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Macrophage Detection, Quantification, and Prognostic Utility by OCT

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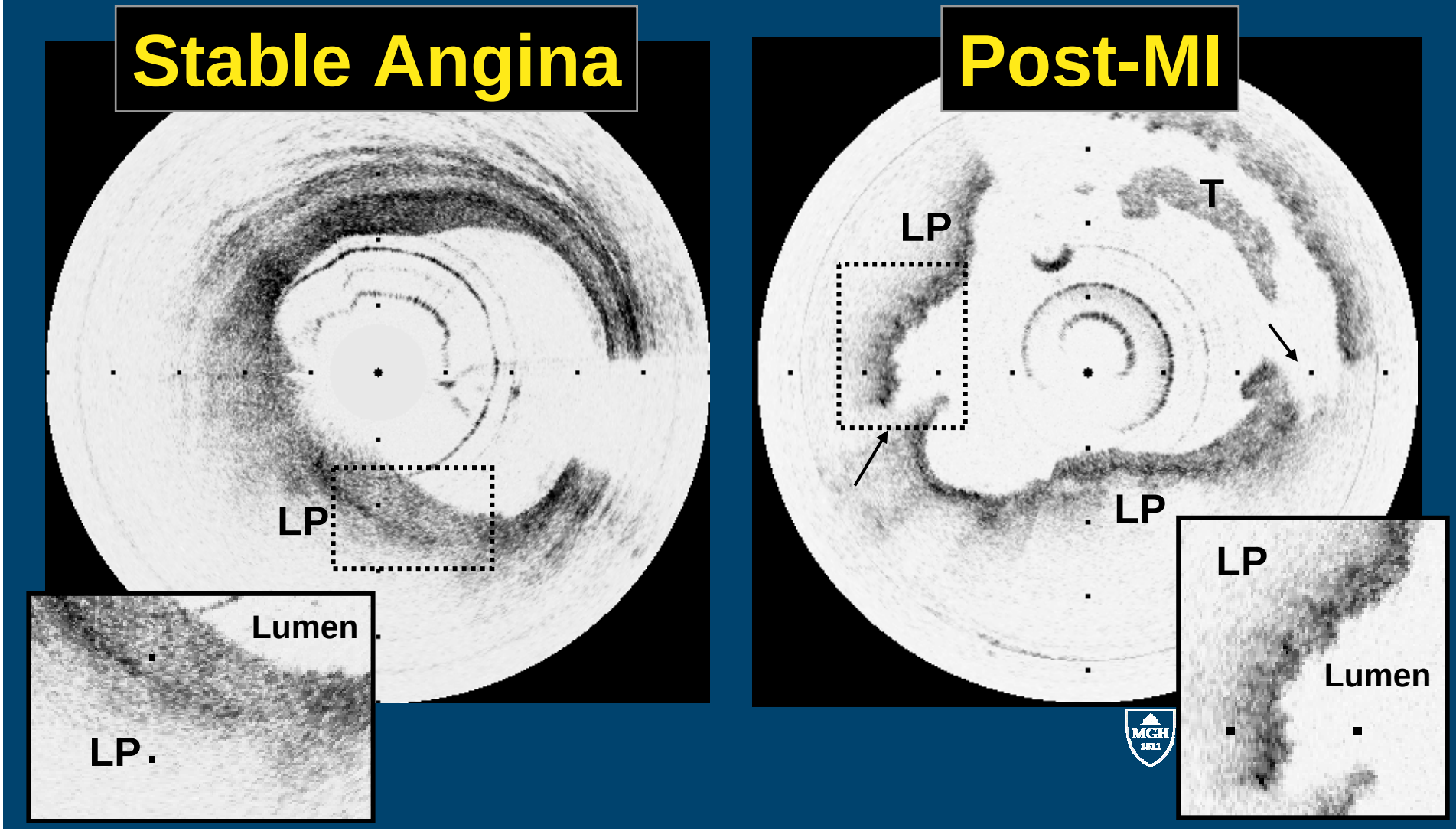
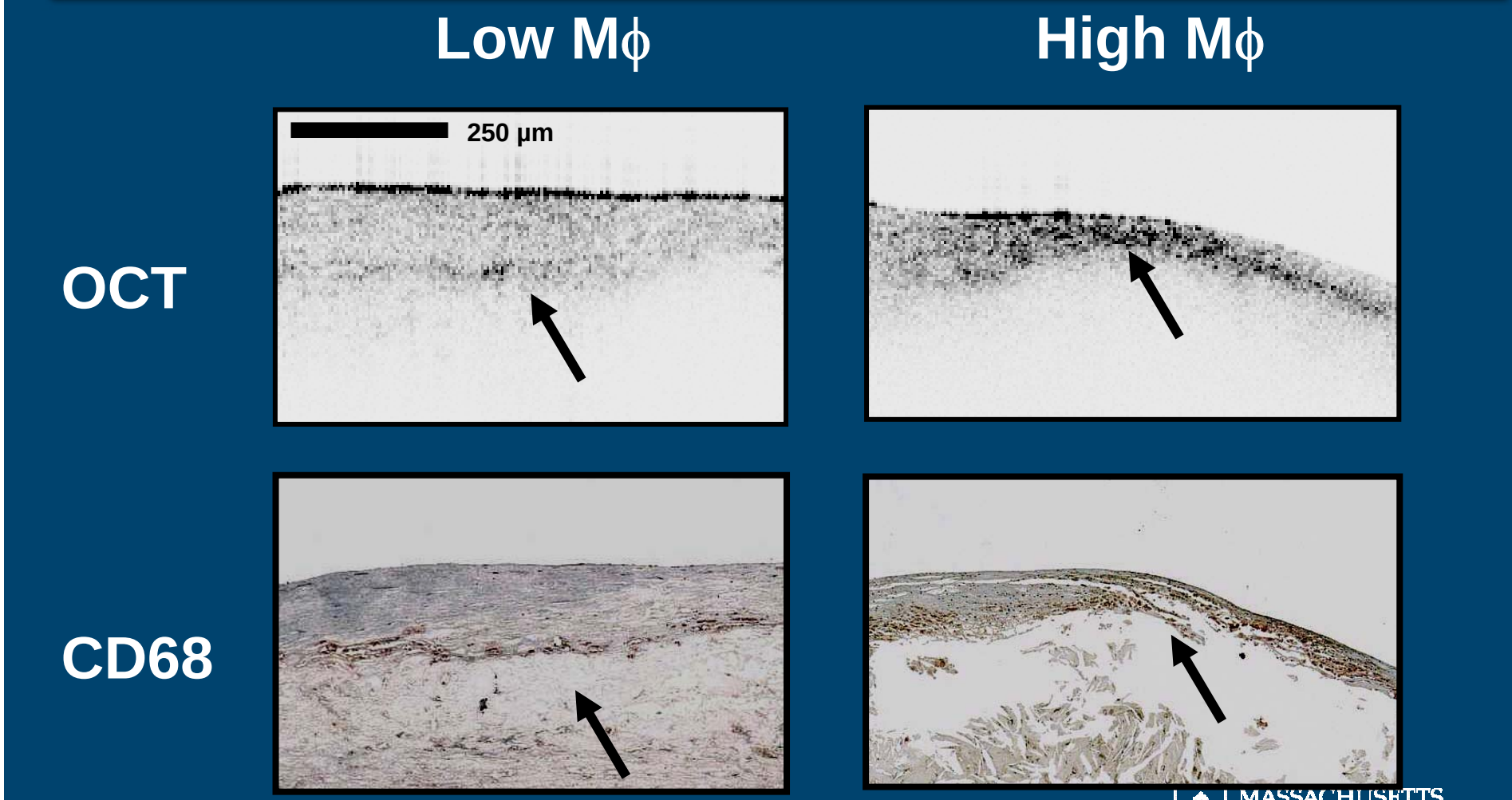
Macrophages by OCT



Ex Vivo Macrophage Study



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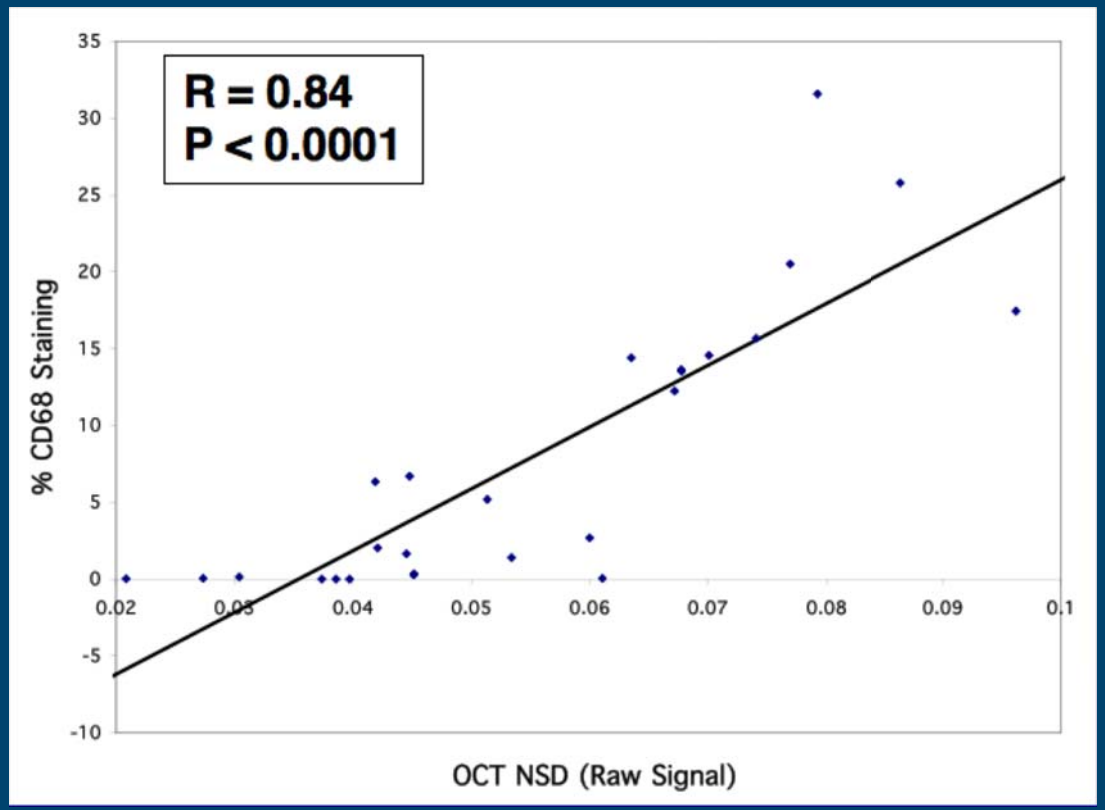
Linear NSD vs. CD68



CD68 % area > 10 % - NSD cutoff 6.2%

SENS **100% (70-100%)**

SPEC **100% (60 -100%)**

Tearney. Circulation, 2003

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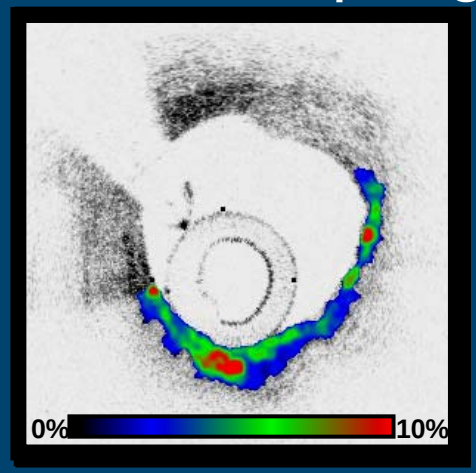
Macrophage Analysis (119 plaques)

- Investigate focal versus multi-focal macrophage distributions



- Cap segmentation-
  - **Entire FA cap**
  - **Rupture (250 μm)**
  - **Surface: ≤ 50 μm from lumen**
    Subsurface: > 50 μm from lumen

- NSD computation-
- Definition:
  - Macrophage Density ~ Mean NSD within Segmented Region

$$NSD(x,y) = \frac{\sigma(x,y)}{(S_{max} - S_{min})} \times 100$$

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Macrophage Quantification in Patients

- **Correlation between OCT measurement and clinical presentation**
  1. **Macrophage density vs. clinical syndrome**
- **Role of focal macrophage distribution**
  2. **Density at rupture sites**
  3. **Surface vs. subsurface density**
- **Role of multi-focal macrophage distribution**
  4. **Culprit vs. remote plaque density**
  5. **Fibrous plaque macrophage content**

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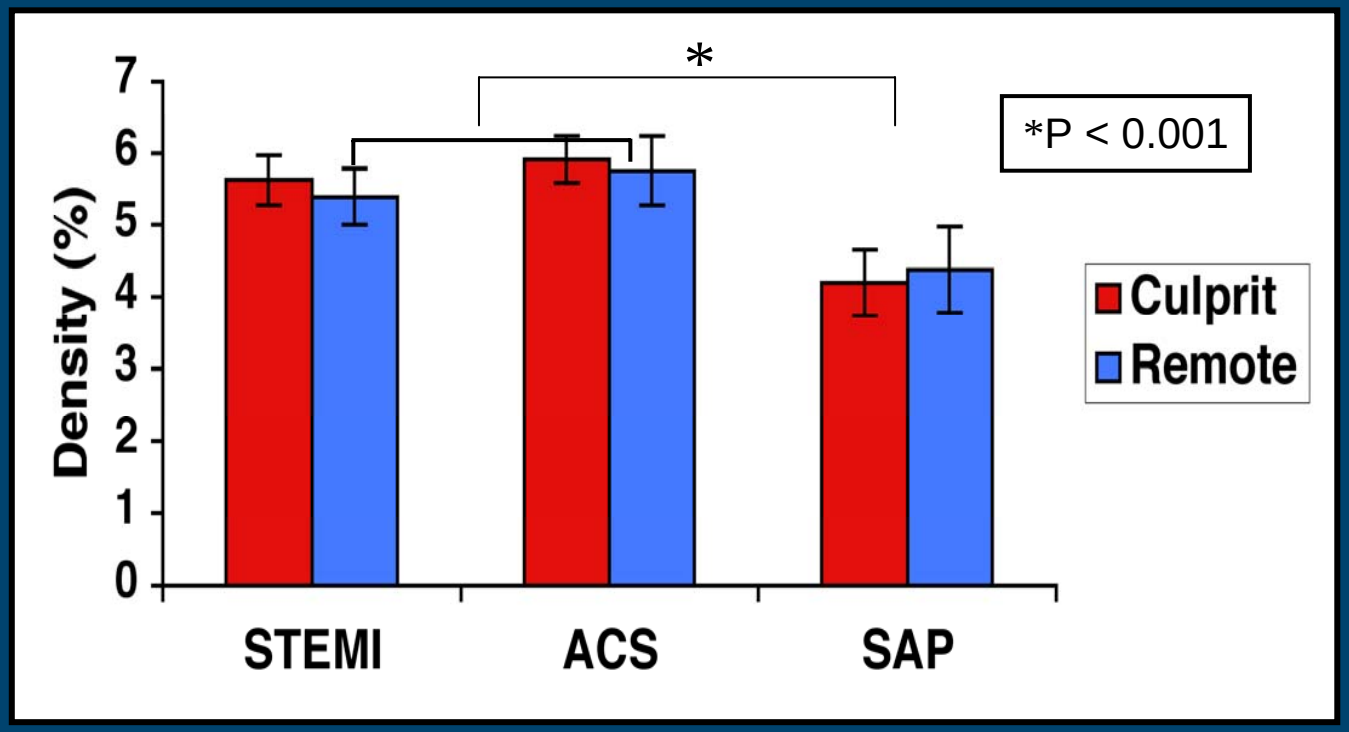
Macrophage Density for Acute and Stable Clinical Syndromes



Cap macrophage density is higher in acute clinical syndromes in both remote and culprit sites

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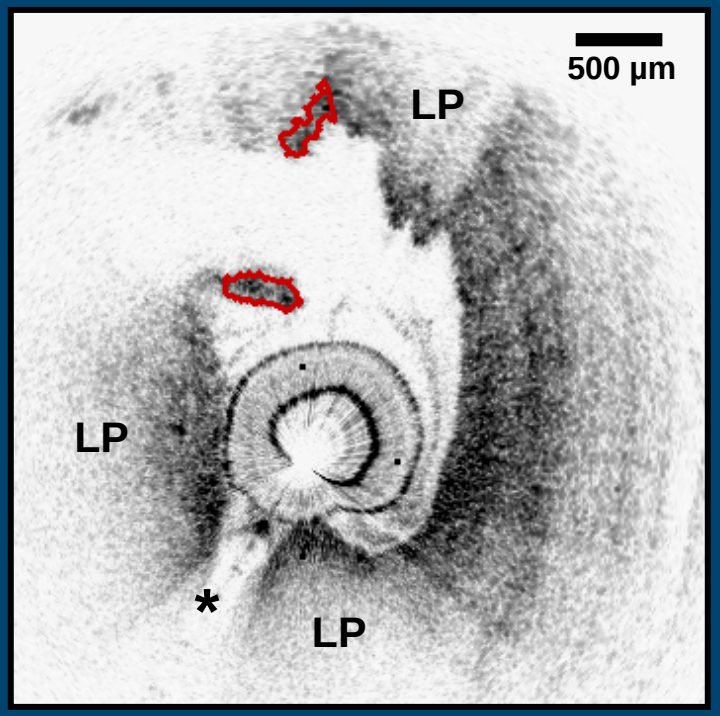
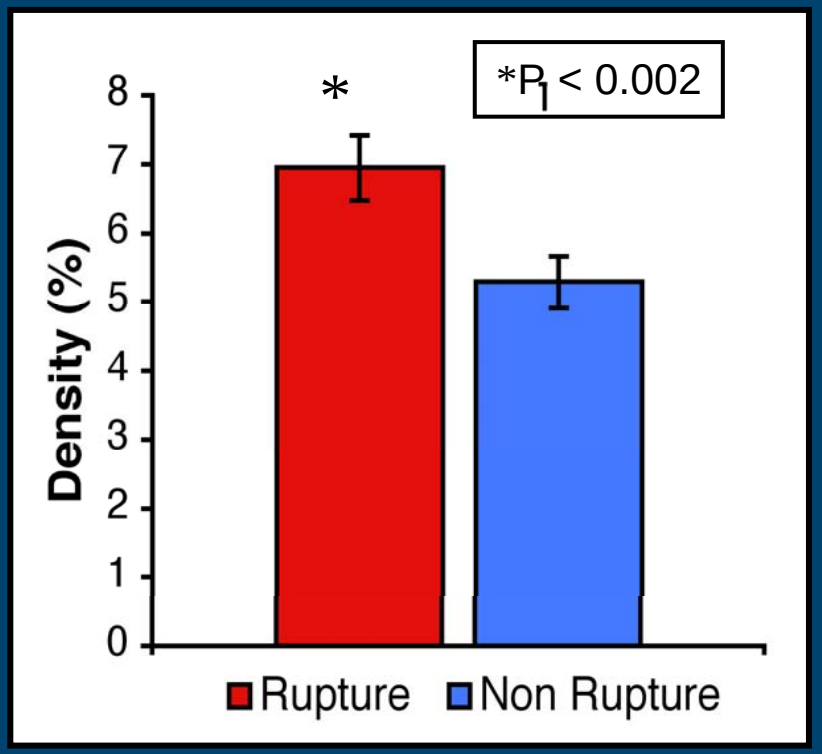
Rupture Sites





Cap macrophage density is higher at rupture sites than remainder of cap

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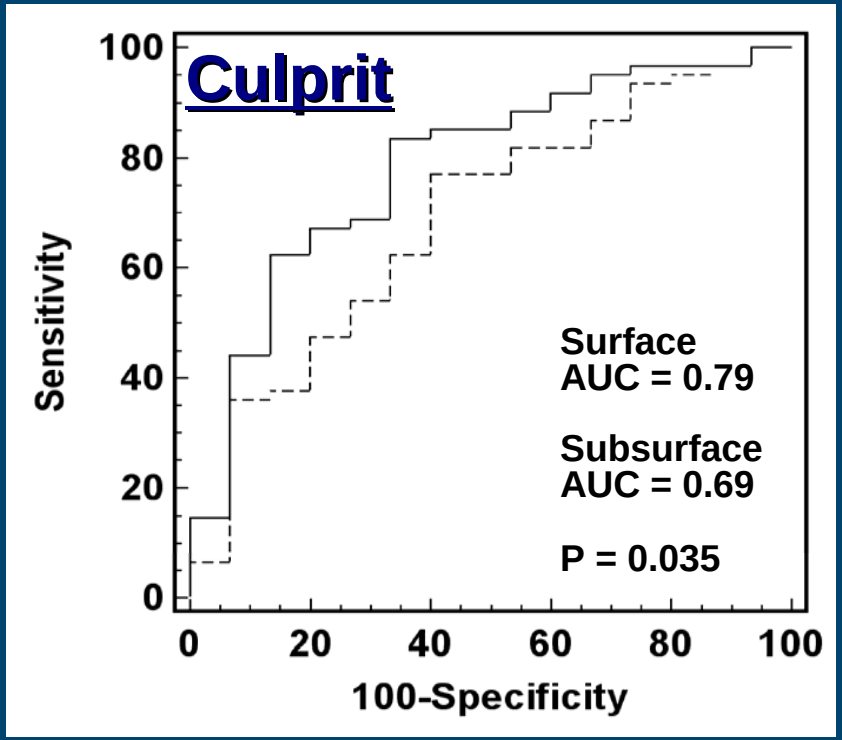
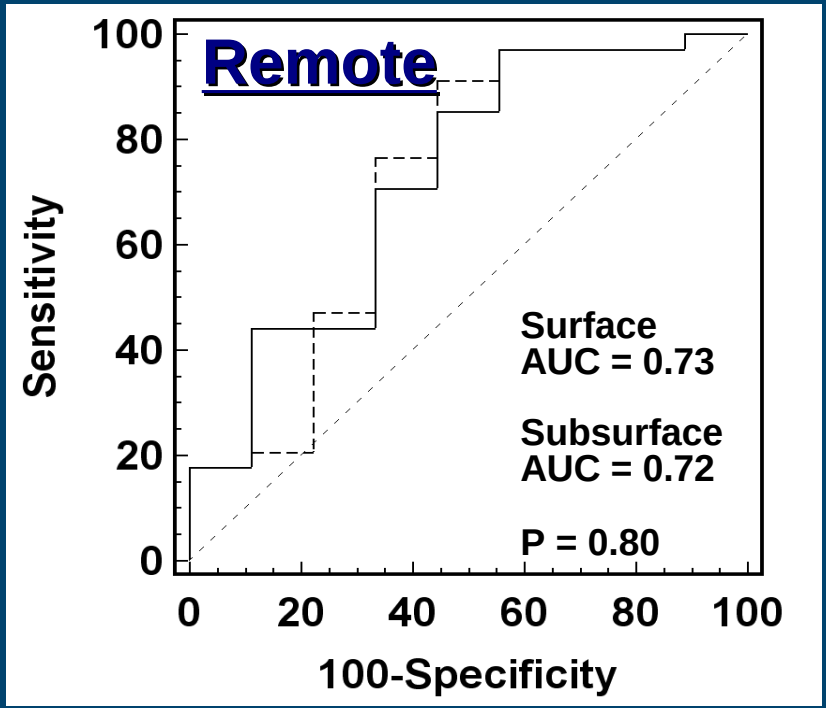
Surface versus Subsurface ROC Analysis





Surface cap macrophage density is more predictive of clinical syndrome than subsurface macrophage density at *culprit*, but not remote sites

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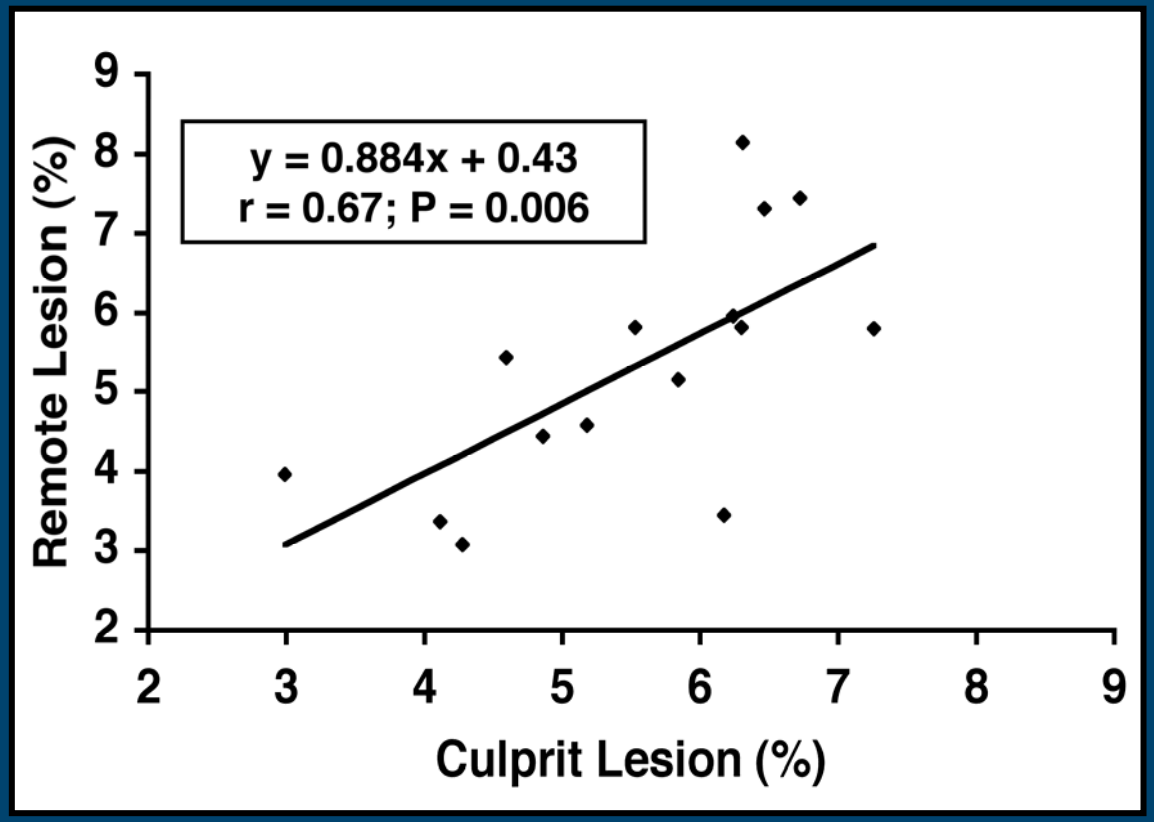
Culprit vs. Remote Sites



Culprit and remote macrophage densities are correlated in the same patient

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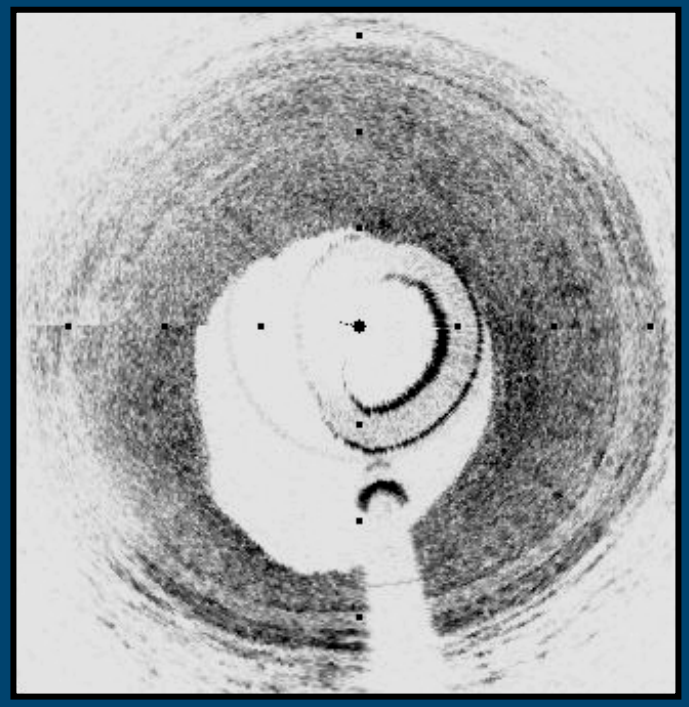
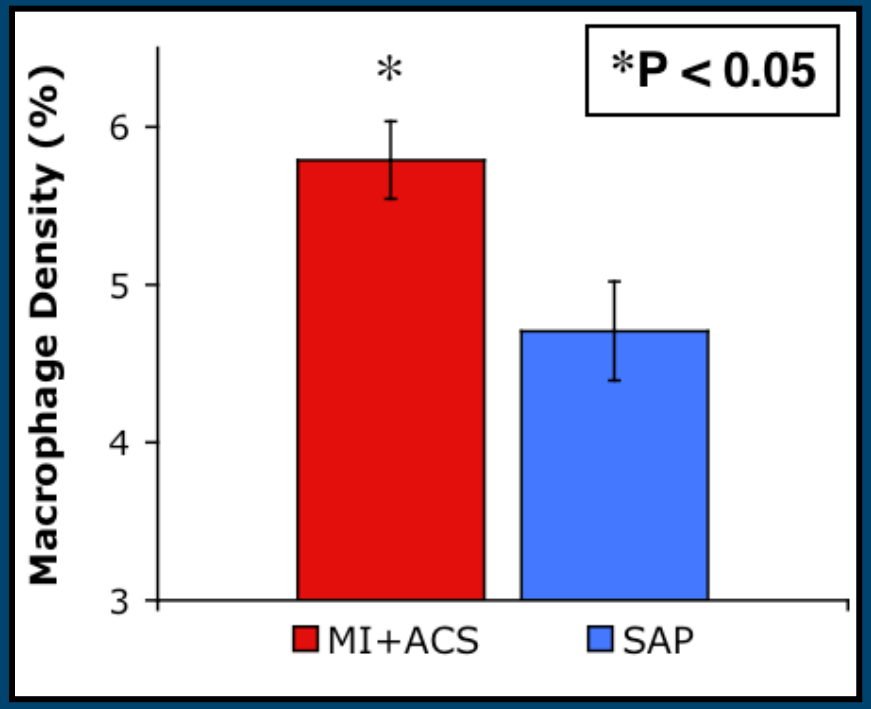
Fibrous Plaques





Fibrous plaque macrophage density is higher in acute patients

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Focal vs. Multi-focal Risk

Evidence for focal risk

1. Rupture sites: greater macrophage content

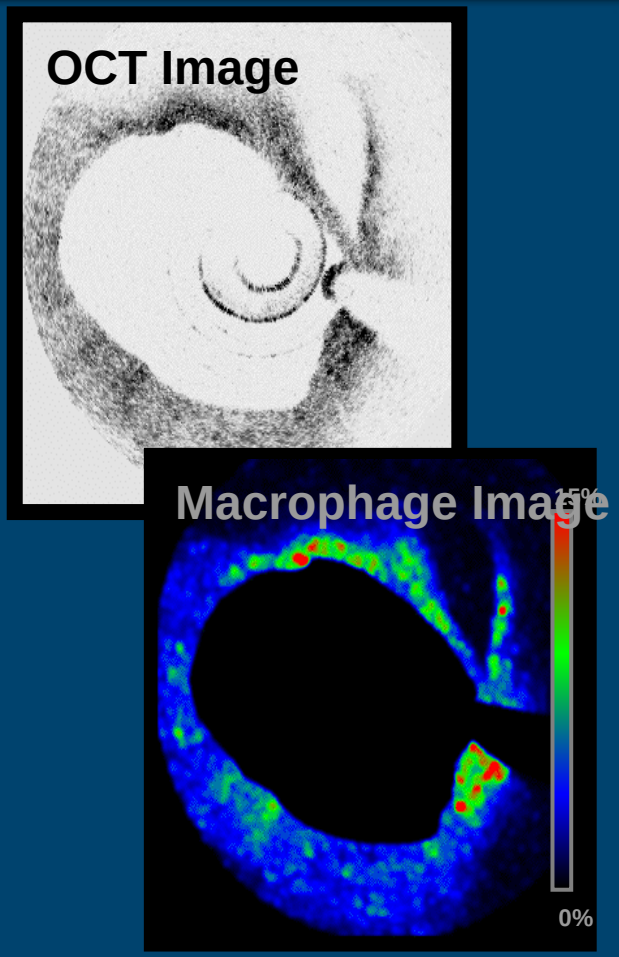
2. Surface macrophage density more predictive of clinical syndrome at *culprit* sites, not remote sites

Evidence for multi-focal risk

1. Remote and culprit densities not different within individual patients and clinical subgroup

2. High intra-patient correlation between remote and culprit densities

3. Fibrous lesions: higher densities in acute syndromes



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Macrophage Prognostic Utility

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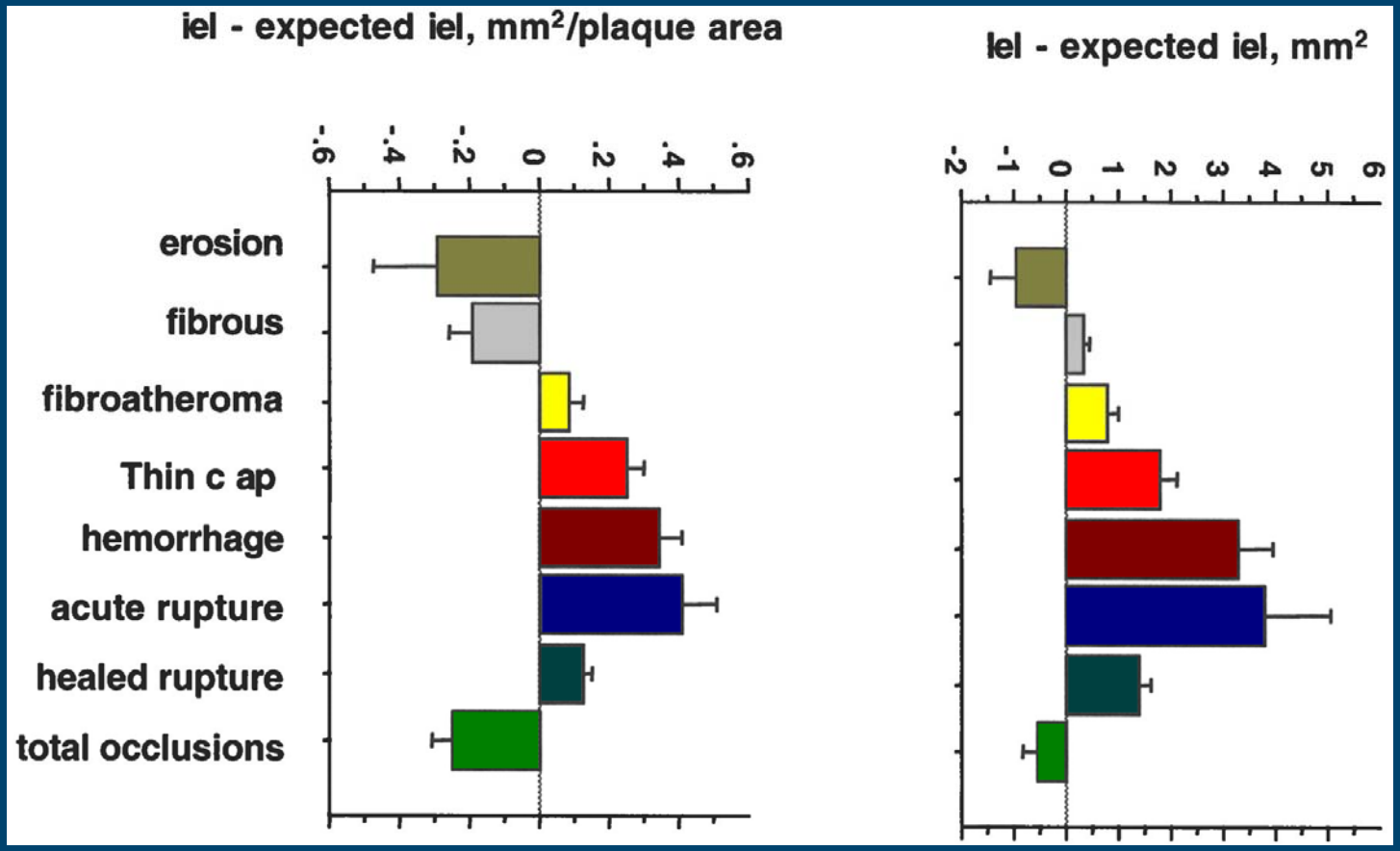
Background: Remodeling and Plaque Morphology
Ex-vivo histopathological study



Burke, A. P. et al. Circulation 2002;105:297-303

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Aim of the study

Evaluate the association between coronary artery remodeling assessed by IVUS and plaque characteristics identified by OCT

Methods

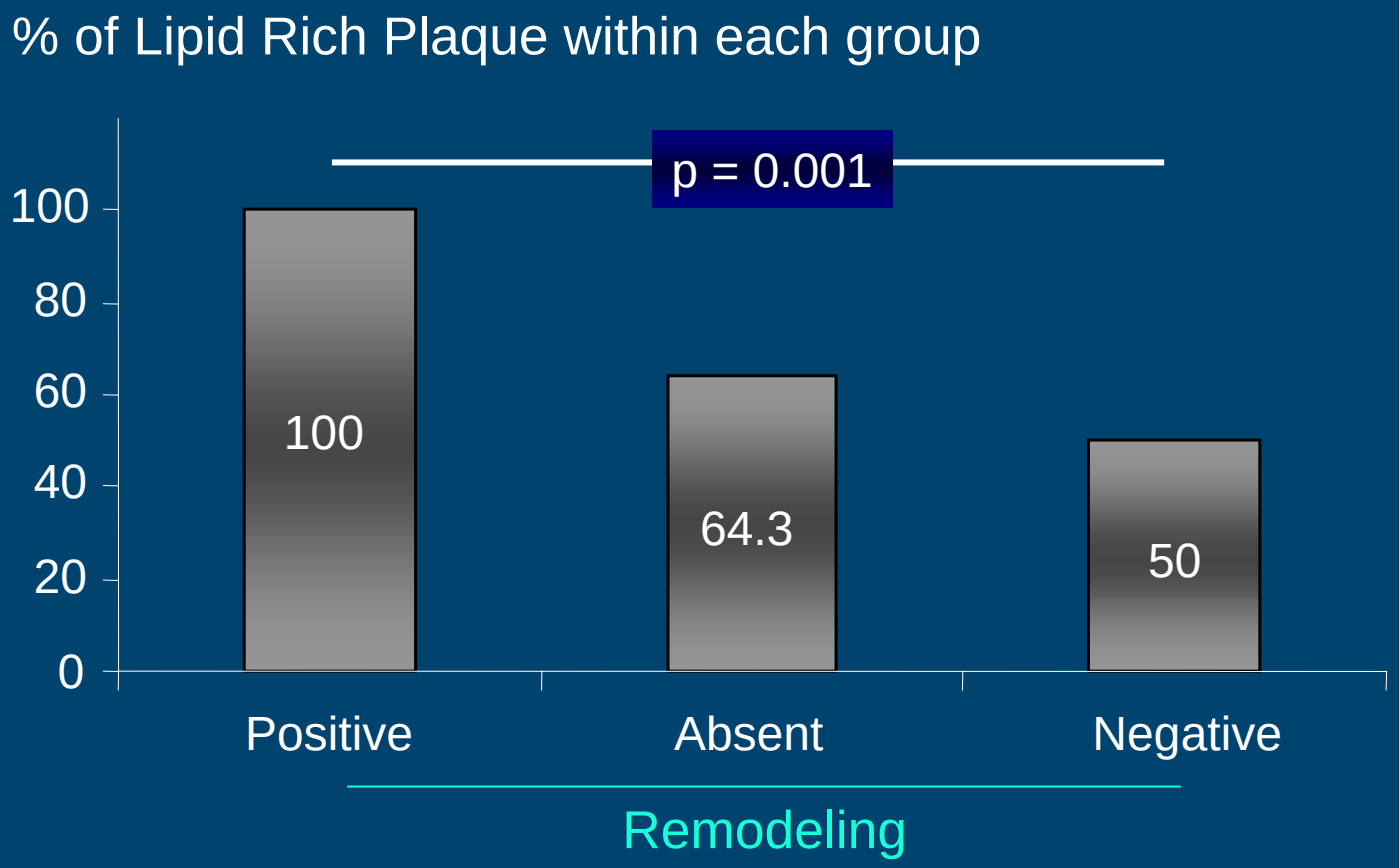
- OCT and IVUS was performed at corresponding lesion sites in patients undergoing catheterization
- Remodeling index (RI) was calculated as the ratio of the lesion to the reference external elastic membrane (EEM) area derived from IVUS images.

- Positive remodeling was defined as RI>1.05

- Absence of remodeling as RI 1.05 – 0.95

- Negative remodeling as a RI <0.95

Association between remodeling and frequency of Lipid Rich Plaque (55 plaques)



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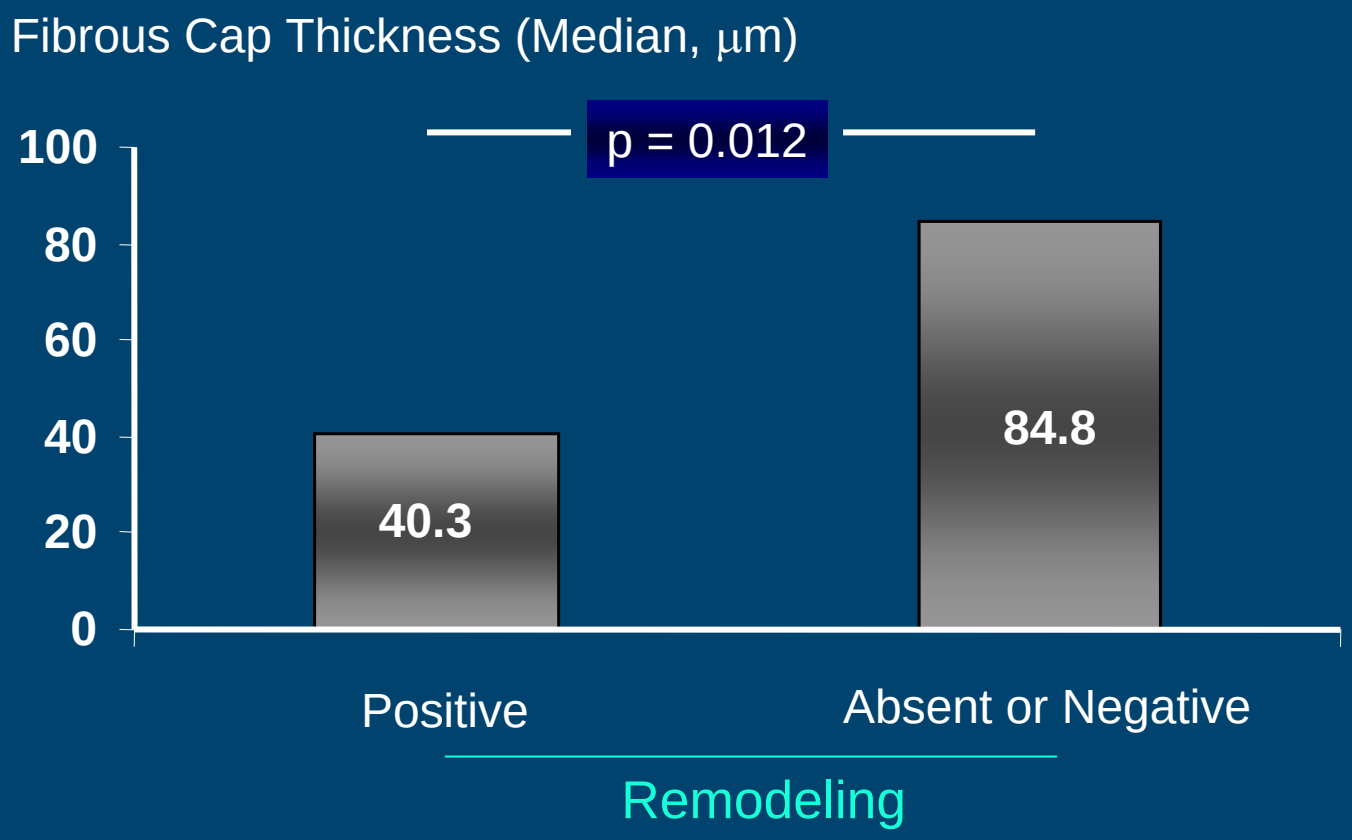
Association Between Remodeling and Underlying Plaque Fibrous Cap thickness



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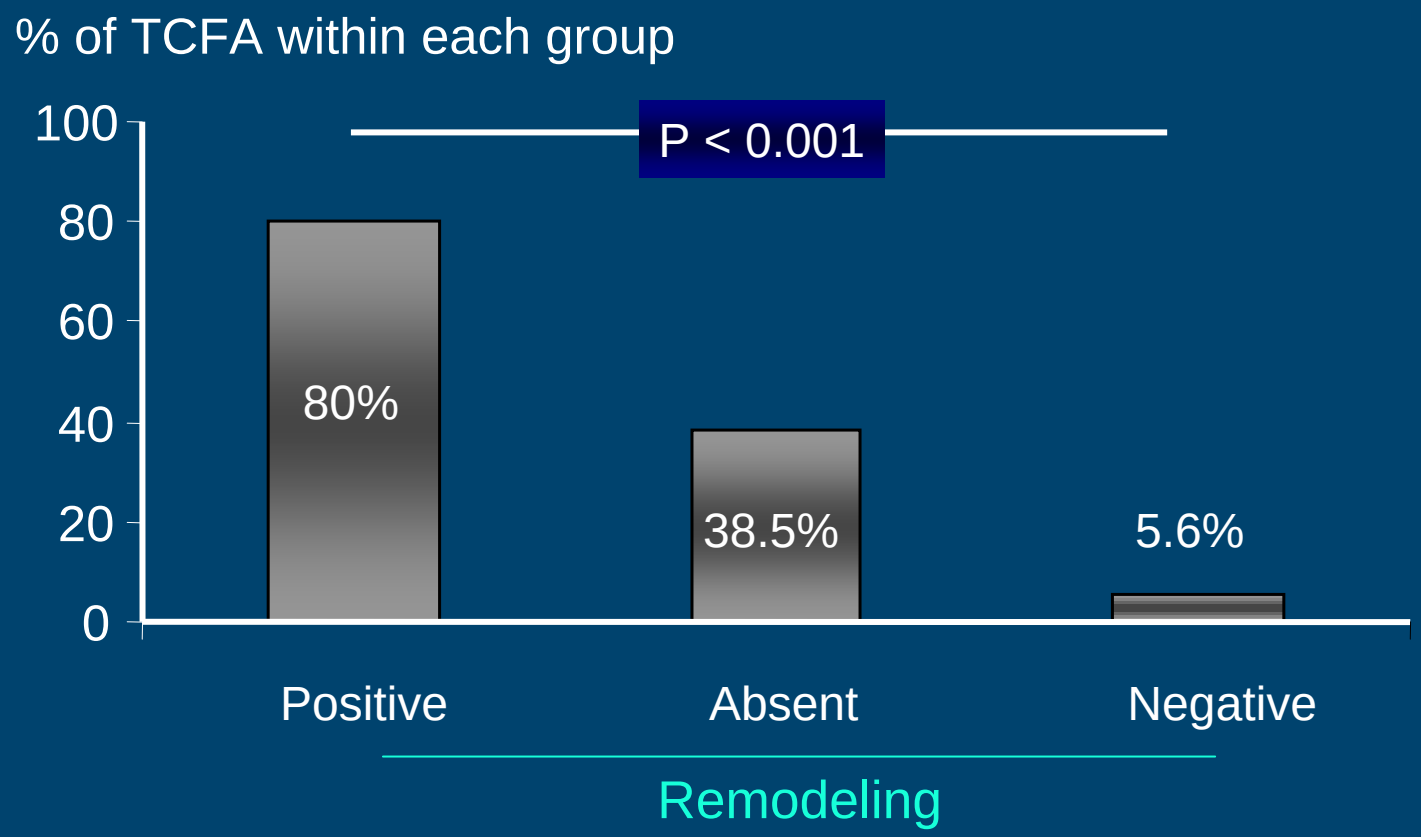
Remodeling and TCFA: Association between type of remodeling and frequency of TCFA



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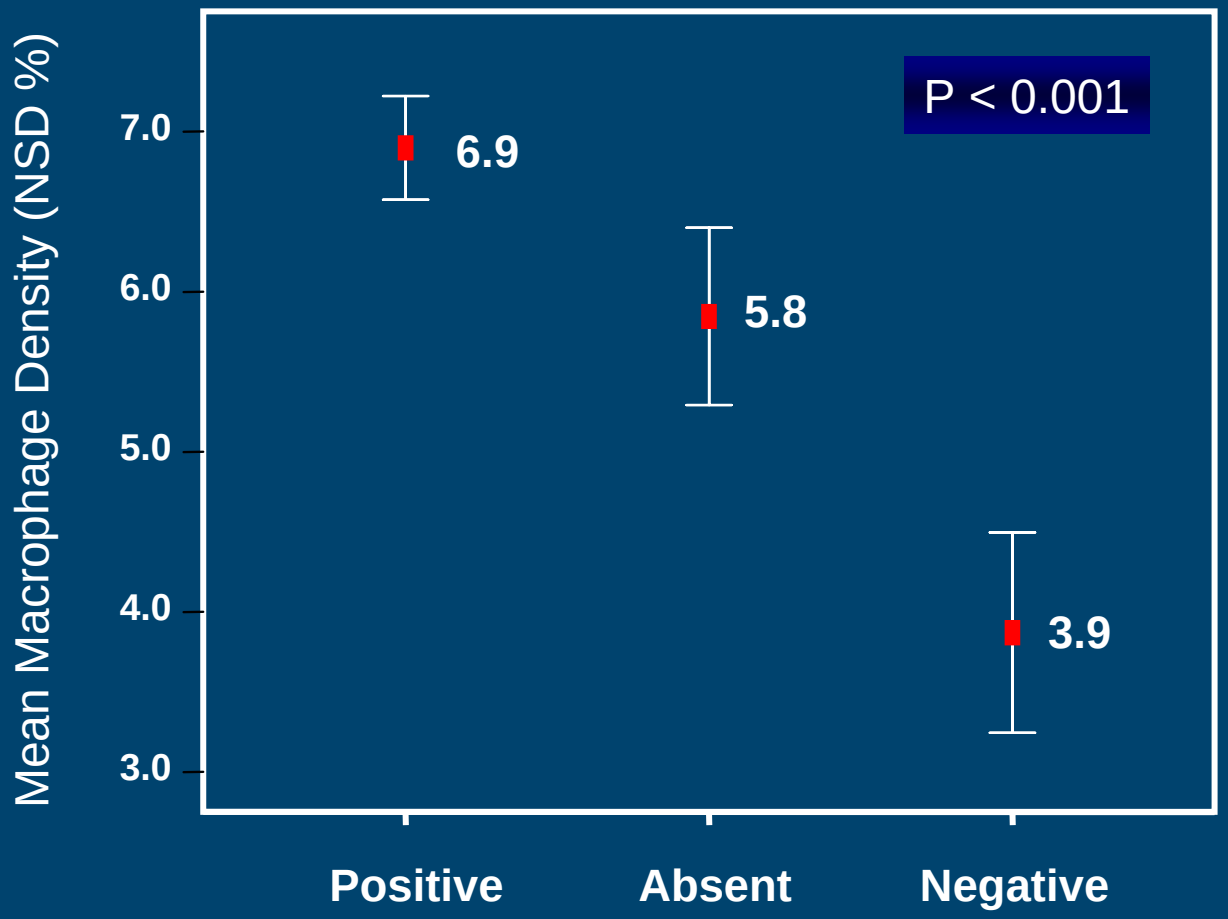
Association Between Remodeling and Underlying Plaque Macrophage Density



RI = Remodeling Index

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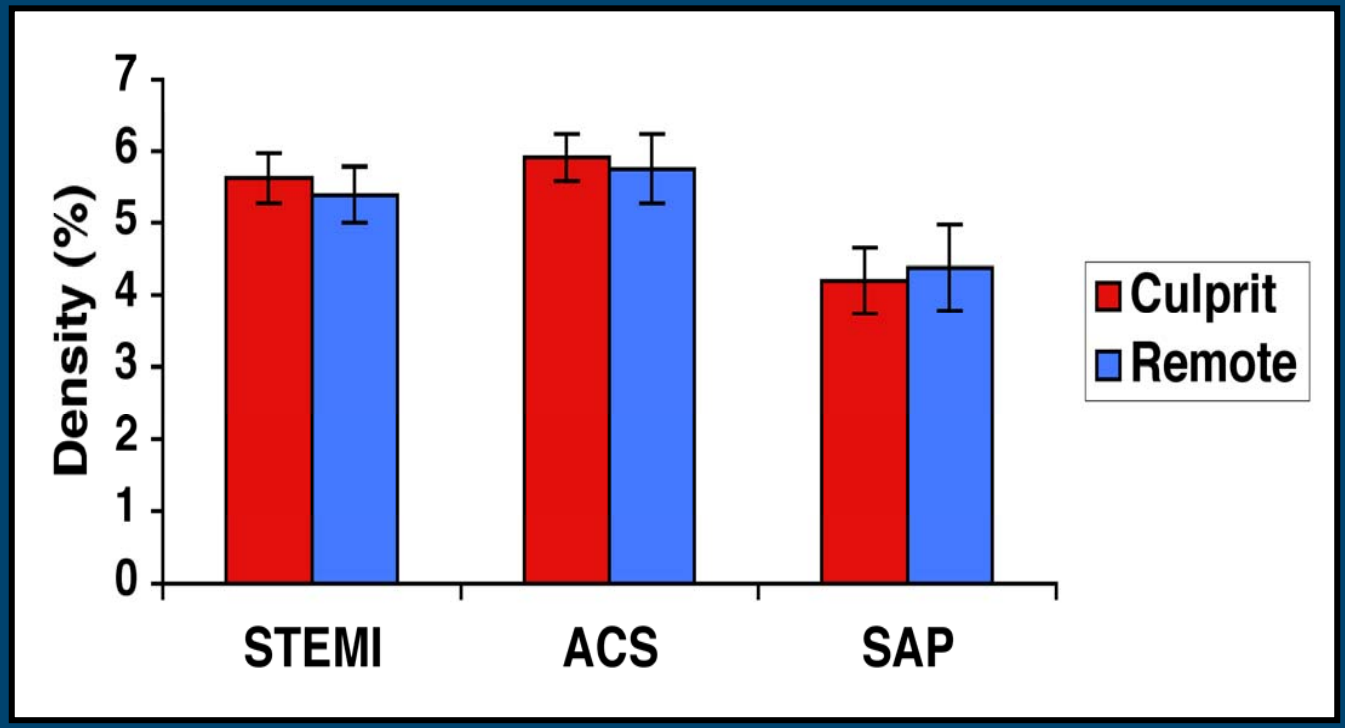
Limitations

1. The difference in macrophage density is marginal.



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Limitations

1. The difference in macrophage density is marginal.
2. Enzymatic activity of macrophage is not known.
3. Diffuse distribution of macrophage including in fibrous rich plaque.

Macrophage by OCT

1. Detection: Probably “yes”

2. Quantification: Possible

3. Prognostic utility: unknown

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