

Opto-Acoustic Correlation with the Gold Standard; Histopathology

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Symposium Agenda

T. Stavros, MD, FACR

Opto-acoustic Overview: Correlation with the Gold Standard; Histopathology

R. Pijnappel, MD, PhD

MAESTRO Interim results from 75 of the 200 subject MAESTRO Study

J. Veltman, MD, PhD

Downclassification and upclassification of suspicious breast masses using opto-acoustic imaging: Case results for the MAESTRO Study in the Netherlands

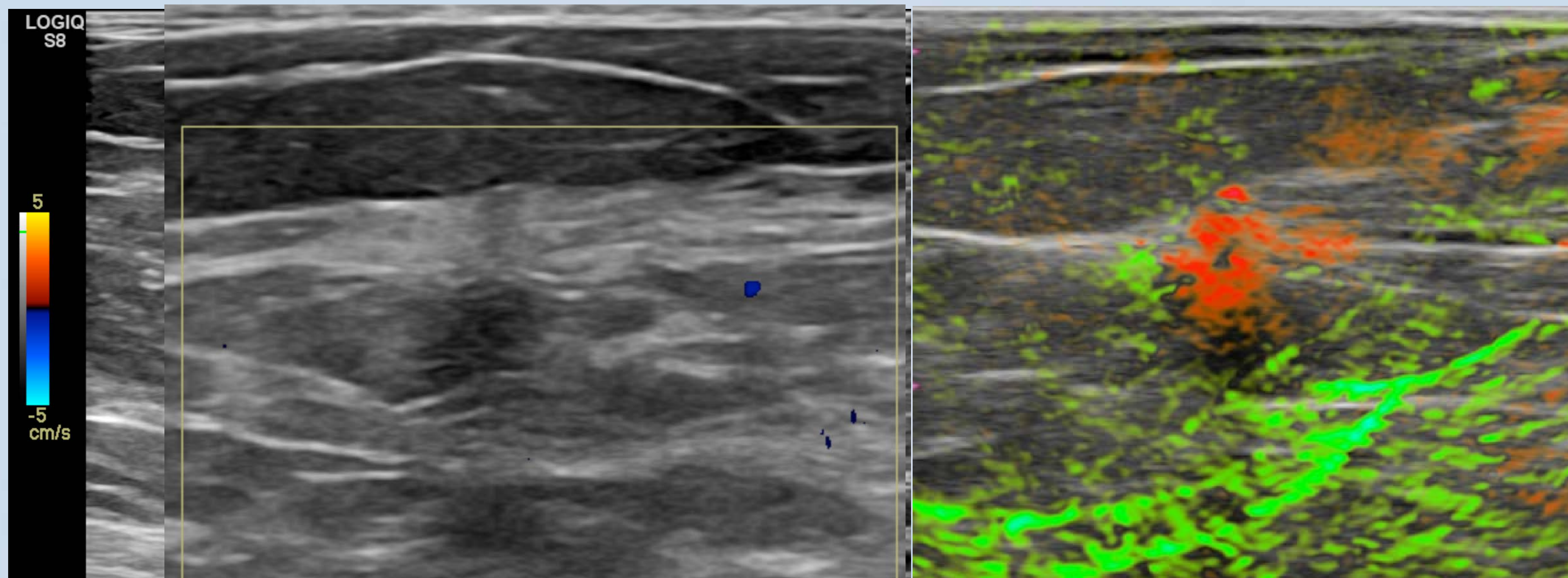
R. Mann, MD, PhD

Opto-acoustics as a potential new diagnostic technology in breast care: Clinical implications and future potential applications

The Fundamentals of Opto-Acoustics

- dual fusion imaging
 - ◆ fusion 1 - laser light in and ultrasound out
 - ◆ fusion 2 - morphology and function
 - ❖ morphology
 - * gray scale ultrasound
 - * OA demonstration of tumor neoangiogenesis
 - ❖ function
 - * OA demonstration of relative degree of oxygenation / deoxygenation

OA is not a “super” color or power Doppler



color Doppler

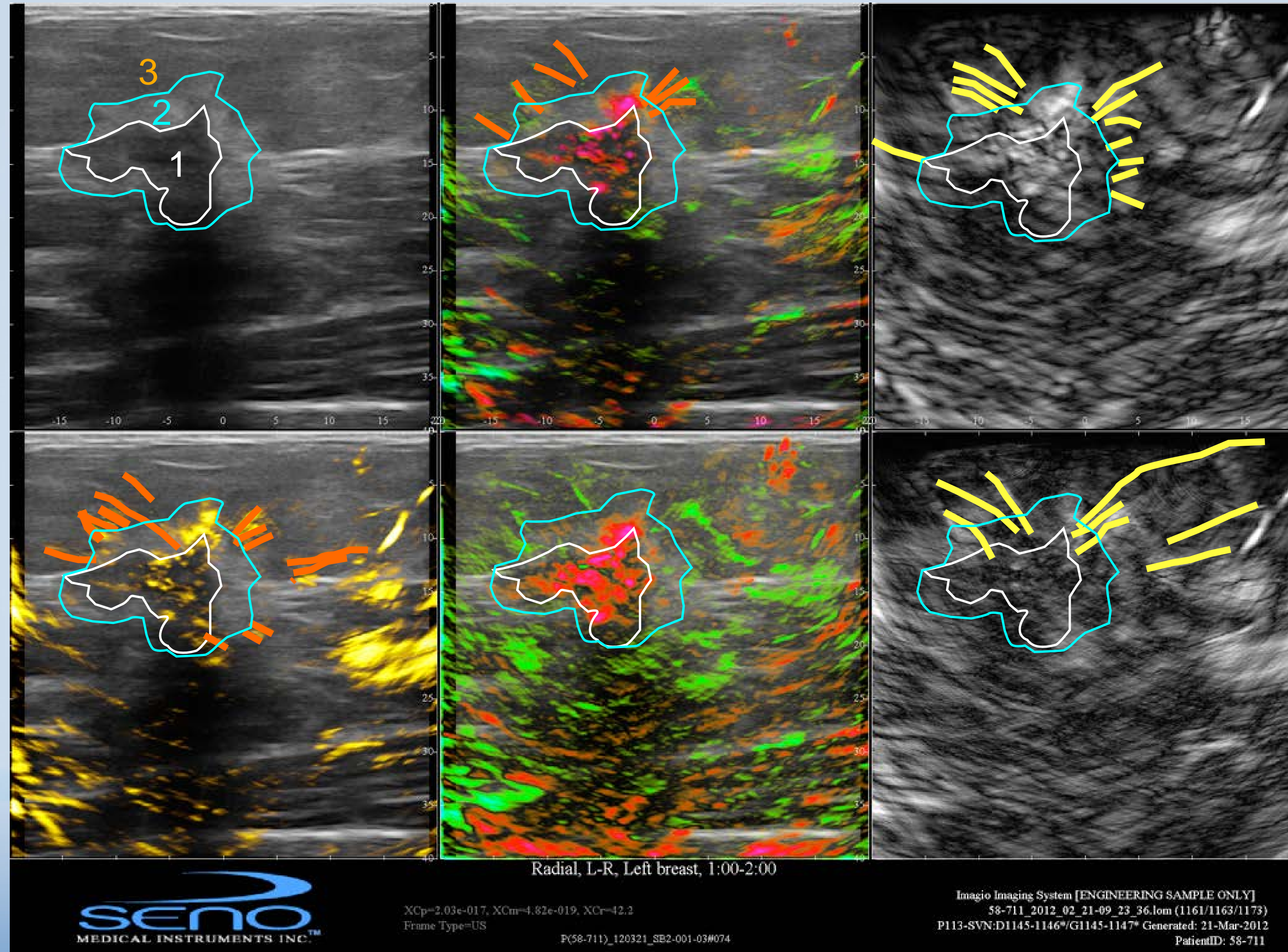
OA relative map

1. OA is not angle dependent - Doppler is
2. OA does not require a critical velocity - Doppler does

discrepancy between OA and CDI performance is the rule, not the exception

4. OA has high contrast ratio - Doppler does not
5. OA shows relative deoxygenation - Doppler does not

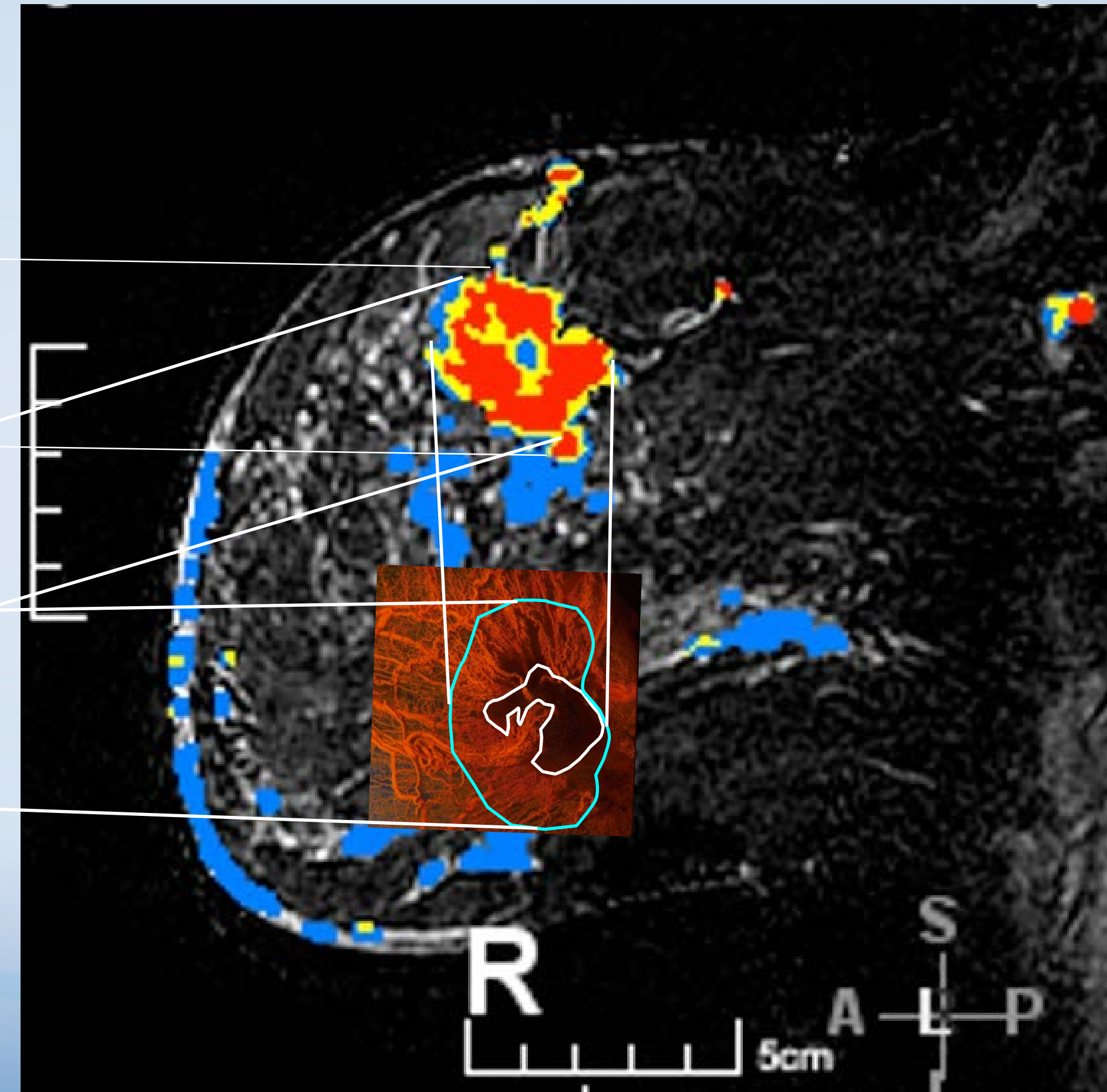
IDC, gr 2 - 3 zones of interest



There is a 0 to 5 or 6 scoring system for
3 internal findings and 2 external findings

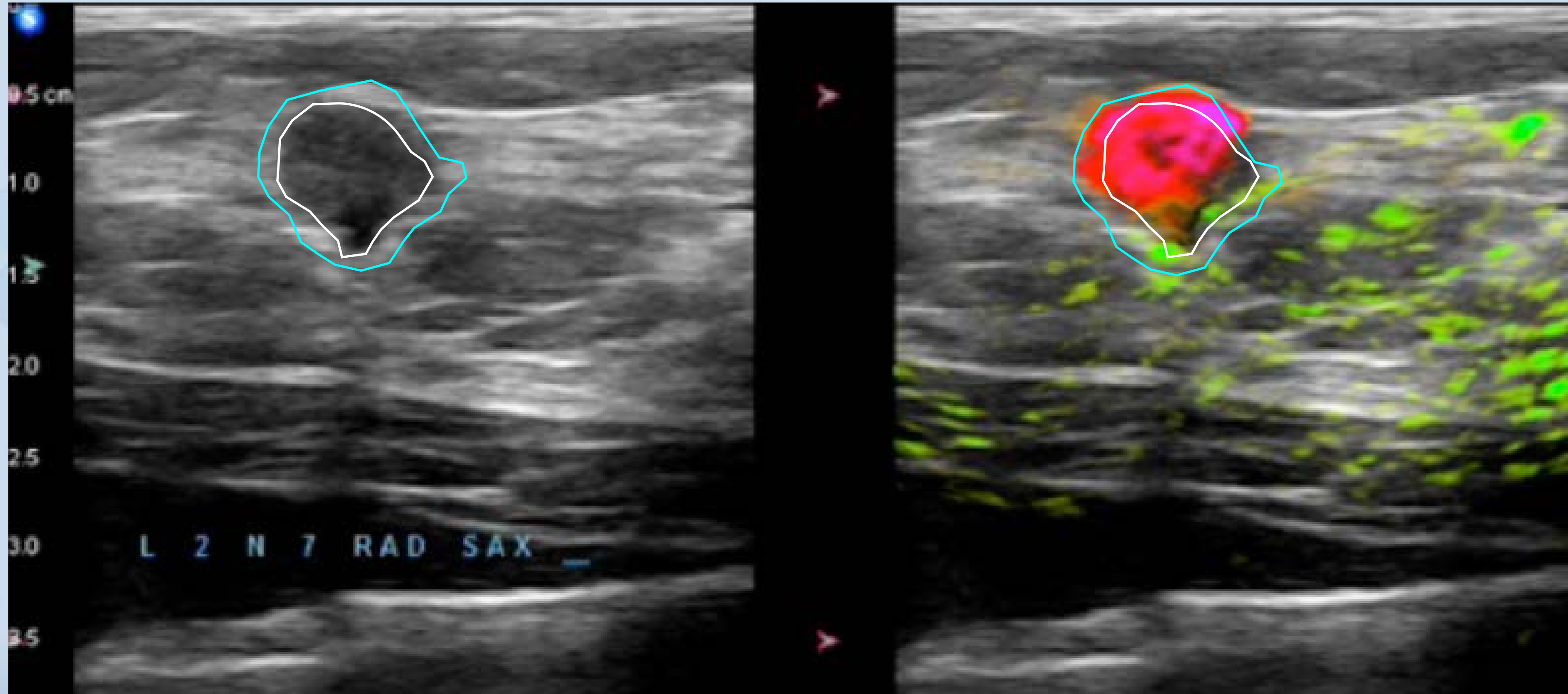
"IMAGINATION IS JUST THE BEGINNING"

There are other imaging precedents for the (boundary zone) being important -- shear wave elastography zone of stiffness and MRI ring enhancement



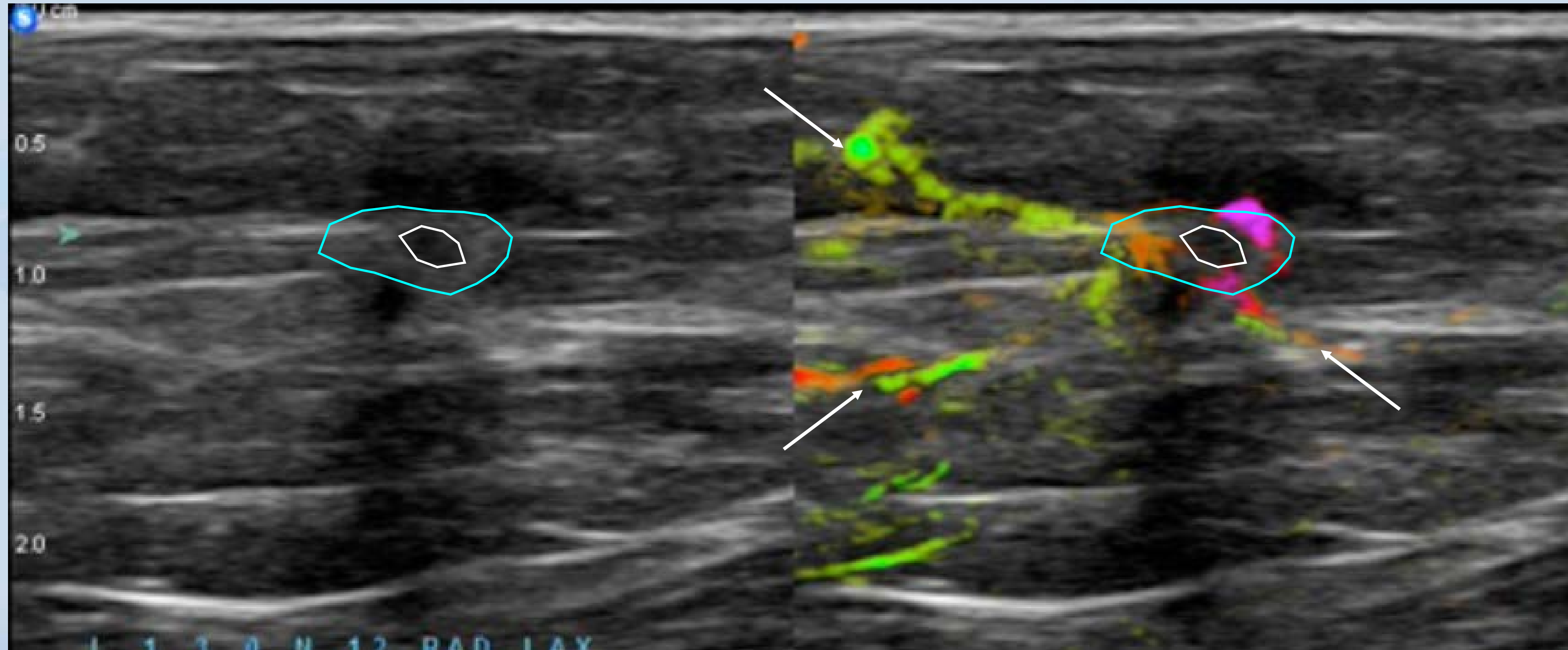
active growth, high cellularity, high vessel density, and desmoplasia are all in the boundary zone

8 mm IDC, grade III



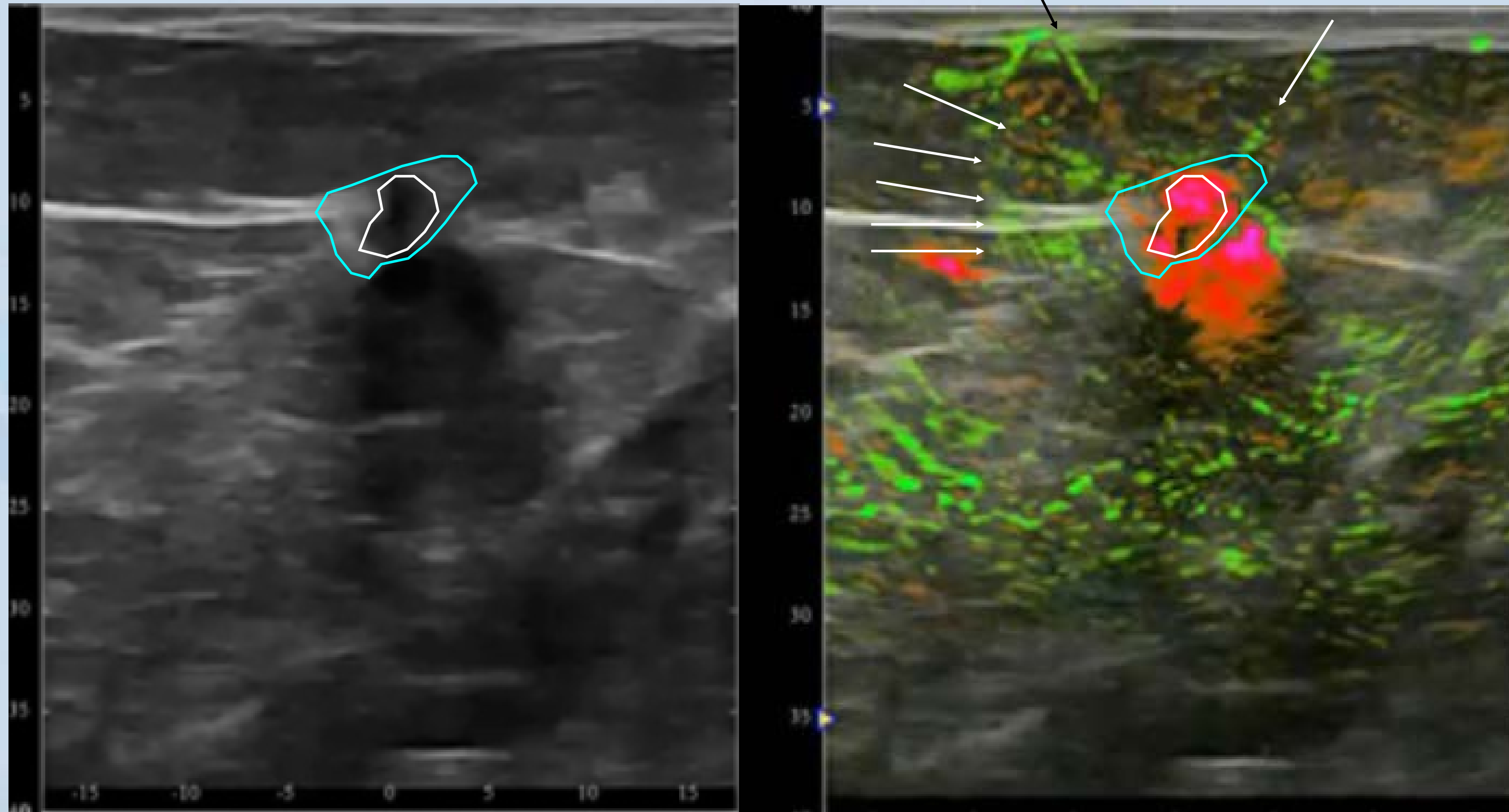
typical internal and external boundary zone findings,
but absent external peripheral zone findings

3.5 mm IDC, grade I



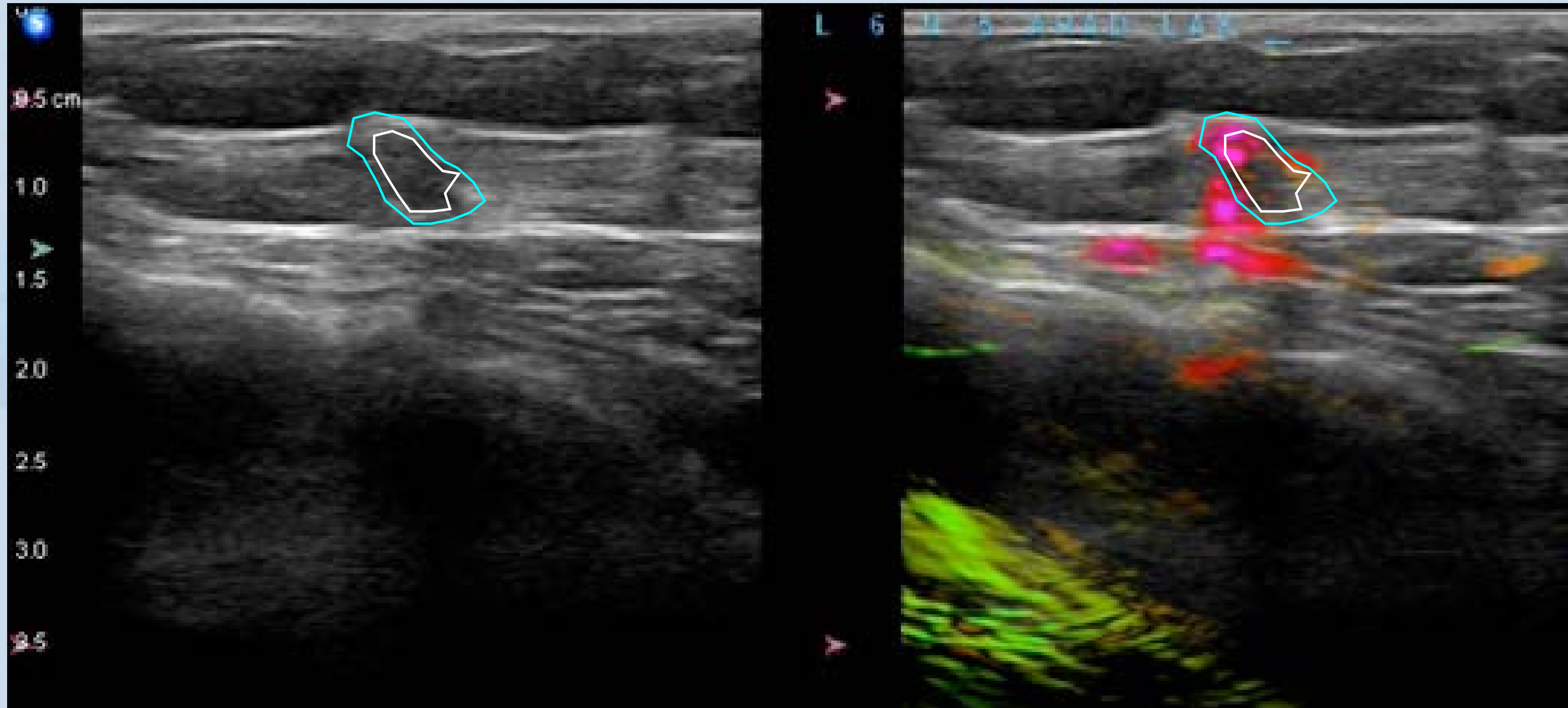
typical external boundary zone and peripheral zone findings,
but absent internal findings

6 mm IDC, grade II



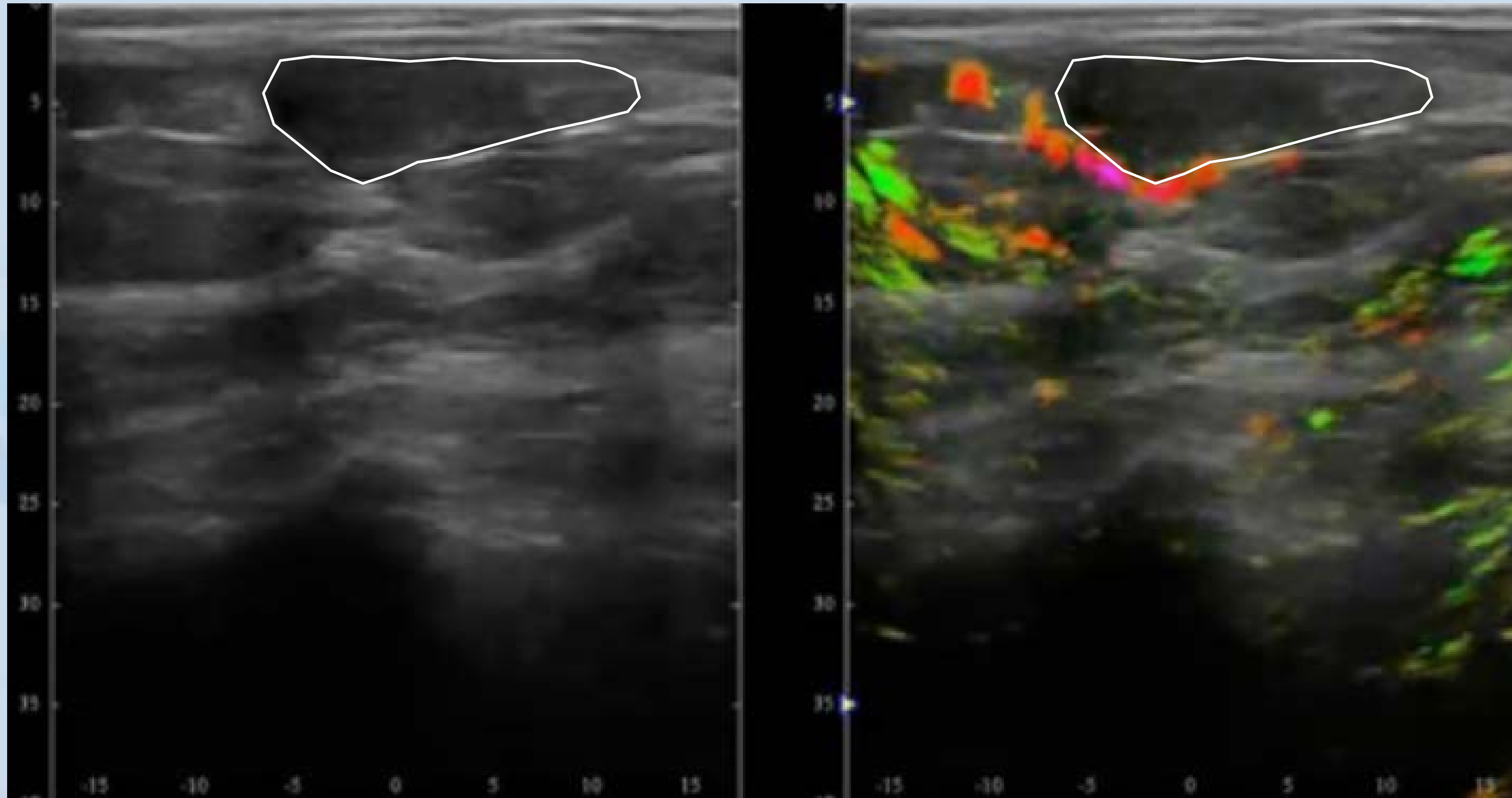
typical OA findings in all 3 zones

5 mm colloid and invasive papillary carcinoma



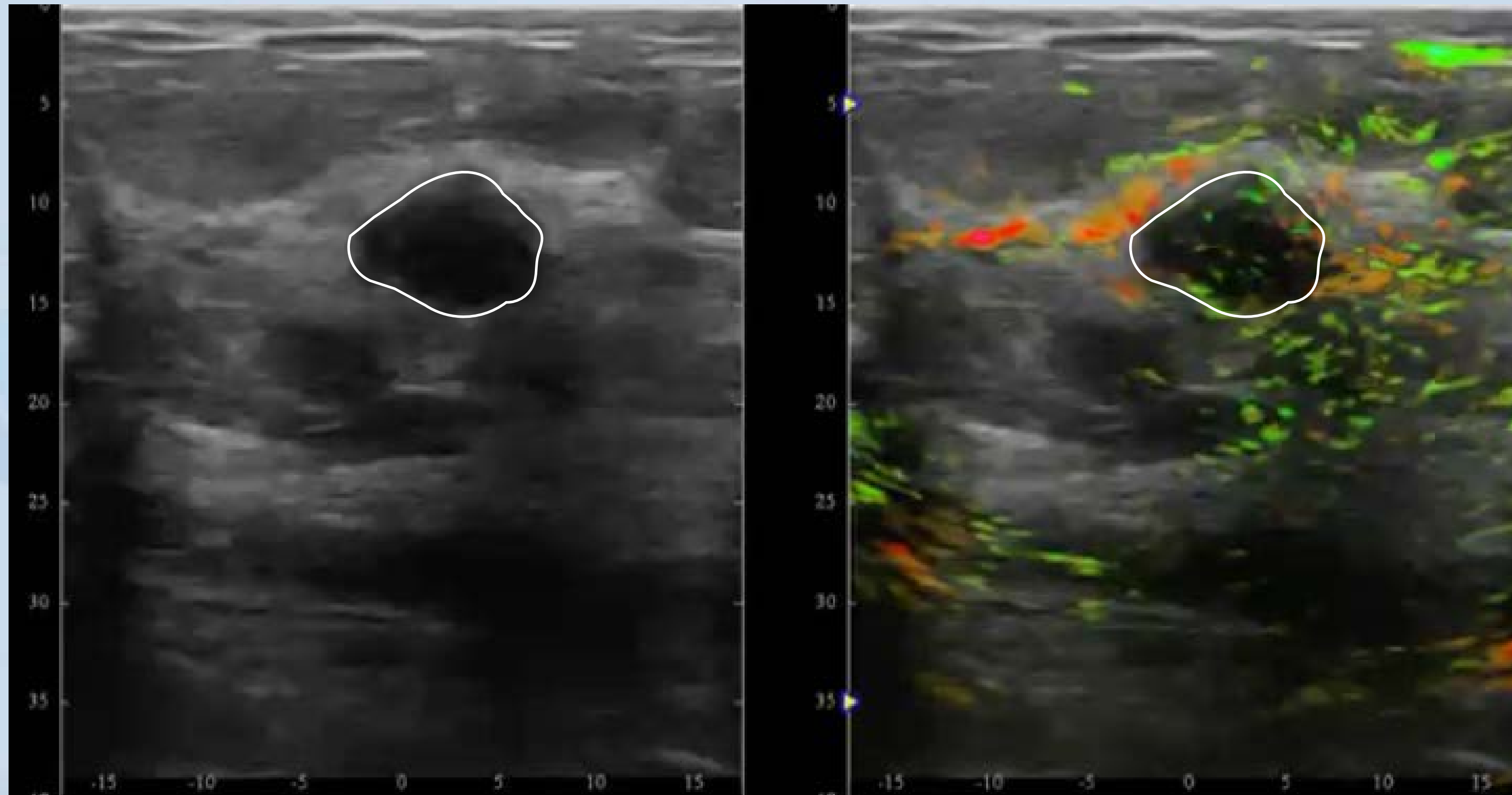
typical circumscribed special type tumors have very thin boundary/capsular zones and tortuous vessels unevenly distributed over surface of lesion

benign fibroadenoma more than red vs green



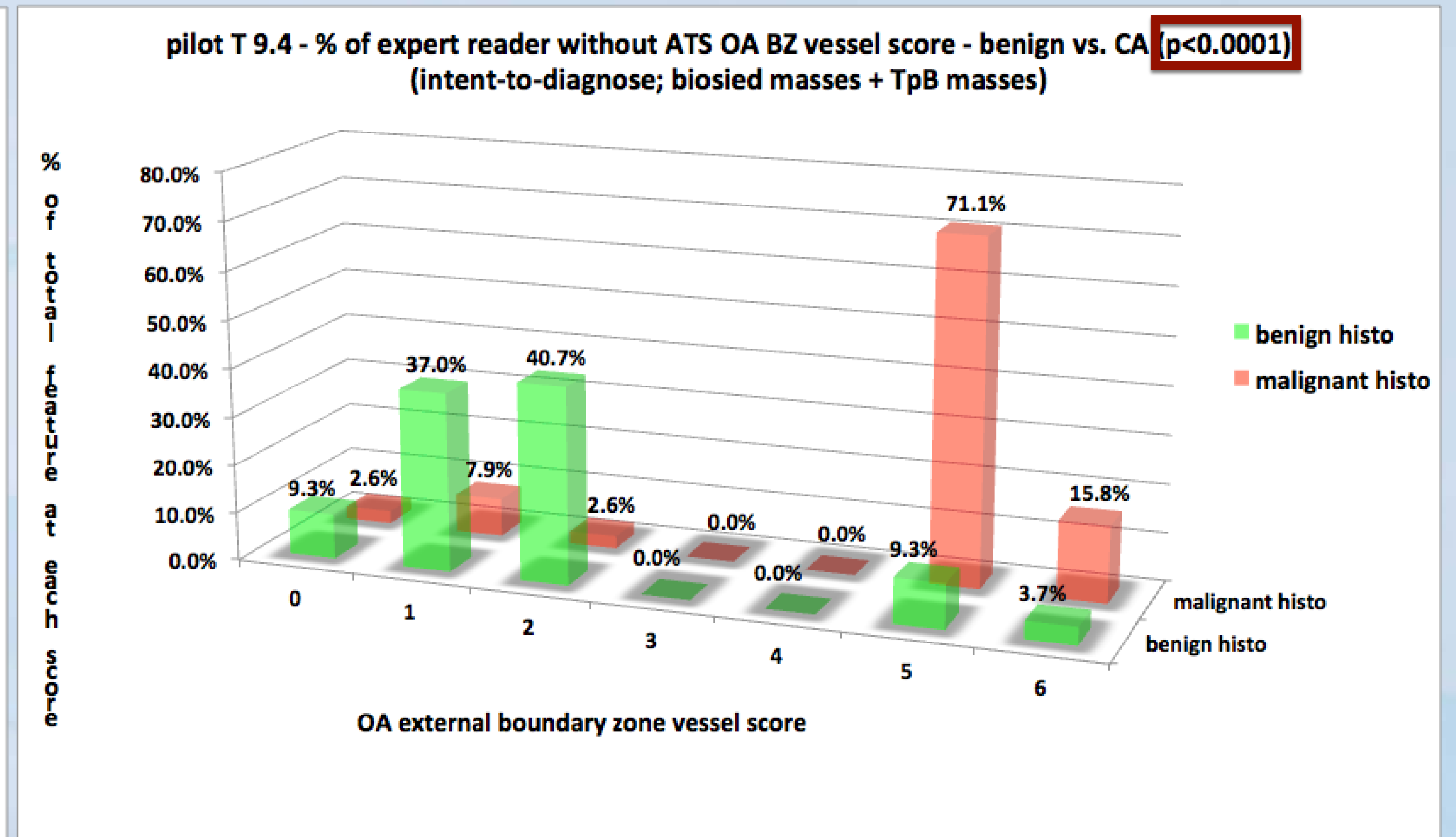
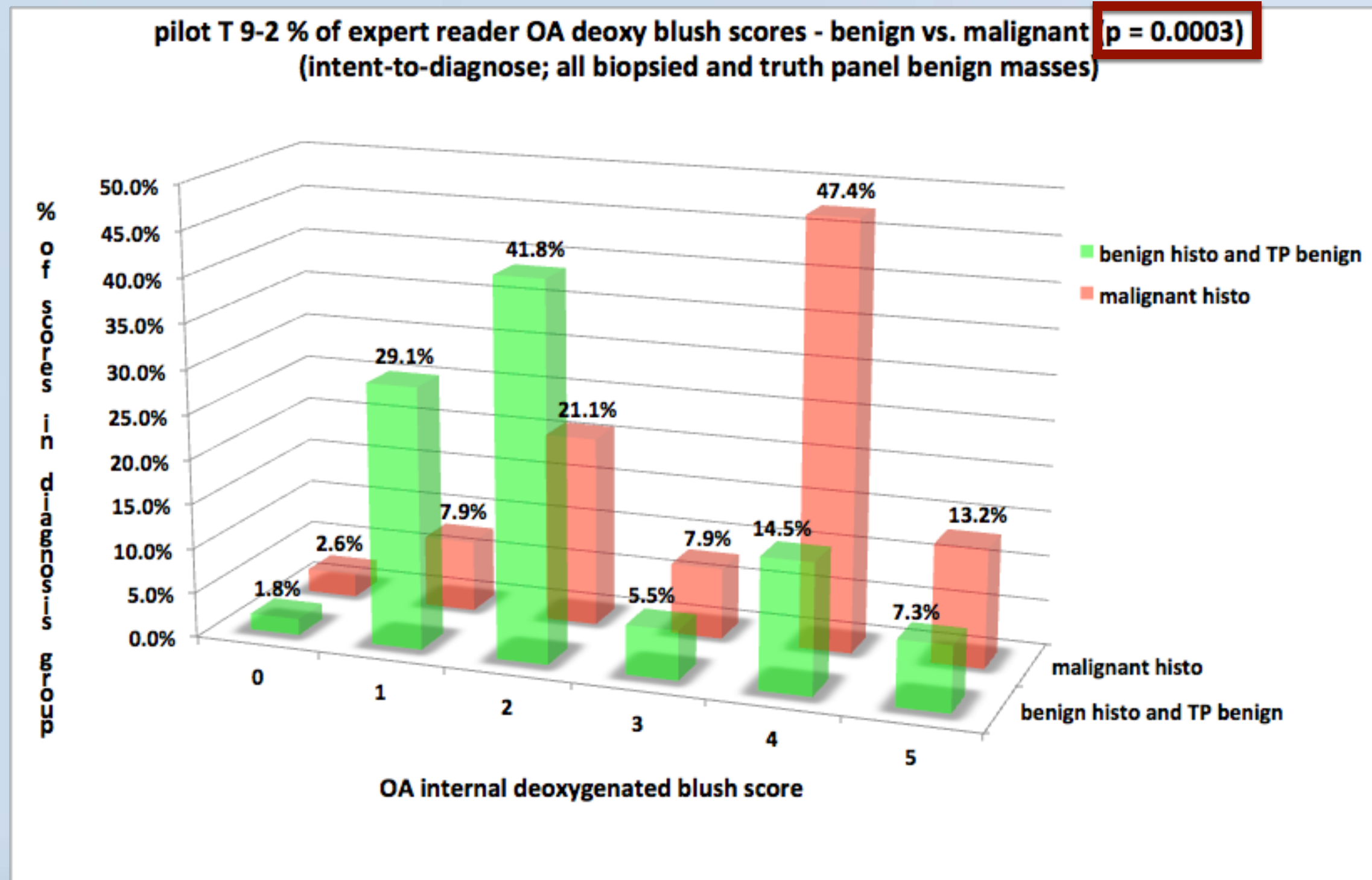
thin capsular zone - even normal tissue and benign masses must have both arteries and veins - this is a classically benign appearing capsular vein long, gently curved, uniform diameter, parallel to and draped over surface

benign fibroadenoma

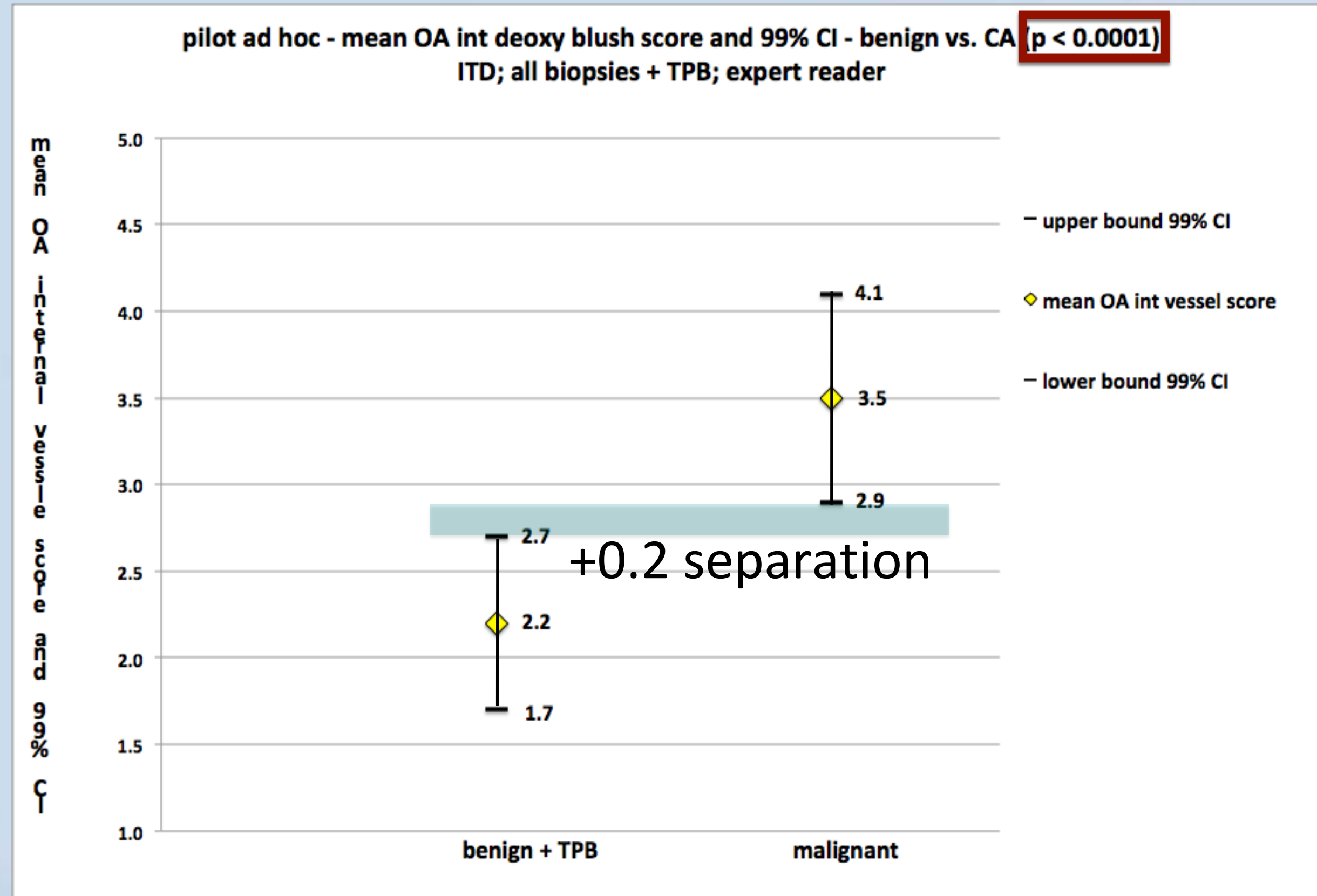


anterior and posterior parallel oriented capsular veins

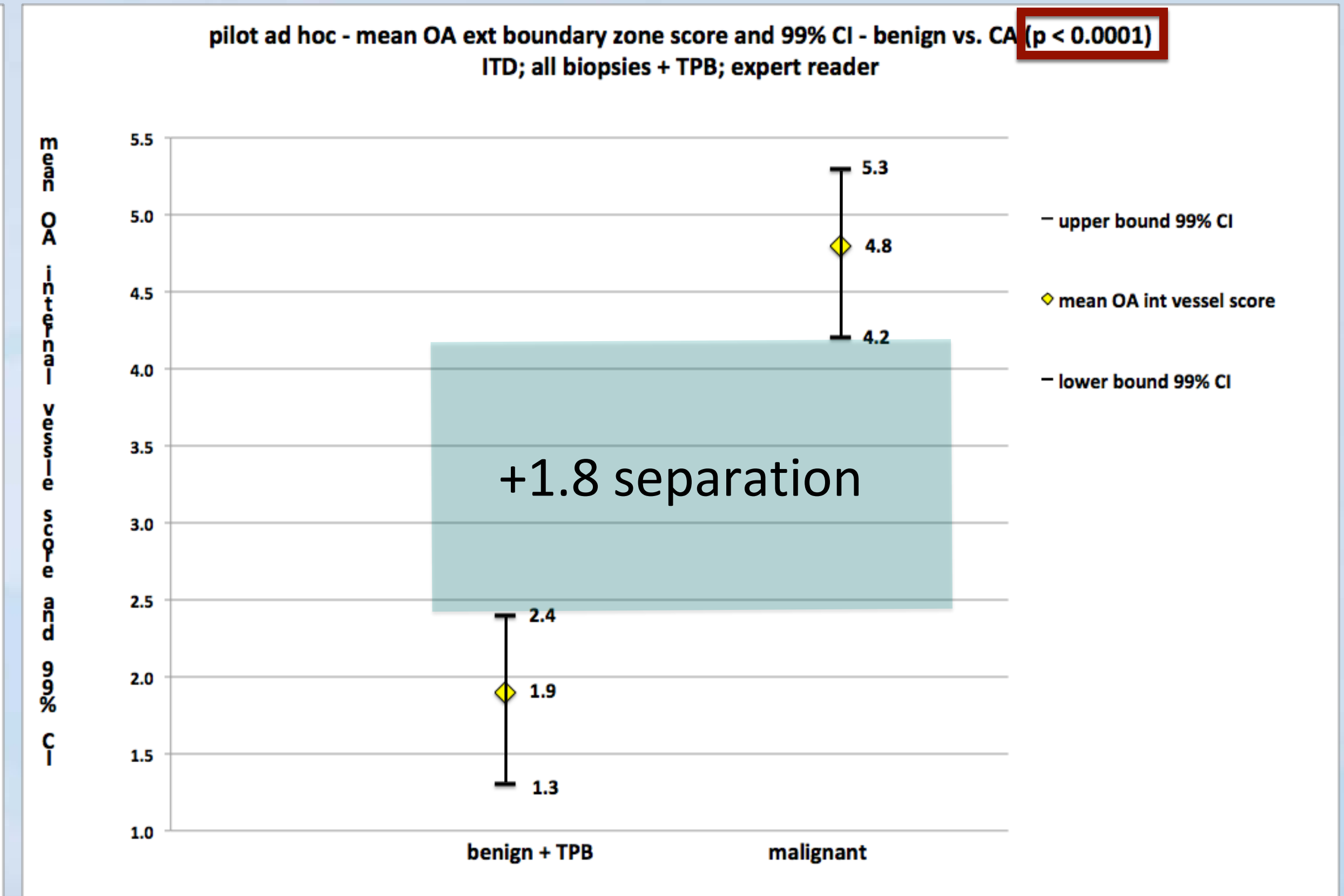
2 external zone OA findings - pilot - expert reader benign vs. malignant



pilot ad hoc - mean OA internal total Hgb score and 99% CI - benign vs. malignant ITD population; all biopsies + TP benign; expert reader



OA internal deoxygenated blush score
best internal OA feature



OA external boundary zone score
best external OA feature

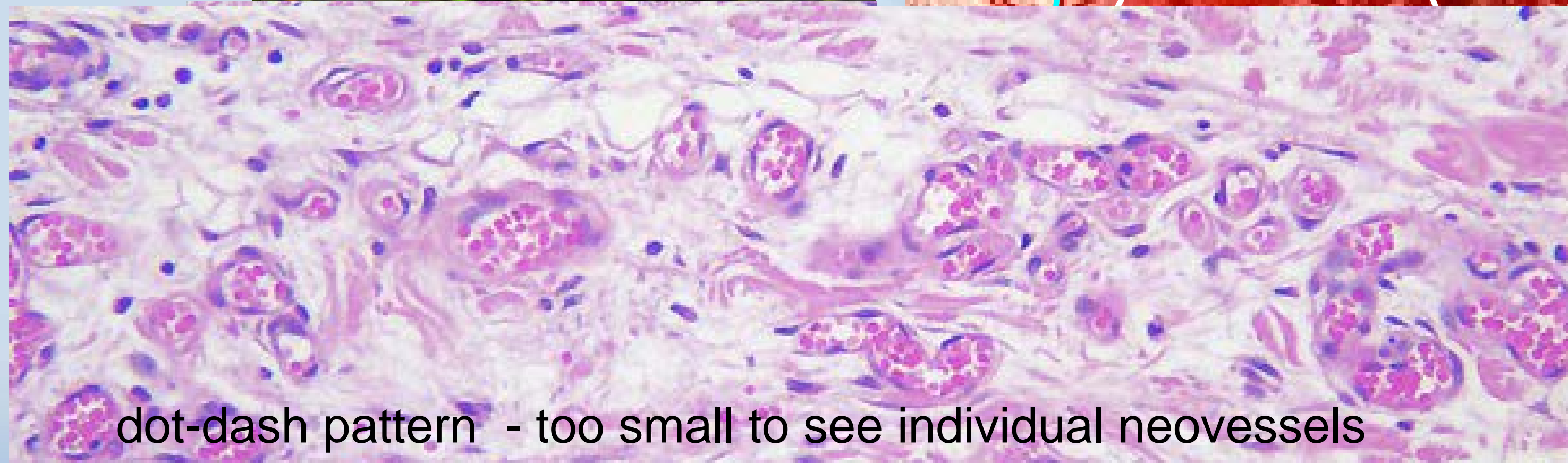
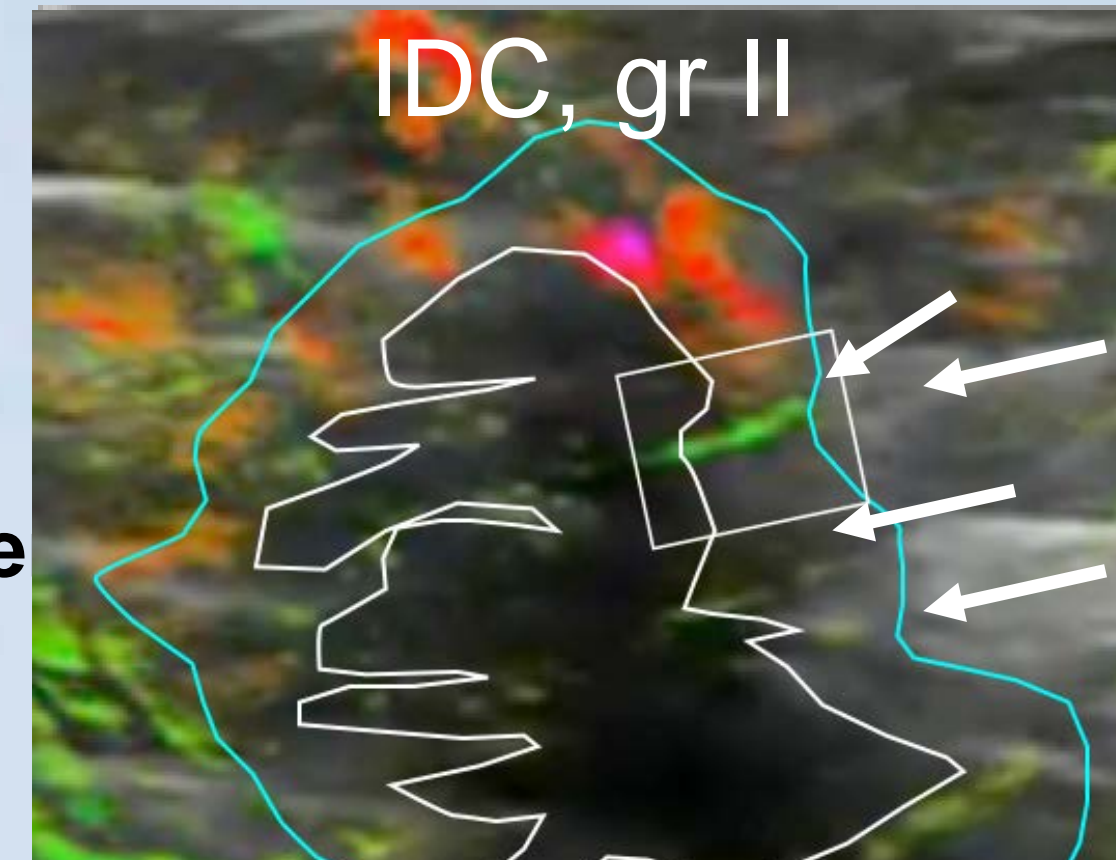
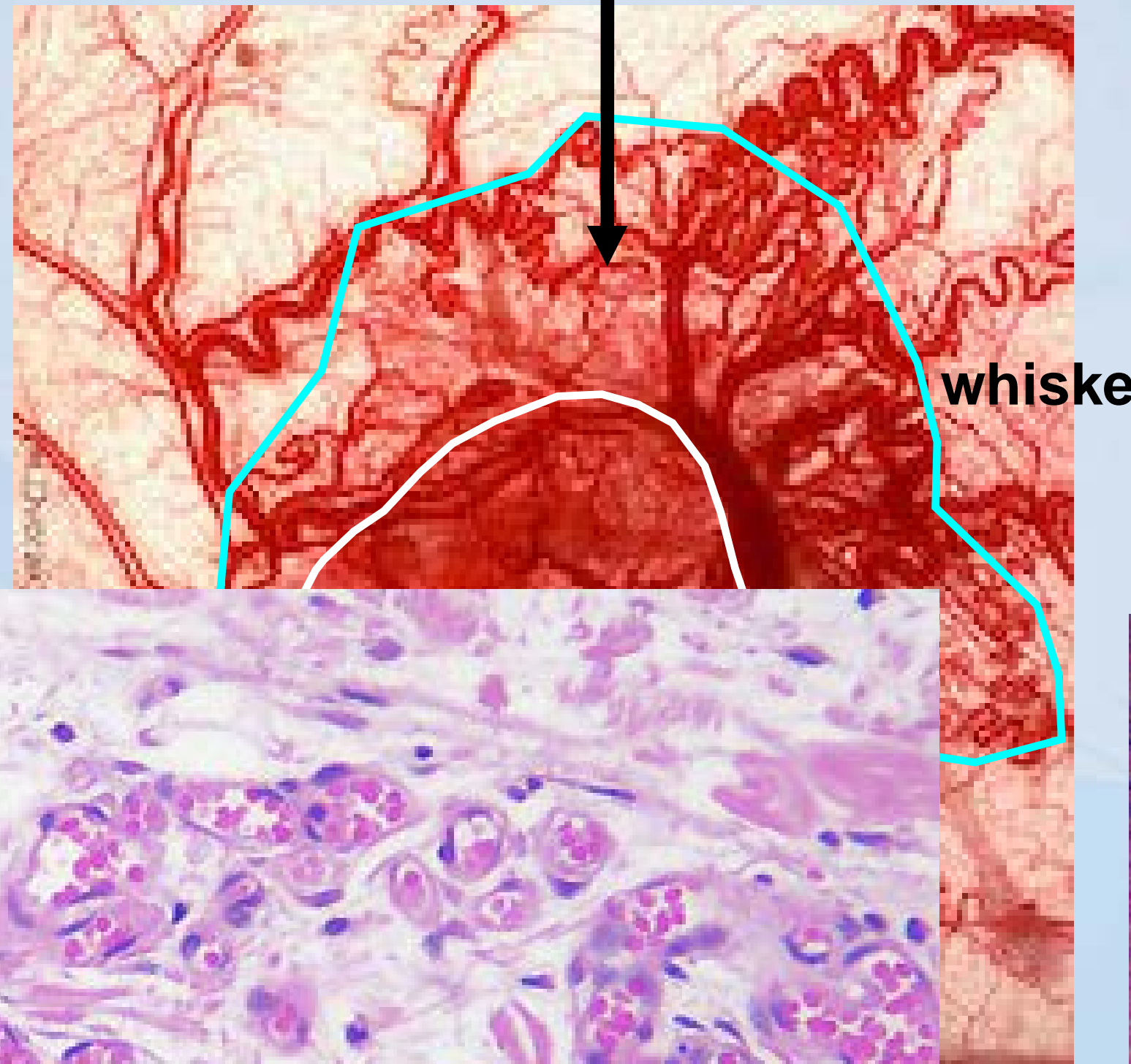
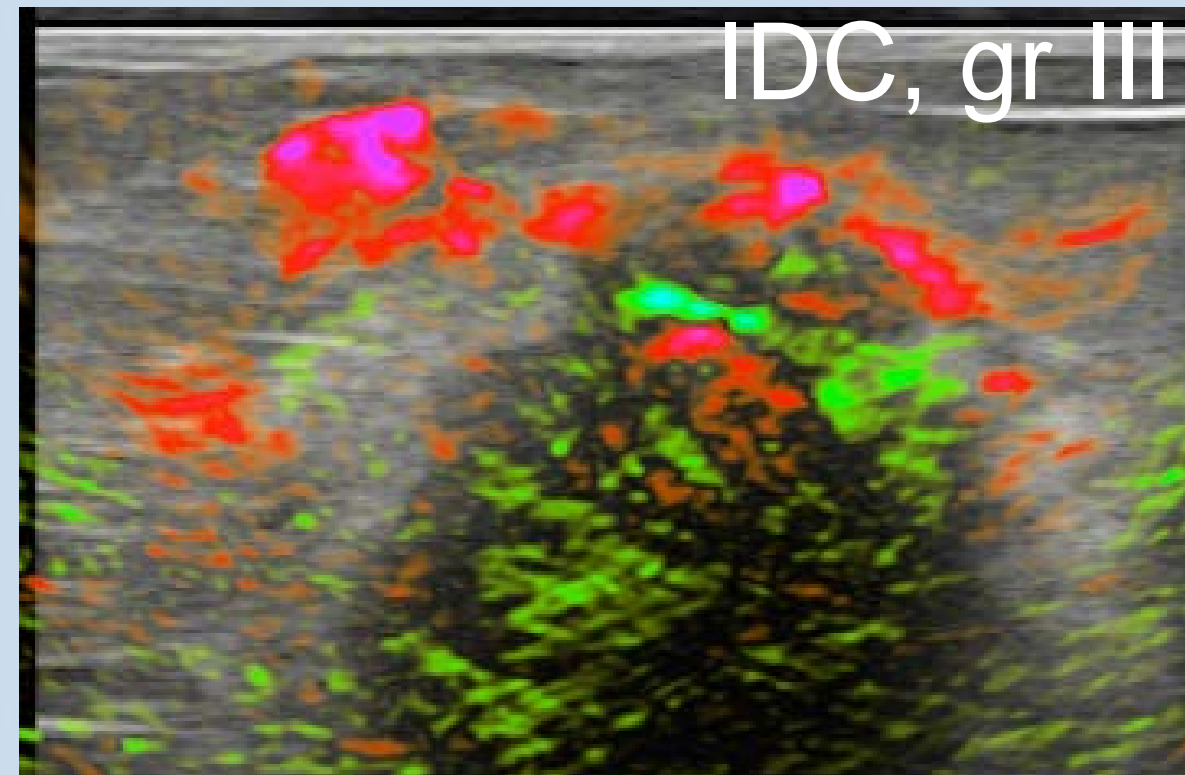
Does it make sense that external OA findings, particularly boundary zone findings, affect OA more than internal findings?

Absolutely, it does!

- It is the battle zone between growing and invading tumor and host response (desmoplastic and immune) to the tumor
- It is where tumor neovessels are densest
- It corresponds to zone of stiffness on shear wave elastography
- It corresponds to “ring enhancement” on contrast enhanced MRI (abnormal leaky neovessels)
- OA boundary zone findings are present in all 3 grades of invasive malignant breast masses
 - ◆ internal zone often absent in grade I IDC's
 - ◆ peripheral zone findings often absent in circumscribed grade III IDC's

boundary zone vessel morphology invasive malignancy - grades I and II vs. grade III

most vessels in BZ are neovessels

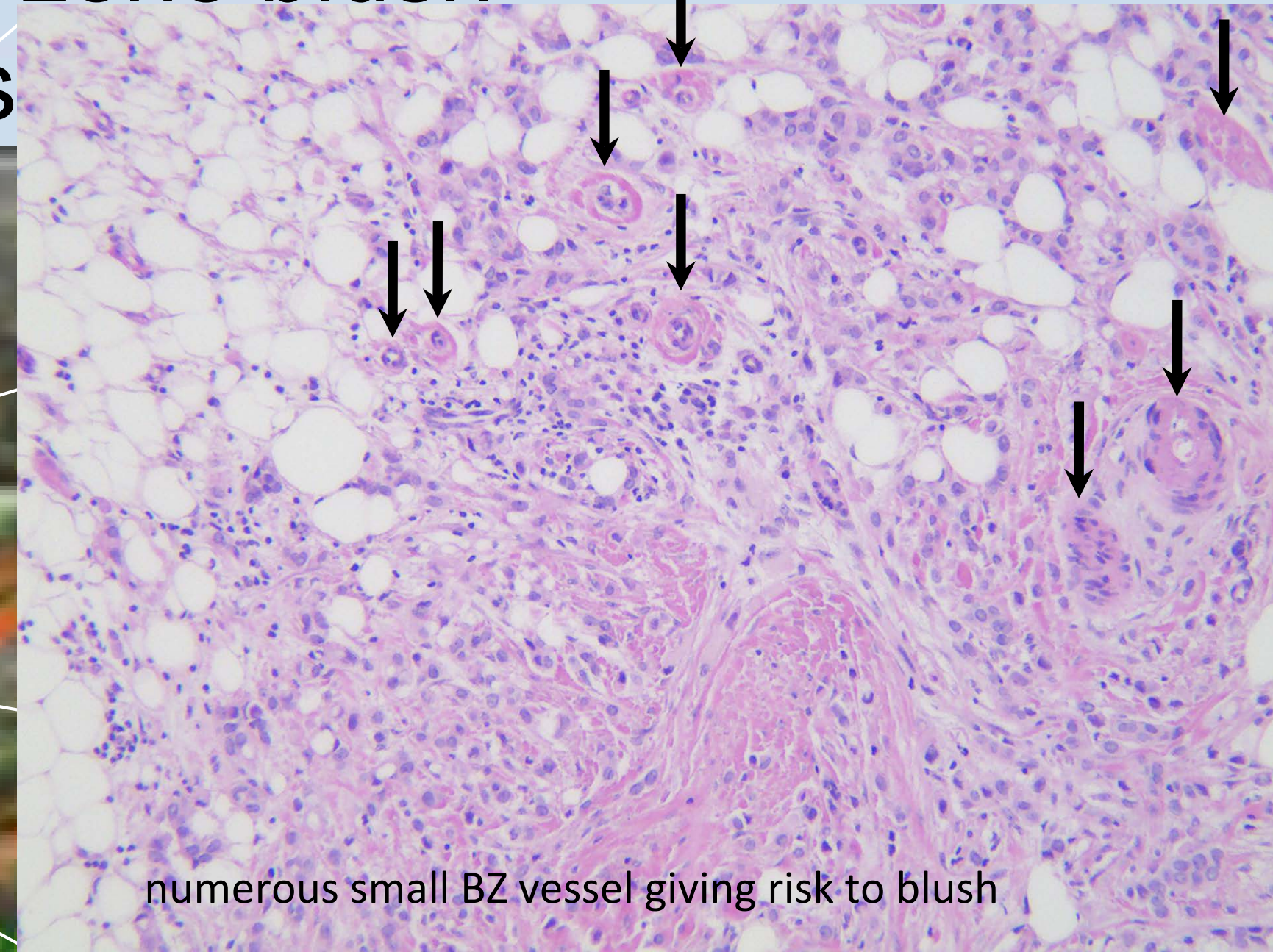
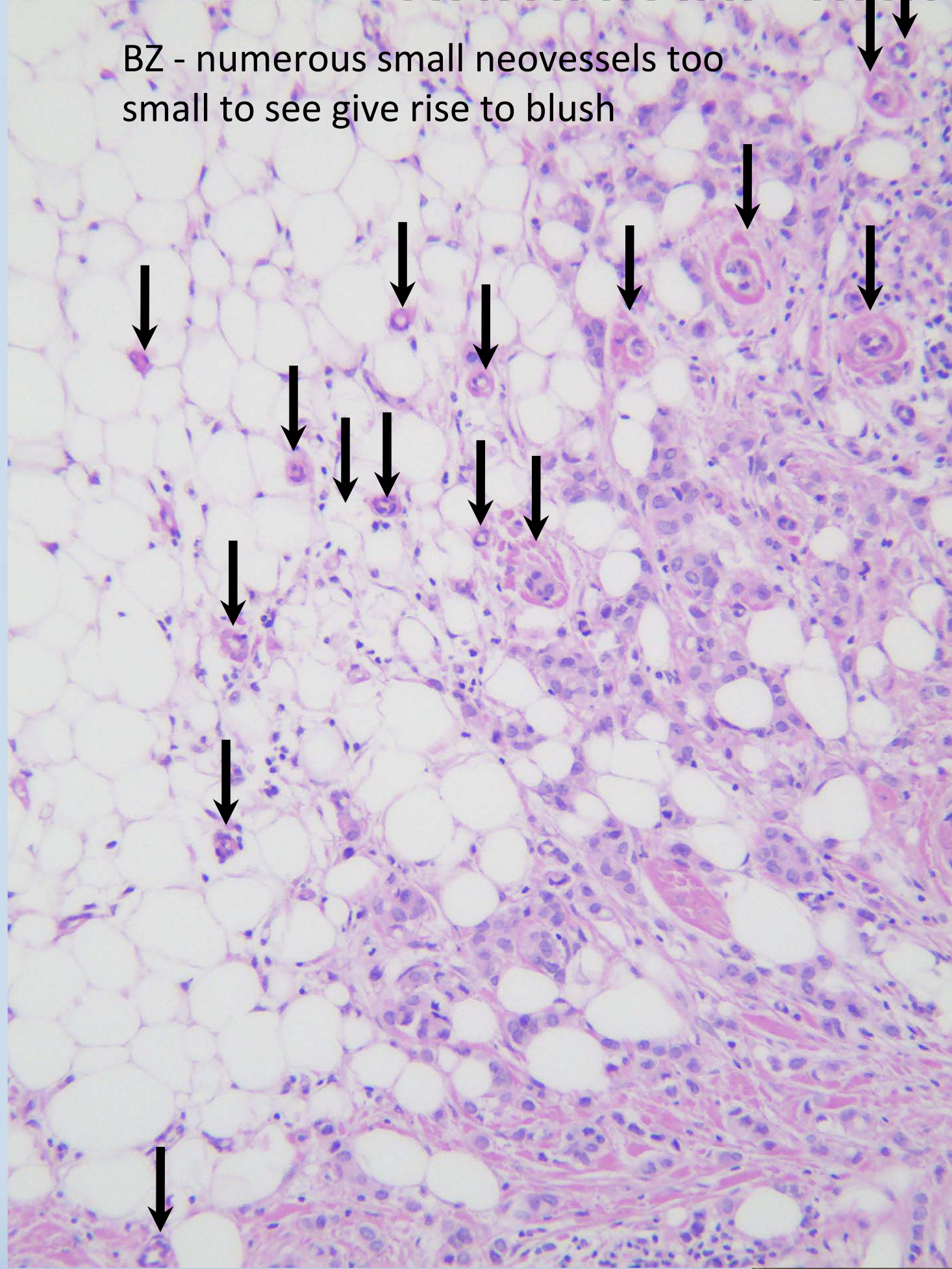


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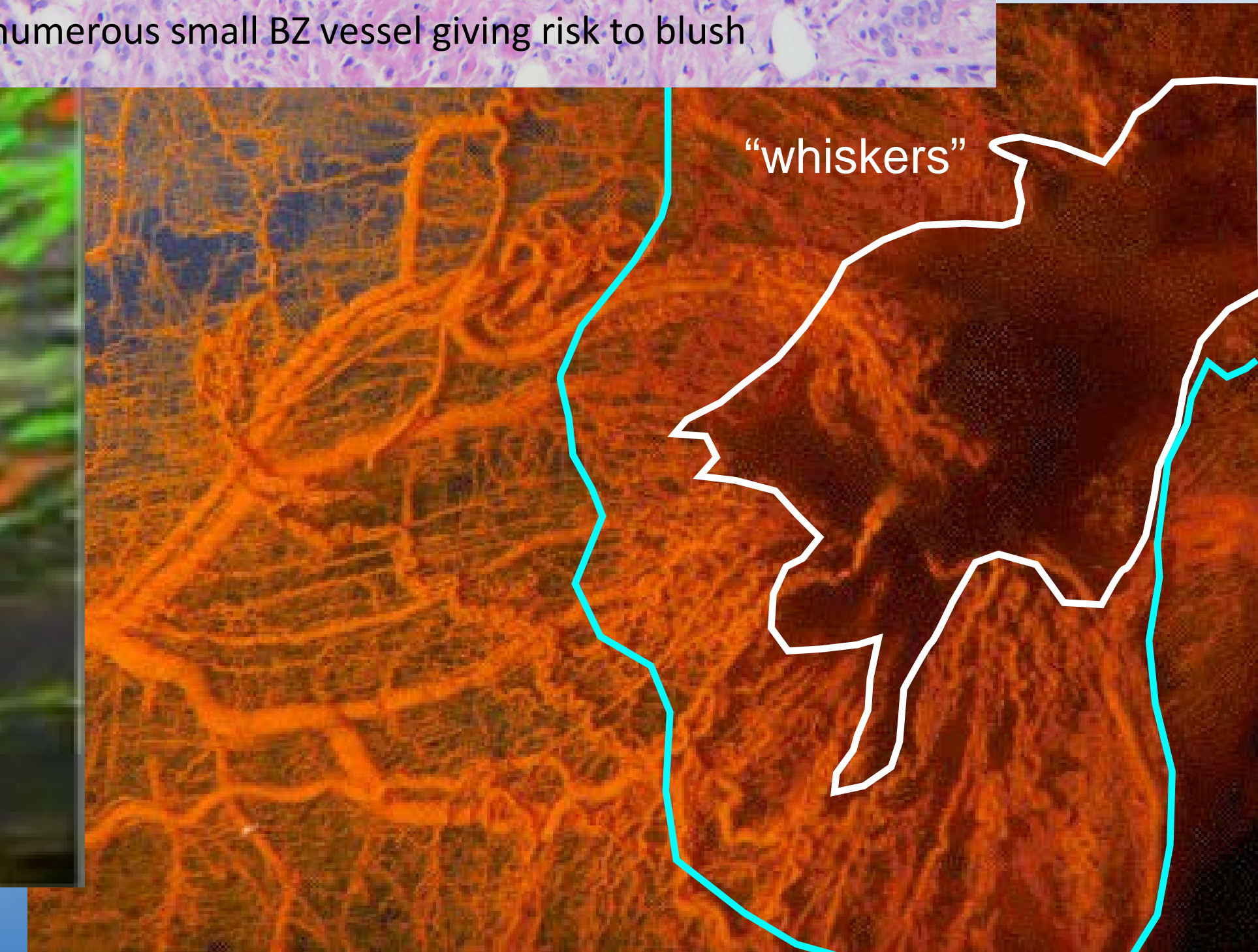
OA external boundary zone blush

numerous tiny neovessels, each too s

BZ - numerous small neovessels too small to see give rise to blush

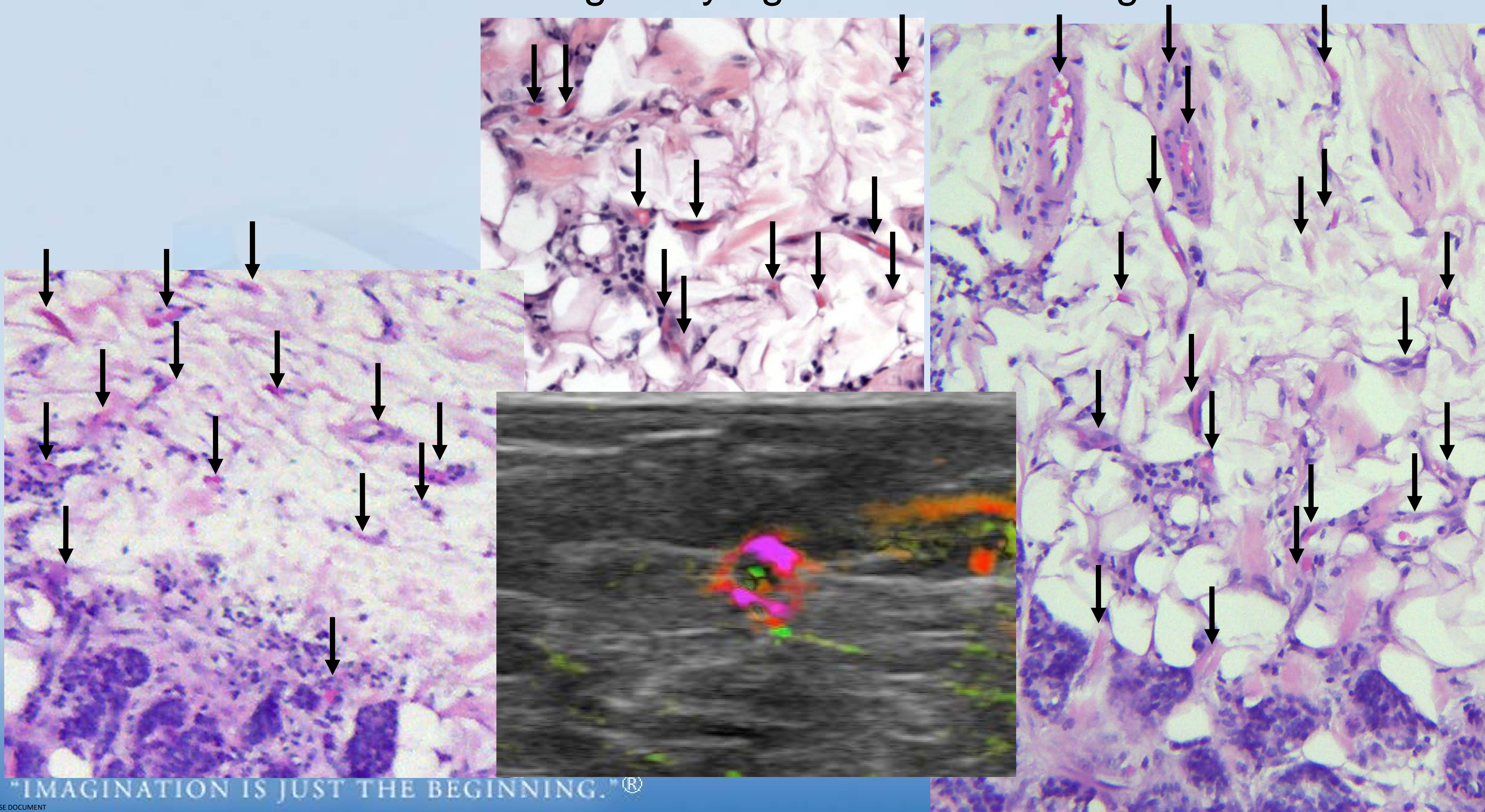


numerous small BZ vessel giving risk to blush



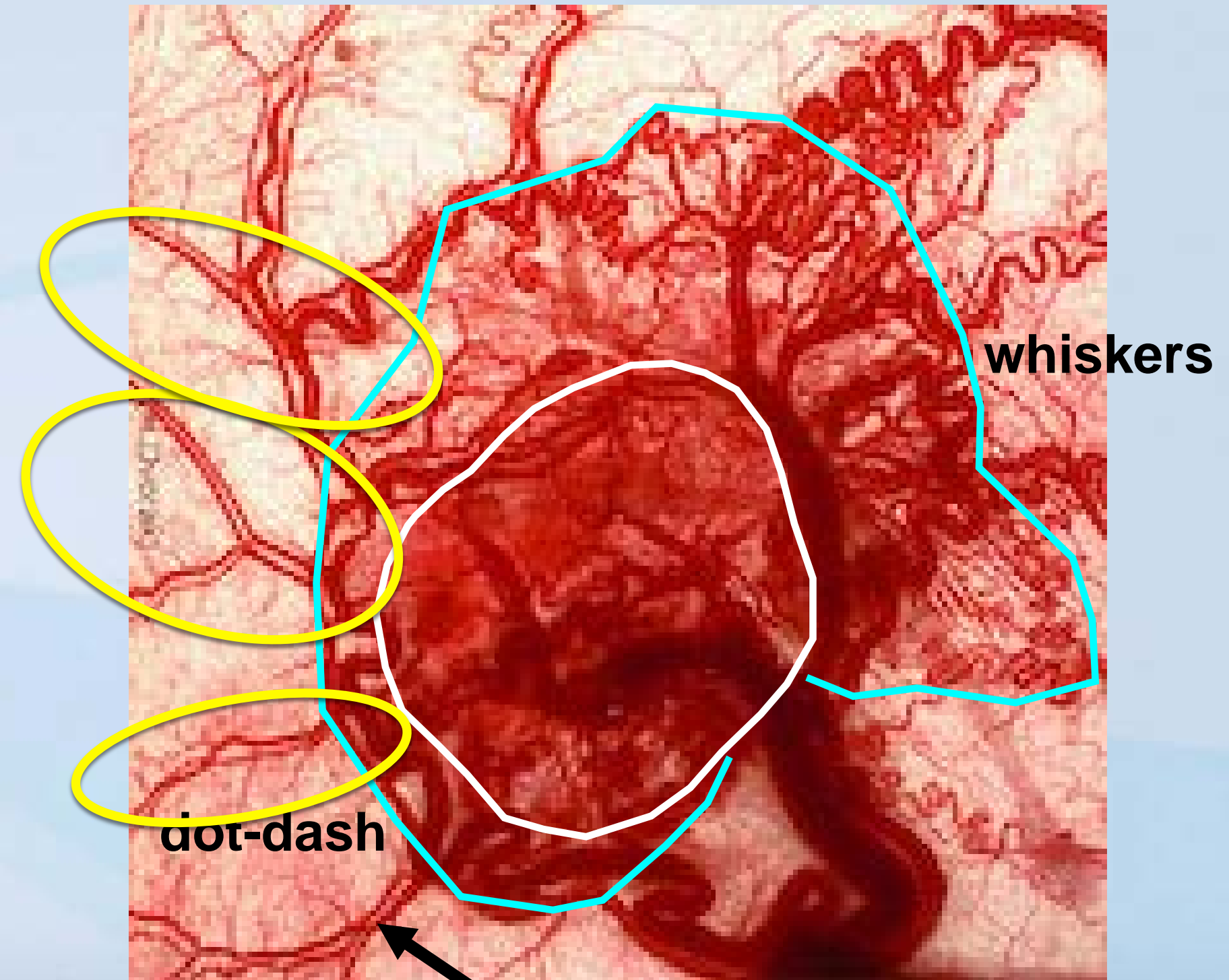
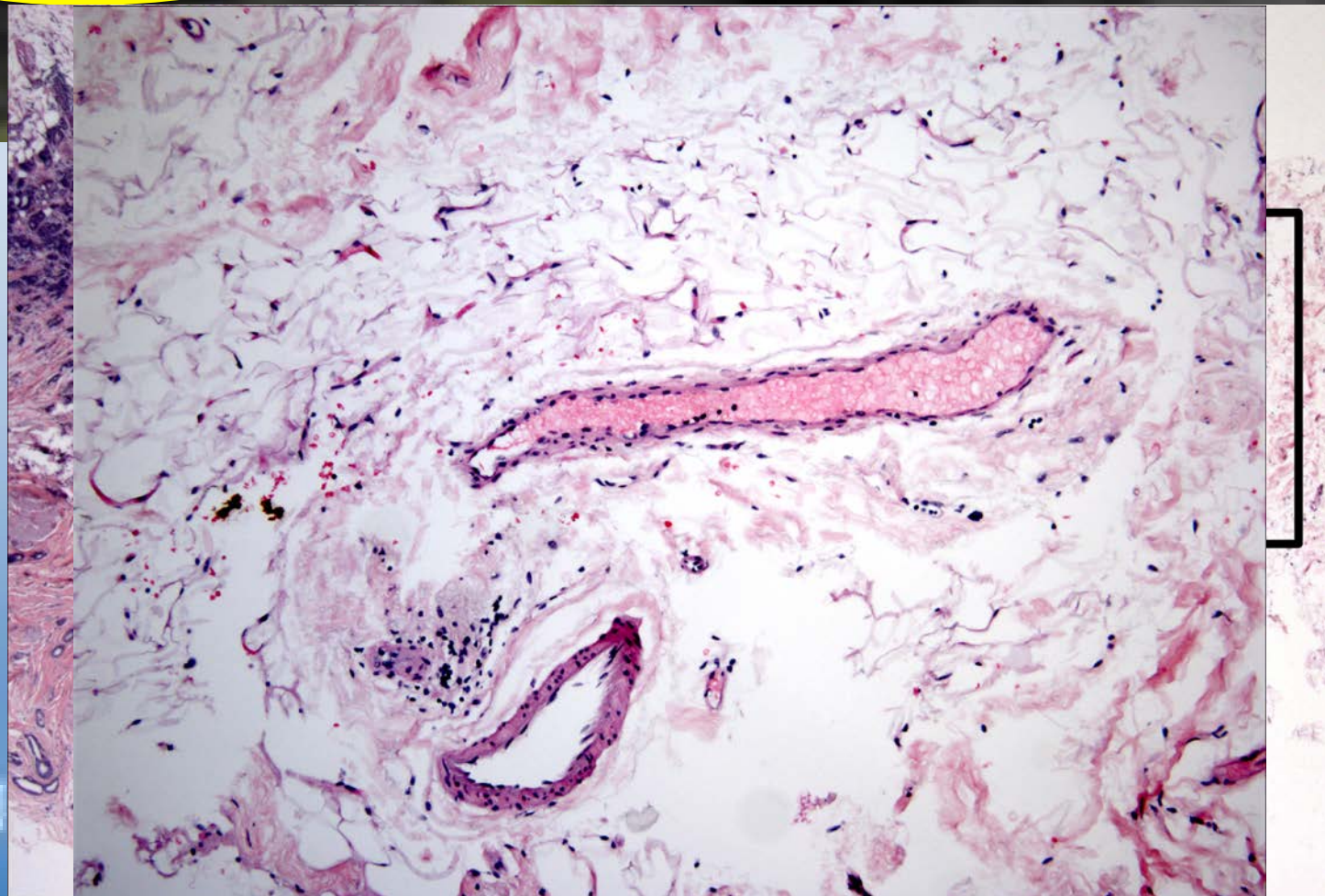
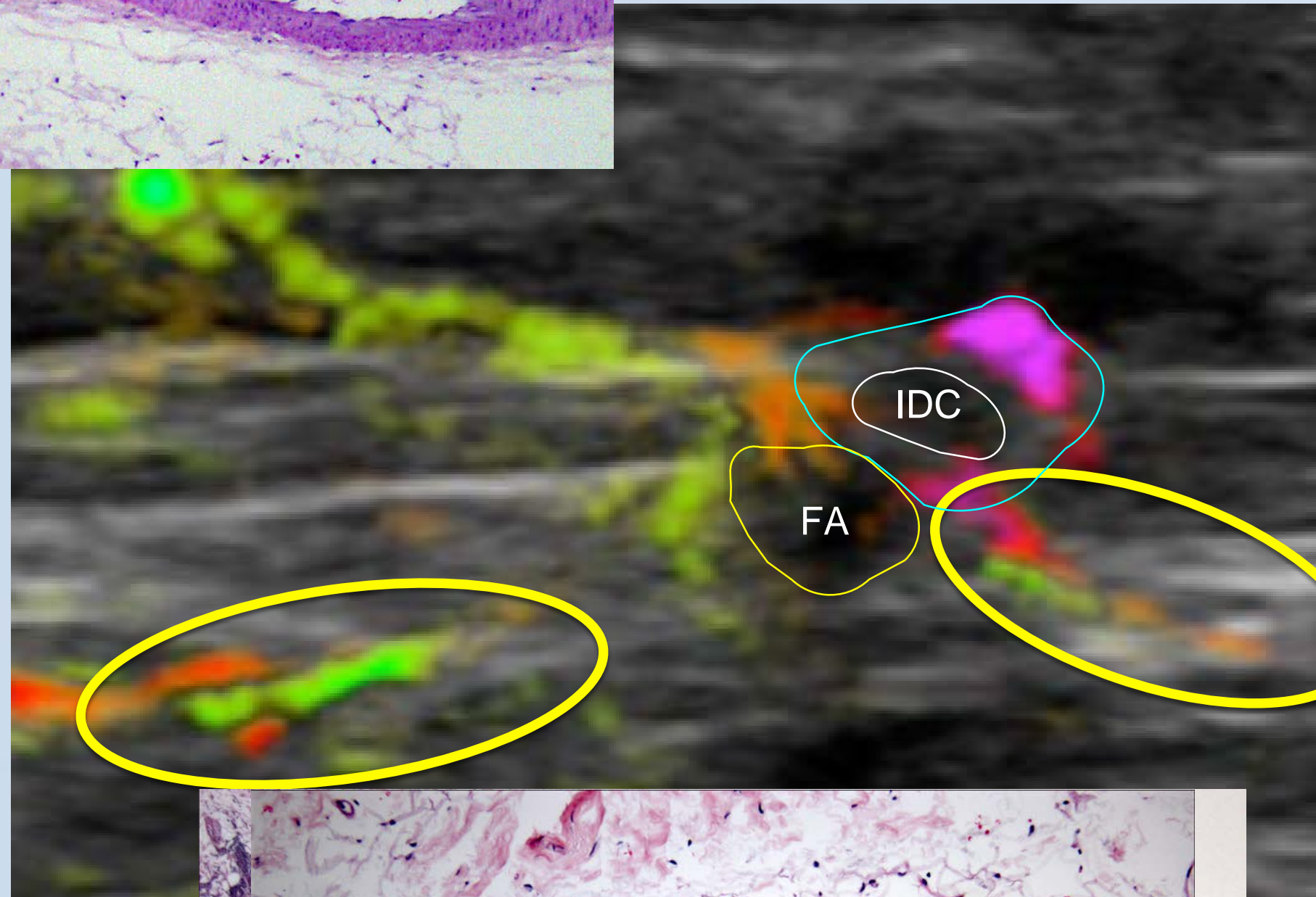
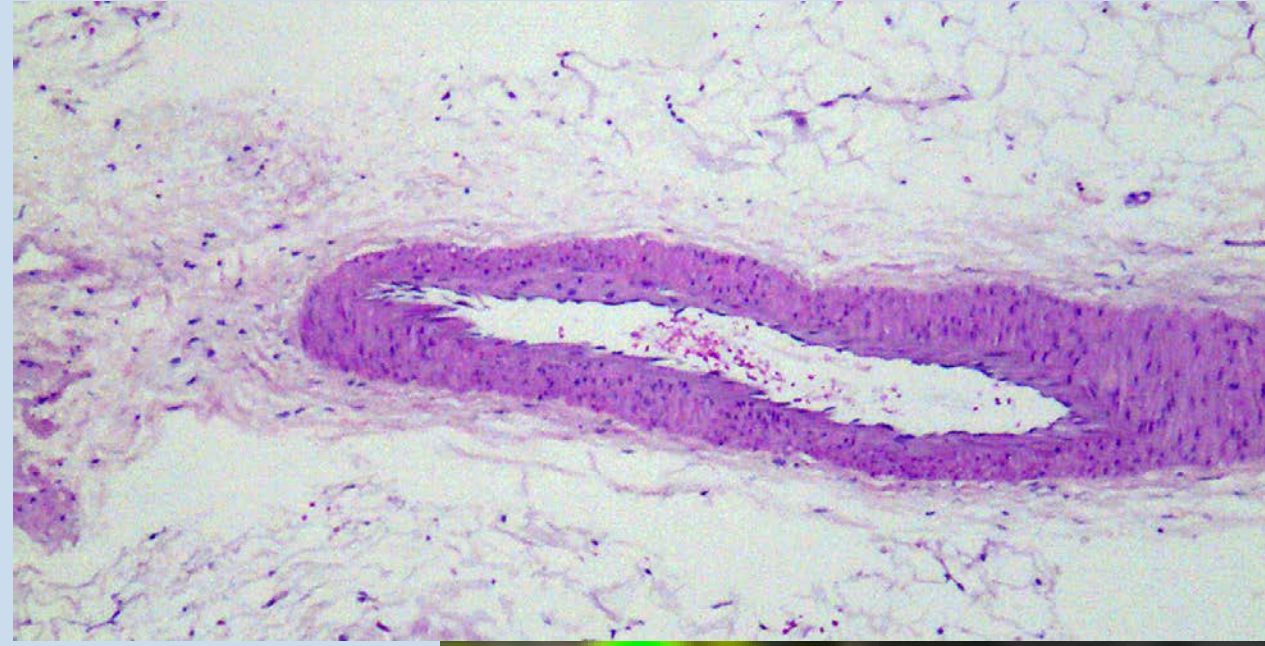
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Boundary zone blush caused by numerous tiny vessels invasive malignancy - grades I and II vs. grade III



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peripheral zone vessel morphology invasive malignancy - grades I and II vs. grade III



most vessels in PZ are
parasitized native vessels
paired a. and v