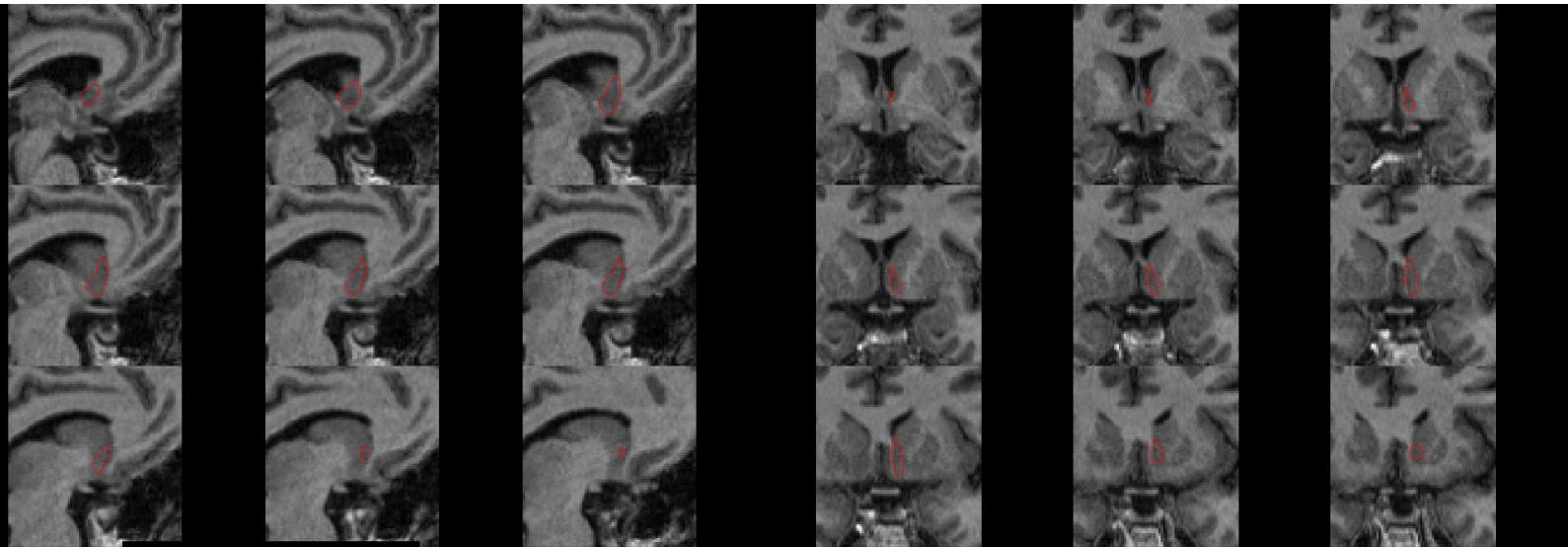
Rating: 2 (Moderate Pass) – Minor edge irregularity (arrow), not severe enough to fail. Generally reflects underlying anatomy.



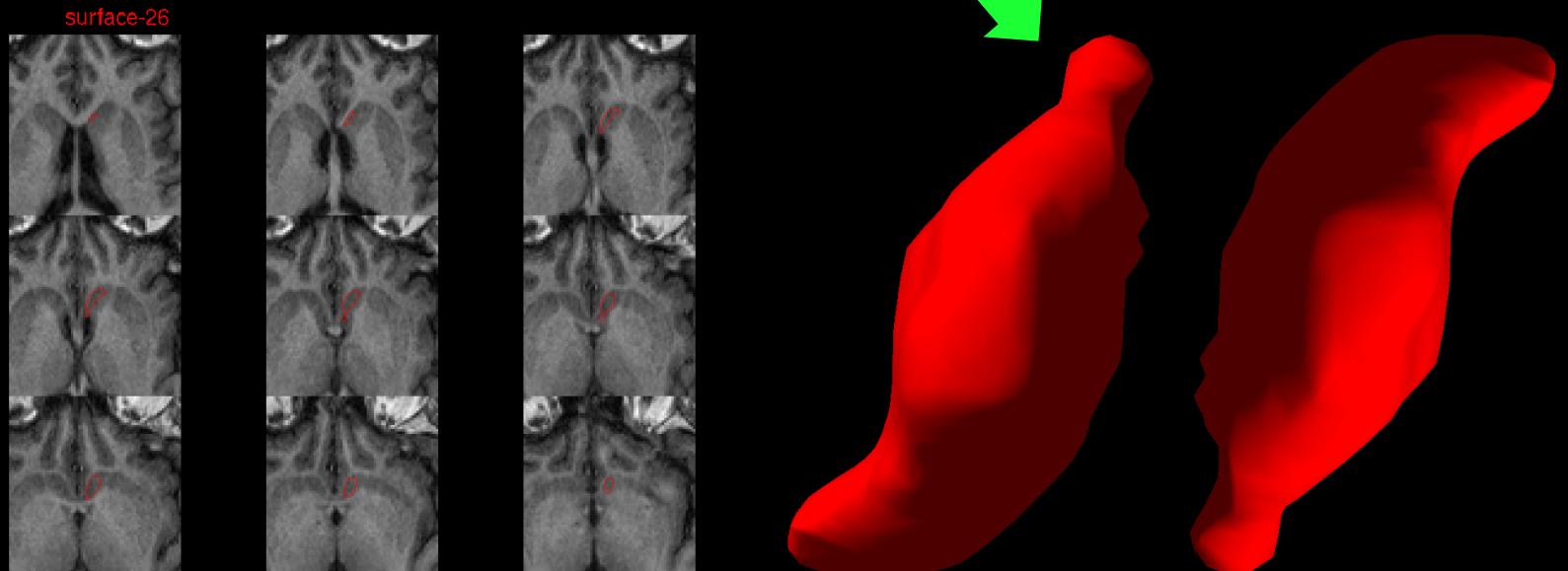
Z Score = 2.03: use



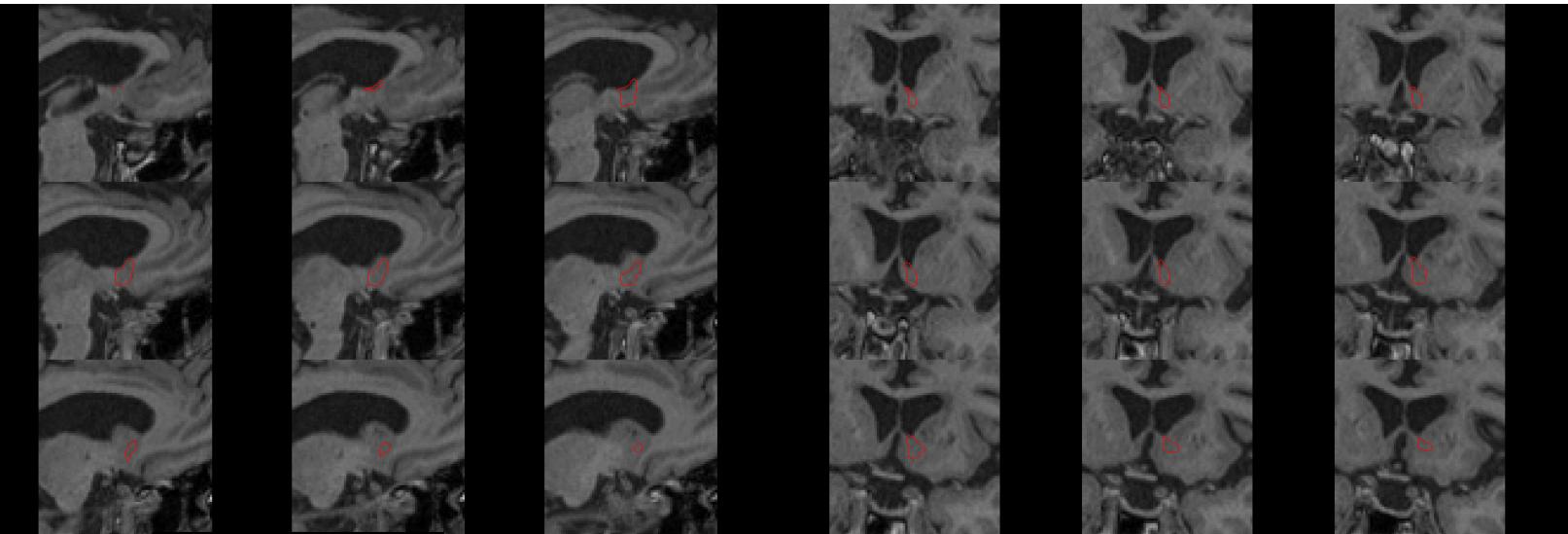
Rating: 2 (Moderate Pass) – Minor edge irregularity (arrow), not severe enough to fail. Generally reflects underlying anatomy.



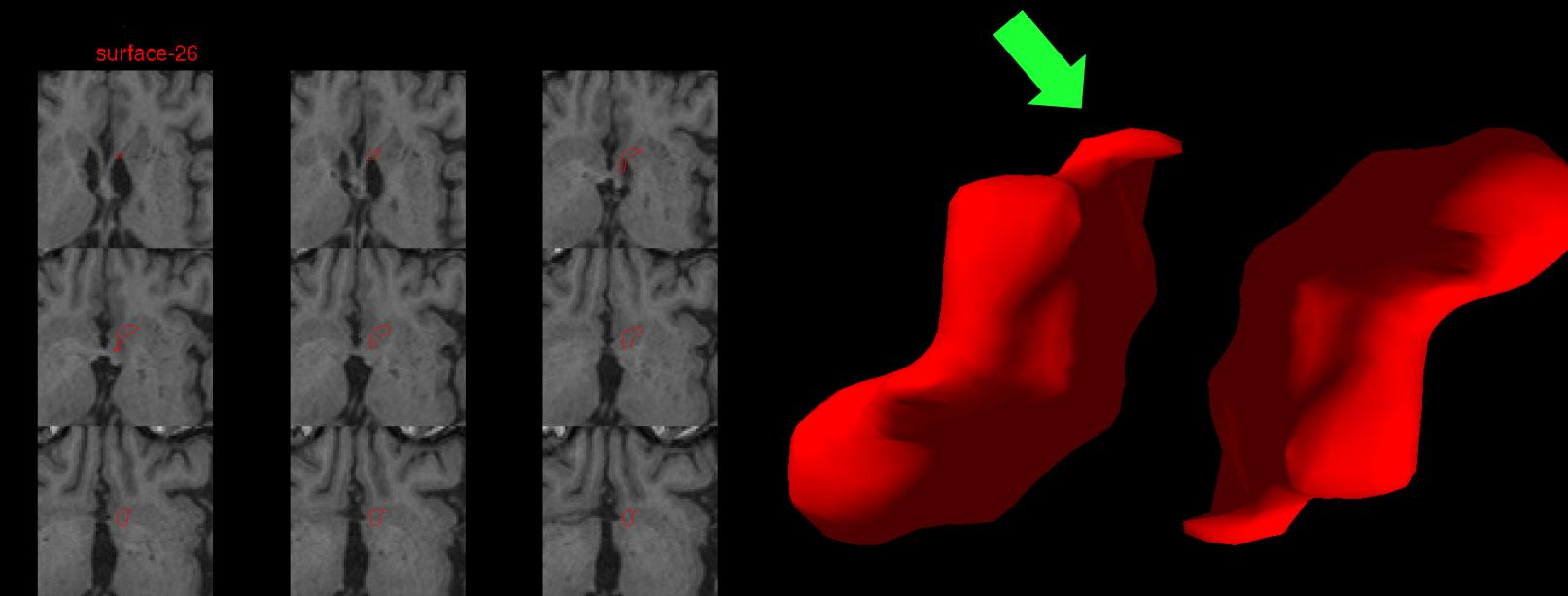
Z Score = 1.63: use



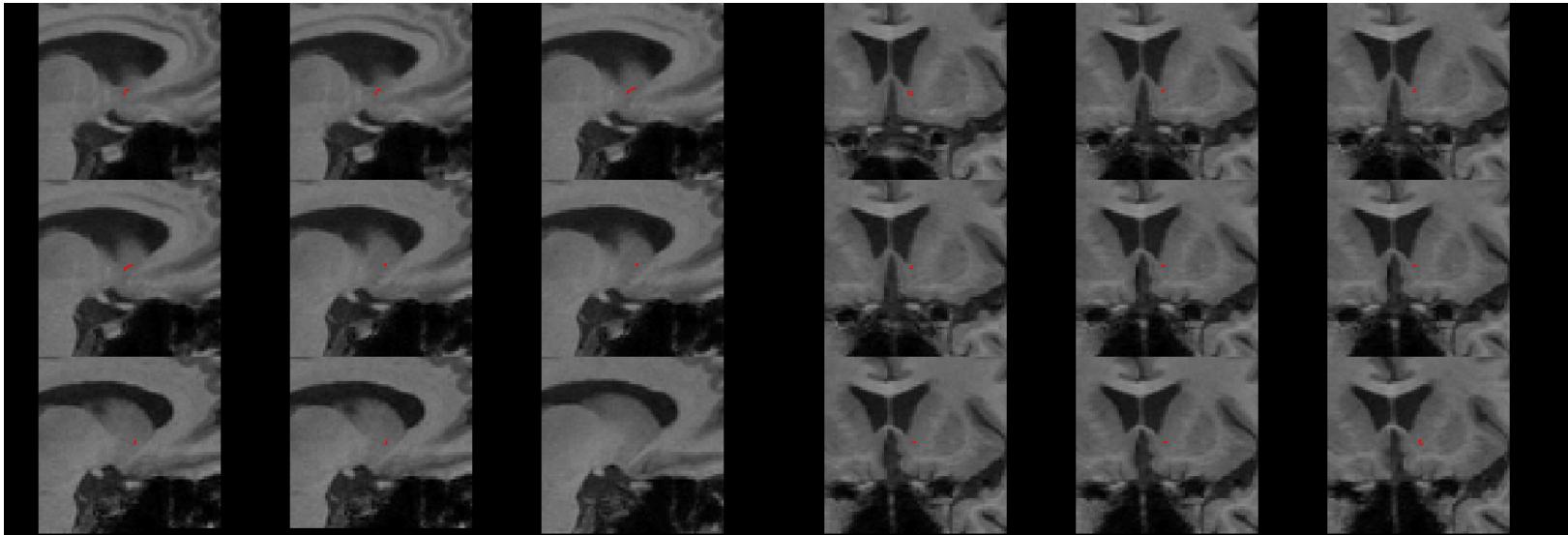
Rating: 2 (Moderate Pass) – Minor edge irregularity (arrow), not severe enough to fail. Generally reflects underlying anatomy.



Z Score = 1.71: use

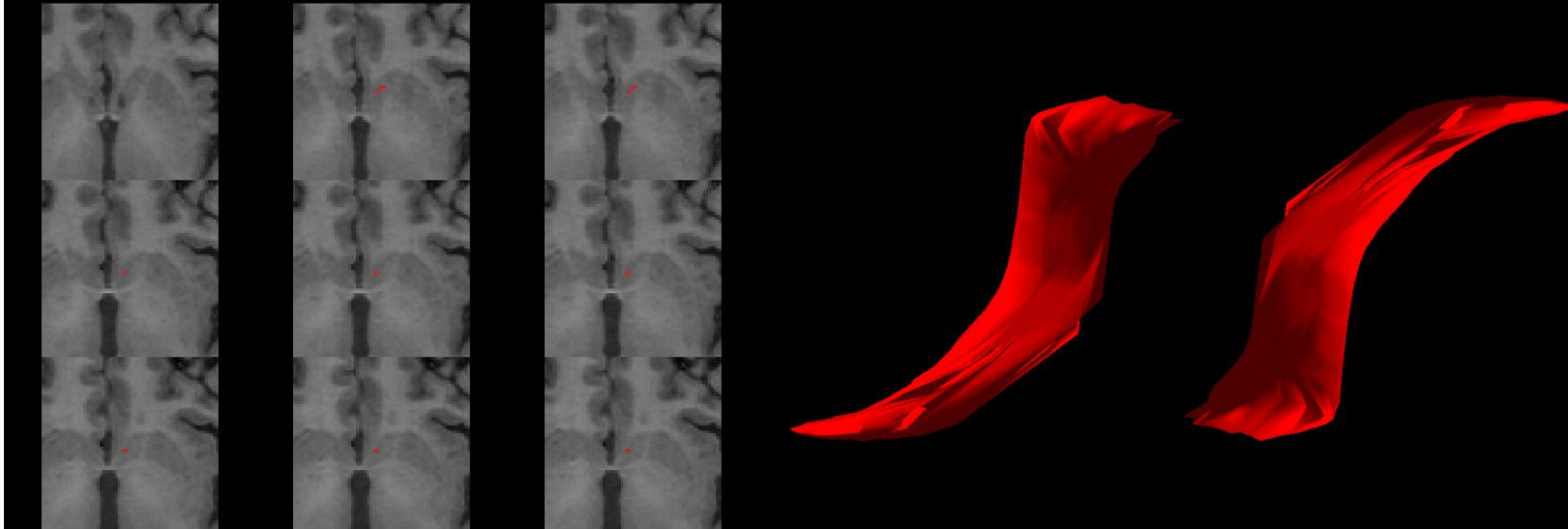


Rating: 1 (Fail) – Severe misclassification (see Z score and arrows).

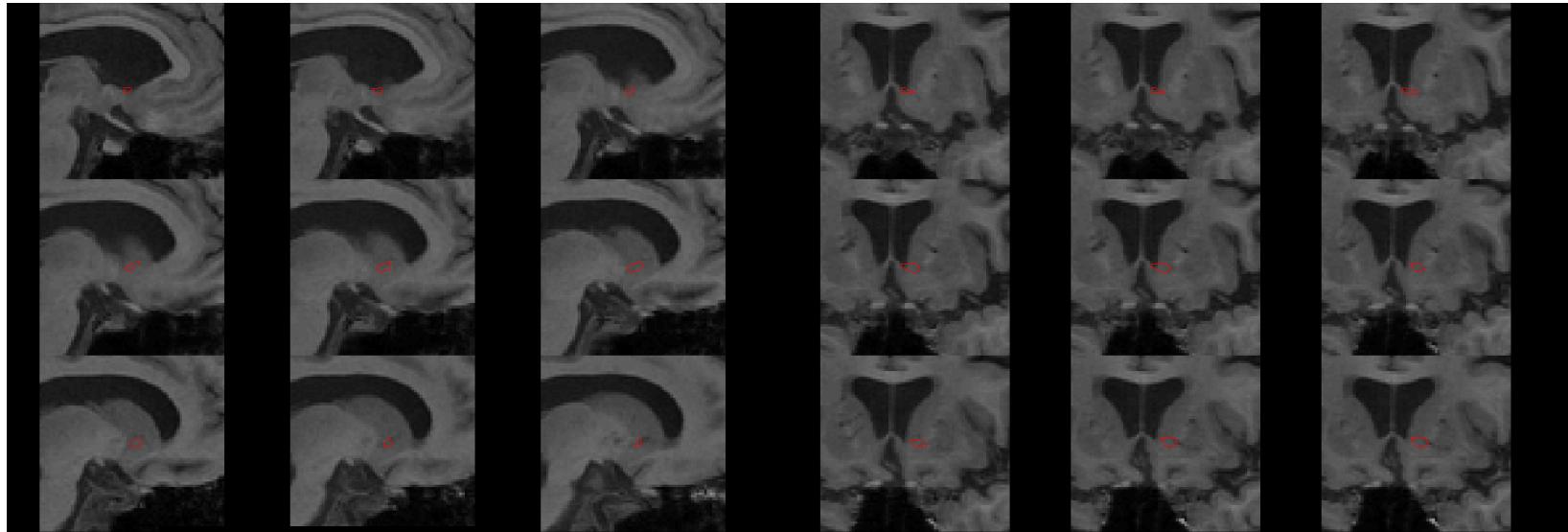


Z Score = 5.89: check

surface-26



Rating: 1 (Fail) – Severe misclassification (see Z score and arrows).



Z Score = 4.14: check

