

# **Clinical Aspects of Intervention**

**S12: 17:30 - 19:00**

Chairs: **Martin Leon, Jean Fajadet, Aaron Frimerman**

## **FFR is a Must for Intermediate LM Lesions?**

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**ICI meeting 2009**  
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# Disclosures

## ברכות מקנדה

(CAIC: Canadian Association of Interventional Cardiology)



**היום, אני שמח, כי יורד גשם בישראל  
ולמדתי שגשם מאד חשוב לישראל**

**I, Erick Schampaert, have no financial relationship to disclose related to this presentation.**

# Why FFR is a Must for Intermediate LM Lesions?

Because Our Patients deserve the Best Care, including CERTAINTY of the diagnosis and the treatment needed !

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# Angiography of the LM

Significant LM lesion (>50-70%DS) :

- Ischemia and Symptoms
- Possible Increased Risk of Plaque rupture <sup>1</sup>
- Worse prognosis, improved with CABG (and PCI?)

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<sup>1</sup> Pijls AJC 2009;103:1204

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# Angiography of the LM

Left Main Disease assessment by Angiography is complicated:

– Variable size:

- Normal LM lumen diameter by QCA:  $4.1 - 4.3 \pm 0.6$  mm <sup>1</sup>
- Influence of Dominance
- LAD-CX: Murray's Law:  $(D_{LMCA}^3 = D_{LAD}^3 + D_{LCX}^3)$  or  $(D_{LM} = 0.67 * (D_{MV} + D_{SB}))$  <sup>2</sup>

– QCA difficult at best:

- Highest intra-observer variability of all coronary segments
- Lack of N Reference segment, undetected diffuse disease
- LAD-CX Bifurcation (60%)

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<sup>1</sup> Zubaid CJC 2002;18:973

<sup>2</sup> Finet EuroInterv 2007;490

# Angiography of the LM

Left Main Disease assessment by Angiography is so complex that it has

**Limited Reliability to predict hemodynamic significance of Intermediate lesion, 40-70% DS**

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## This Is Very Important because...

If a LM lesion is assessed as being significant:

- Influence the decision to revascularize: CABG, PCI

And is treated as such, but is not significant :

- Same procedural risks of the revascularization
- CABG: Premature graft occlusion and Lack of protection in the event of progression or rupture
- PCI: Potential risk of restenosis, SAT and bleeding

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# IVUS: Valuable Adjunctive Modality for the LM

- Presence - extent disease, Size, Ca<sup>2+</sup>(limitation)
- QCA underestimates the “True” MLD and MLA IVUS (non-co-axial measures: limitation)
- QCU: MLA: <5.8-7.5 mm<sup>2</sup>, MLD < 2.8 mm: “significant”, and linked to prognosis
- Sano AHJ 2007;154:938: only 44% intermediate Lesions were found to be < 6.0 mm<sup>2</sup>
- These values do not take into account lesion length nor the amount of myocardium to be supplied

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Abizaid: JACC.1999;34:707  
Jasti: JACC 2004;110:2831  
Fassa: JACC 2005;45:204

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# Fractional Flow Reserve: The Physiological Assessment

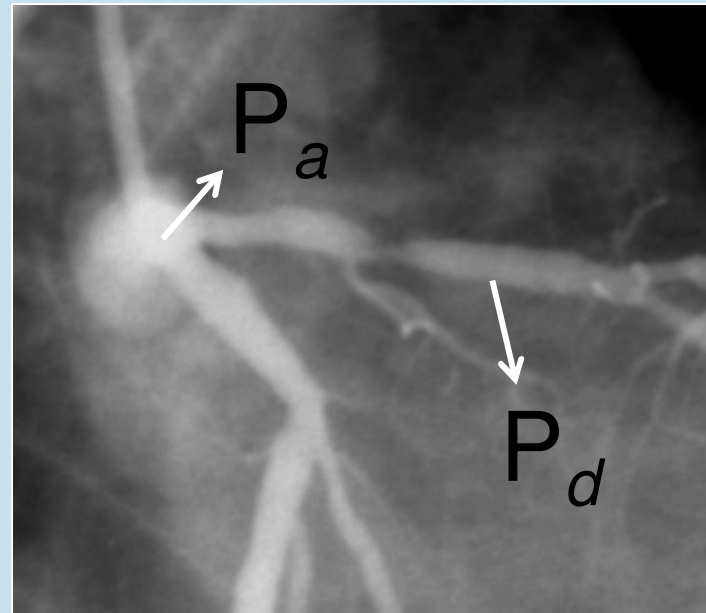
*FFR = Ratio of hyperemic flow in the stenotic vessel over hyperemic flow in the same vessel but in the absence of the stenosis*

*FFR = extent (%) to which maximal myocardial flow is limited by epicardial stenosis*

$$\text{FFR} = \frac{Q_{\max}^S}{Q_{\max}^N} = \frac{(P_a - P_d) / R_{\max}^S}{(P_a - P_d) / R_{\max}^N}$$

$$\text{FFR} = \frac{Q_{\max}^S}{Q_{\max}^N} = \frac{P_d}{P_a}$$

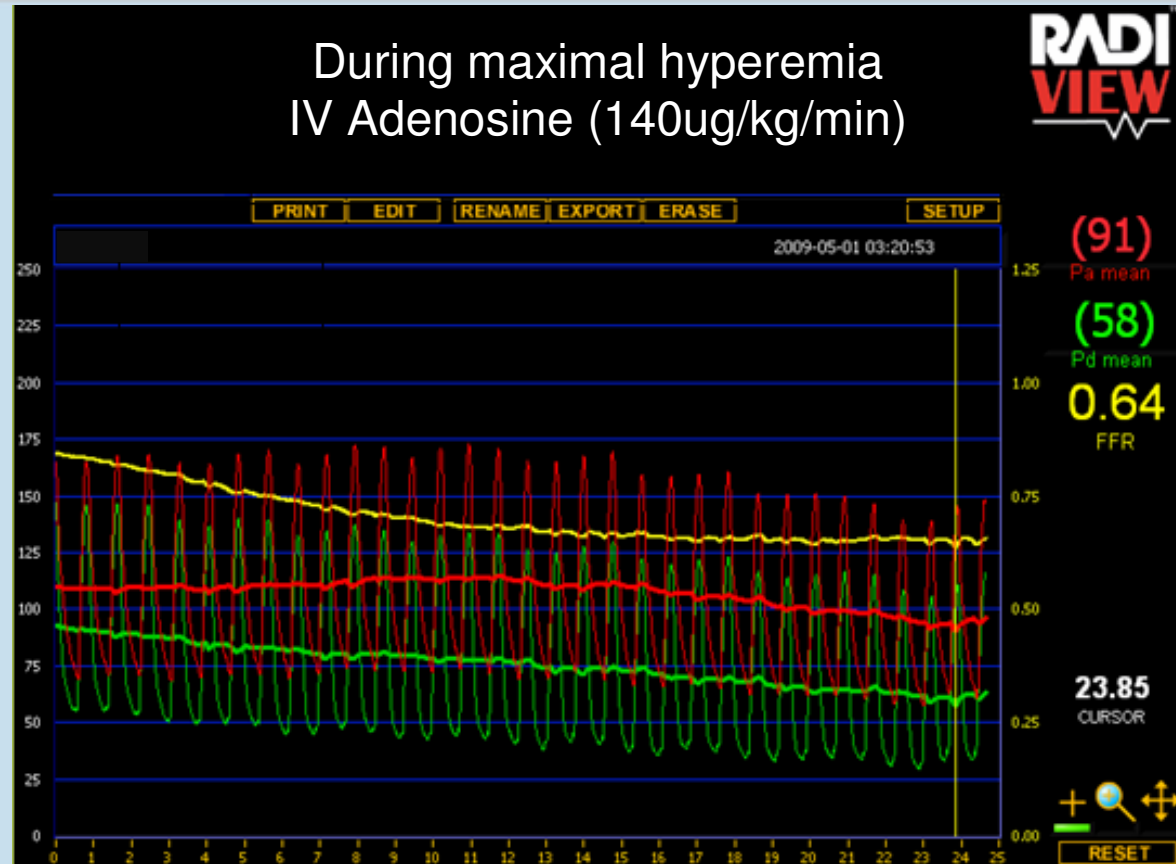
**During maximal hyperemia**



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# Fractional Flow Reserve: The Physiological Assessment

$$FFR = \frac{P_d}{P_a}$$



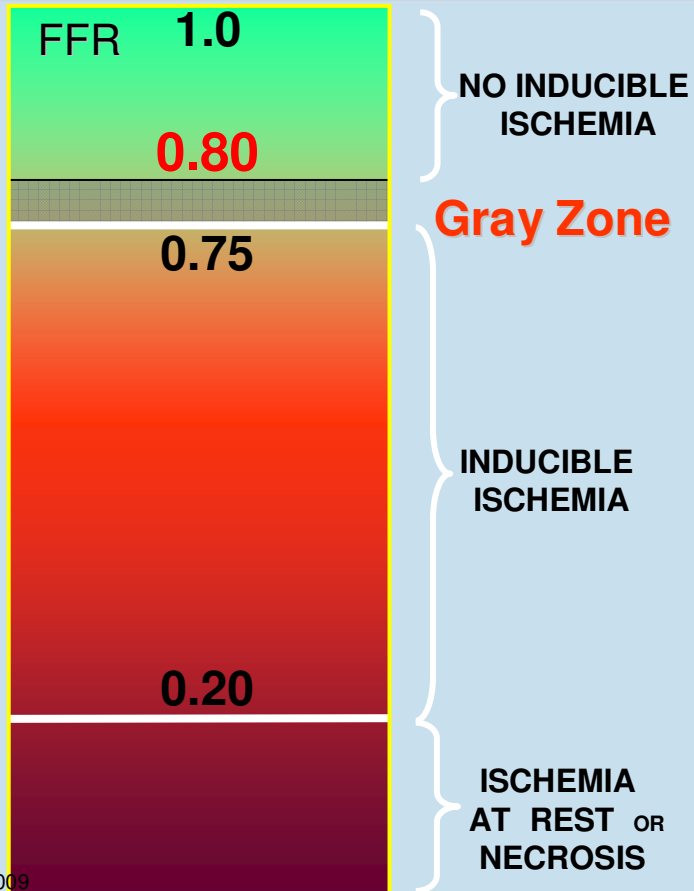
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Courtesy W. F. Fearon, MD  
LM Summit 2009

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# Fractional Flow Reserve



$$FFR = \frac{P_d}{P_a}$$

During Hyperemia

- Quick measurement
- Robust +++ and reproducible
- Independent from hemodynamics
- Stenosis Specific
- Unequivocal normal value = 1.0

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# Intermediate LM Stenoses: How Often Are They Hemodynamically Non-Significant?

FFR:  $> 0.75 - 0.80$

- Bech Heart 2001;86:547: 54 Pts: 40-60% DS
  - **44%** of Intermediate lesion: FFR  $> 0.75$ , deferred CABG
- Jasti JACC 2004;110:2831: 55 Pts: 49  $\pm$ 15% DS
  - **75%** of Intermediate lesions: FFR $>0.75$
- Curtis AJC 2009;103:943: 142 Pts: 42  $\pm$ 13% DS
  - **58%** of Intermediate lesions: FFR  $>0.80$
- Hamilos Circ 2009;120: 1505: 213 Pts: 30-70% DS
  - **65%** of Intermediate lesion: FFR $> 0.80$

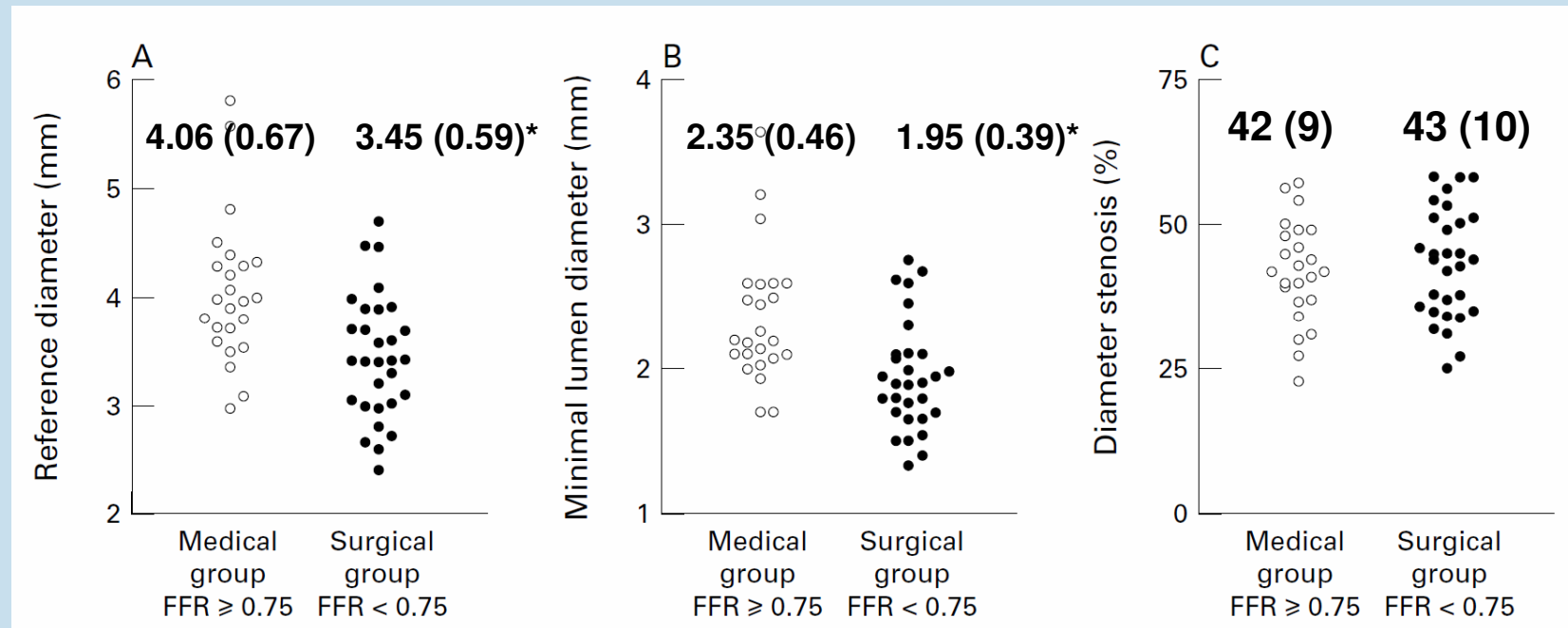
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# Intermediate LM Stenoses:

## 1. How Valuable is the FFR?

Bech: 54 Pts 40-60% DS:

24 (44%) FFR > 0.75: Med.-PCI vs. 30 FFR ≤ 0.75: CABG



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# Intermediate LM Stenoses:

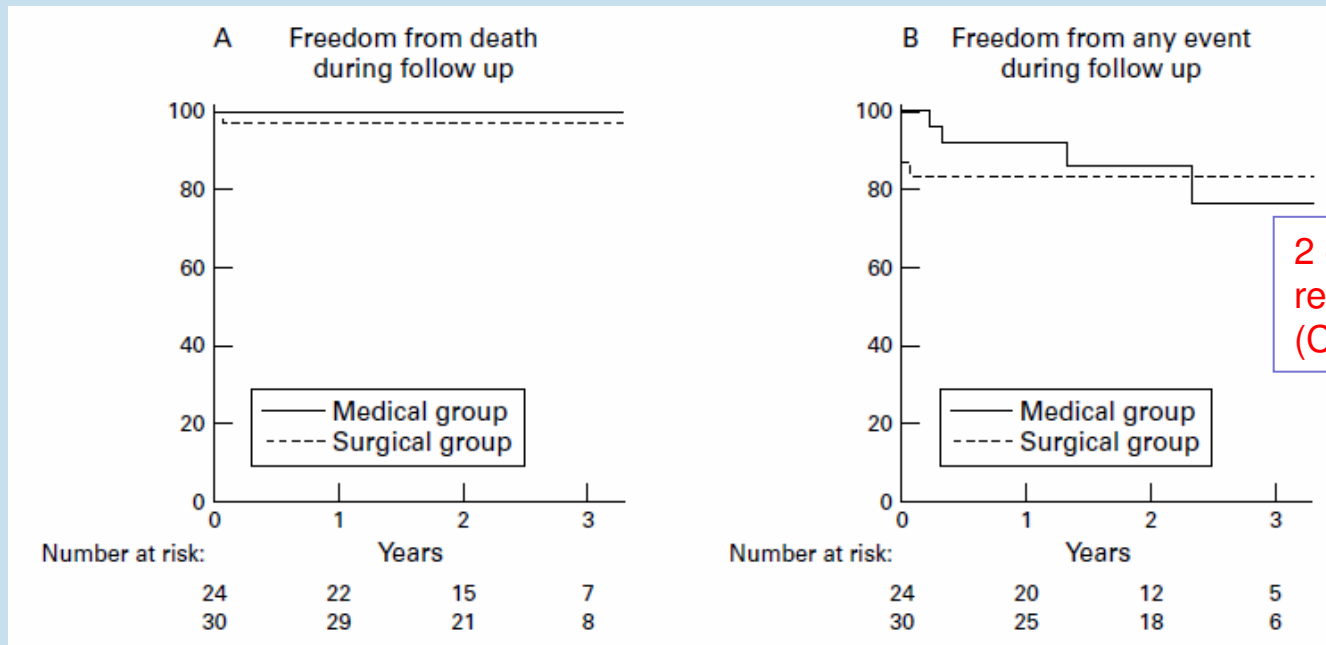
## 1. How Valuable is the FFR?

Bech: 54 Pts 40-60% DS: FFR > 0.75

FFR ≤ 0.75

3Y Event-Free: 76%

83%



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# Intermediate LM Stenoses:

## 1. How Valuable is the FFR?

Bech: 54 Pts 40-60% DS: FFR $>$ 0.75      FFR  $\leq$ 0.75

Limitations:

Very Small sample size, short F/U

Unknown event-rate for:

FFR $>$  0.75 with CABG or LM PCI

FFR $<$ 0.75 with Medical Tx. or LM PCI

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Bech Heart 2001:86:547

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# Intermediate LM Stenoses: 2.How Valuable is the FFR?

Jasti: 55 Pts: 49 ±15 %DS: 41 (75%) 14 (25%)

	FFR ≥0.75 (n=41)	FFR <0.75 (n=14)	P
QCA parameters			
Reference lumen diameter, mm	4.25±0.95	4.16±1.0	0.78
MLD, mm	2.32±0.86	1.70±0.83	0.015
Diameter stenosis, %	47±11	45±11	0.68
IVUS parameters			
MLD, mm	3.43±0.47	2.26±0.25	<0.001
Lumen CSA, mm <sup>2</sup>	9.29±2.76	4.0±9.6	<0.001
CSN, %	52±11	76±10	<0.001
AS, %	40±15	69±14	<0.001
Plaque and media CSA, mm <sup>2</sup>	10.14±3.14	13.84±2.84	<0.001
FFR	0.91±0.14	0.67±0.06	<0.001

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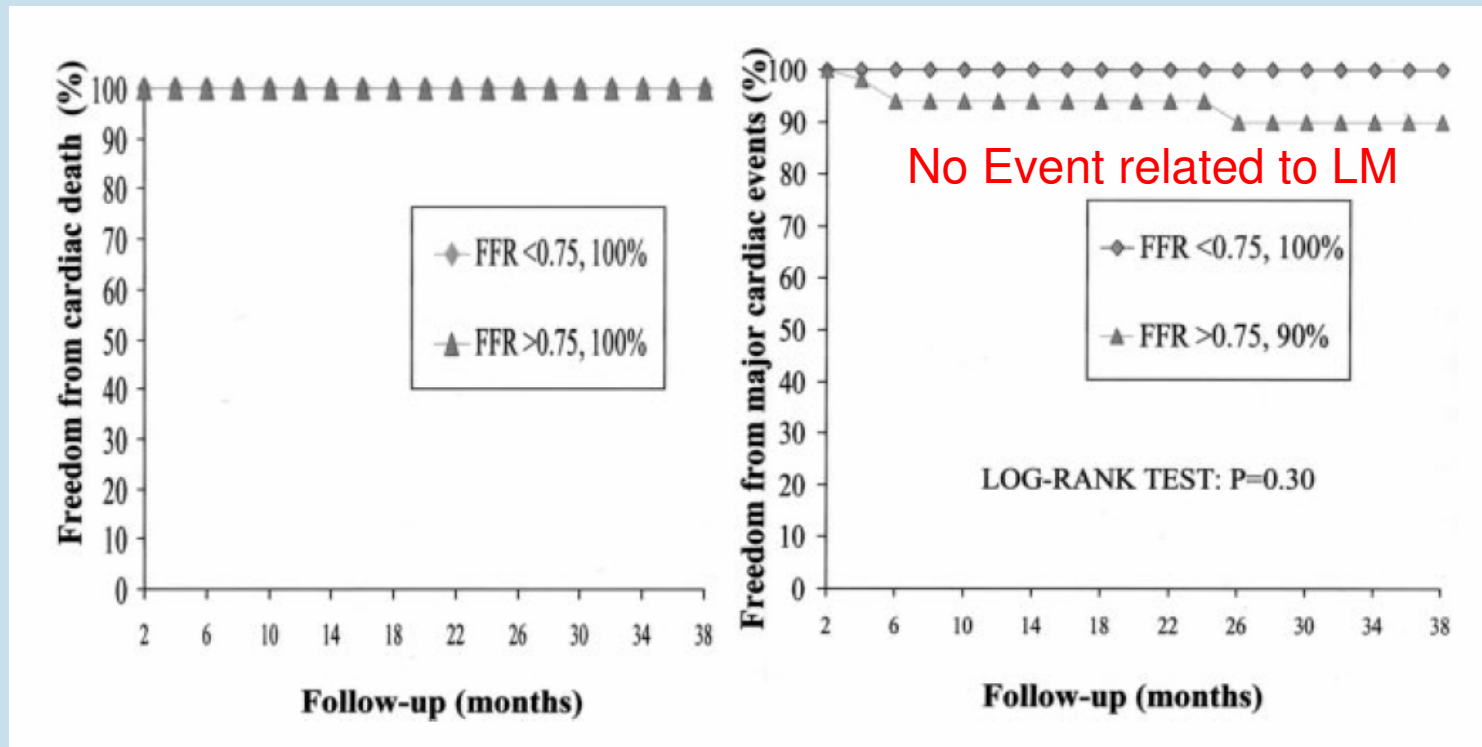


Jasti JACC 2004;110:2831

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# Intermediate LM Stenoses: 2.How Valuable is the FFR?

Jasti: 55 Pts:  $49 \pm 15$  %DS: Similar Limitations as Bech



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# Intermediate LM Stenoses: 3.How Valuable is the FFR?

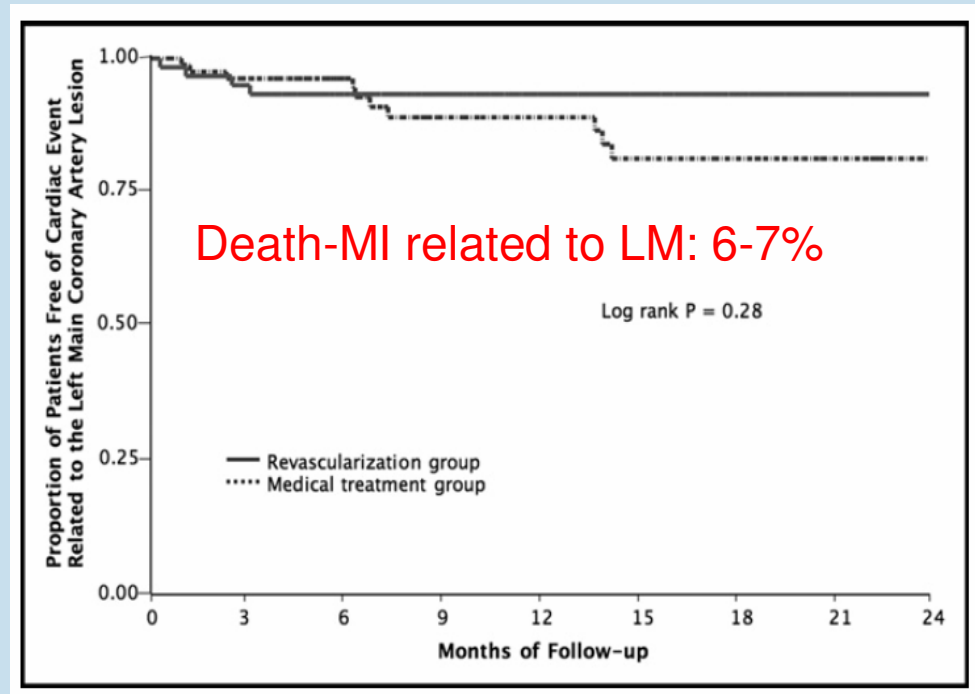
Courtis: 142 Pts: 42 ±13 %DS: IC Adenosine

58% Pts: FFR >0.80: Med. Tx vs. 42% Pts: FFR<0.75: CABG or PCI

Events in Med. Tx:

Low (<90ug) dose i.c. Adenosine  
(Sub-optimal hyperemia:  
falsely high FFR)

DM (Disease progression,  
or microvascular disease):  
Higher cut-off of FFR



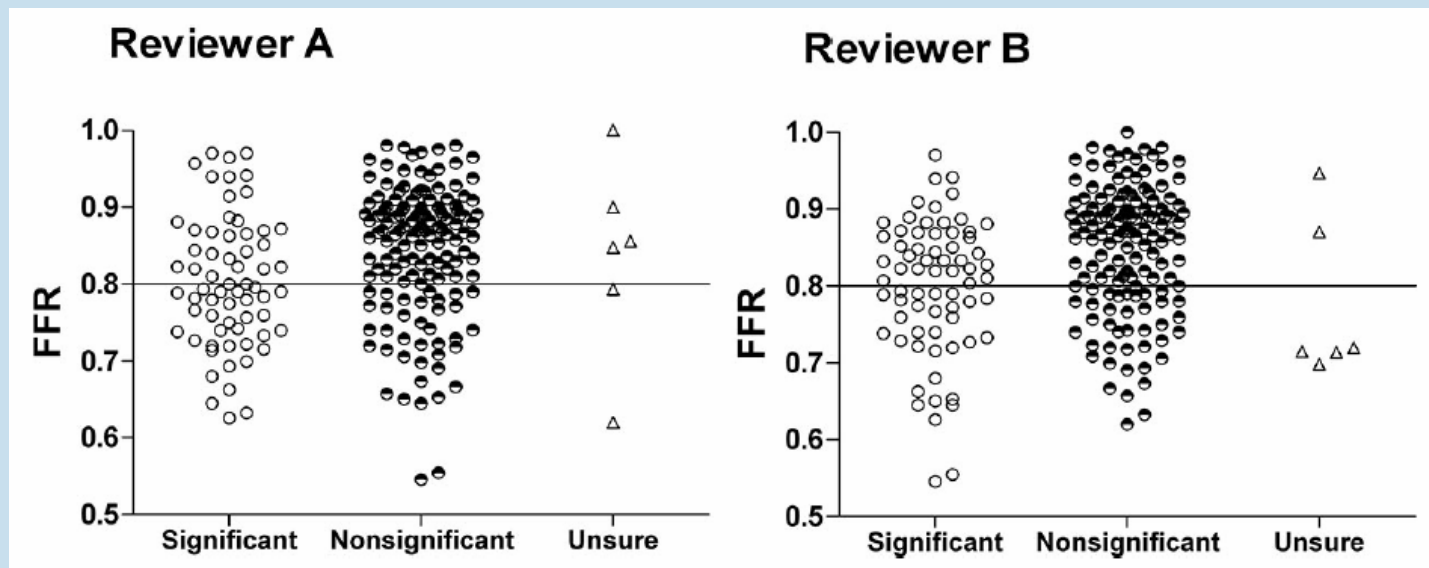
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# Intermediate LM Stenoses: 4.How Valuable is the FFR?

Hamilos Circ 2009;120: 1505: 213 Pts: 30-70% DS

65% Pts: FFR >0.80: Med. Tx vs. 35% Pts FFR < 0.80: CABG

Inter-observer variability: 48%



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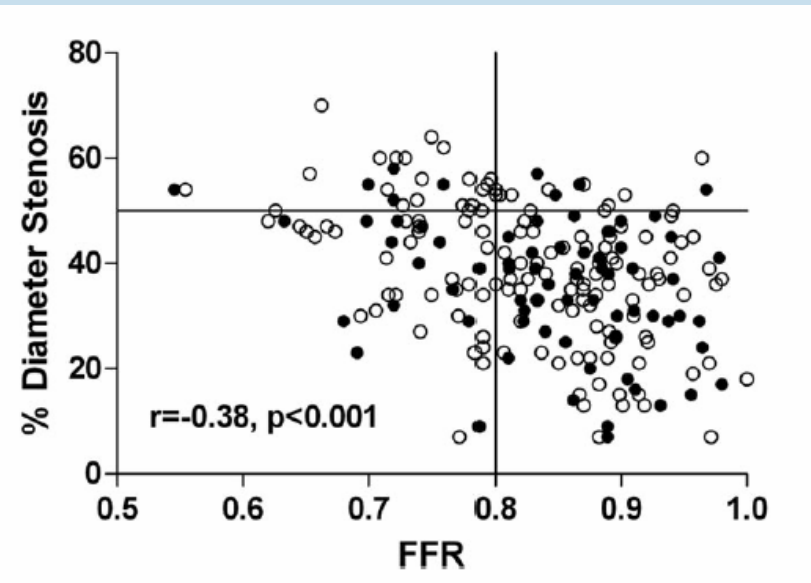
# Intermediate LM Stenoses: 4.How Valuable is the FFR?

Hamilos Circ 2009;120: 1505: 213 Pts: 30-70% DS

65% Pts: FFR >0.80: Med. Tx vs. 35% Pts FFR < 0.80: CABG  
% DS: 44 ±13 vs. 35 ±12 p < 0.001

29% of Pts misclassified by QCA:

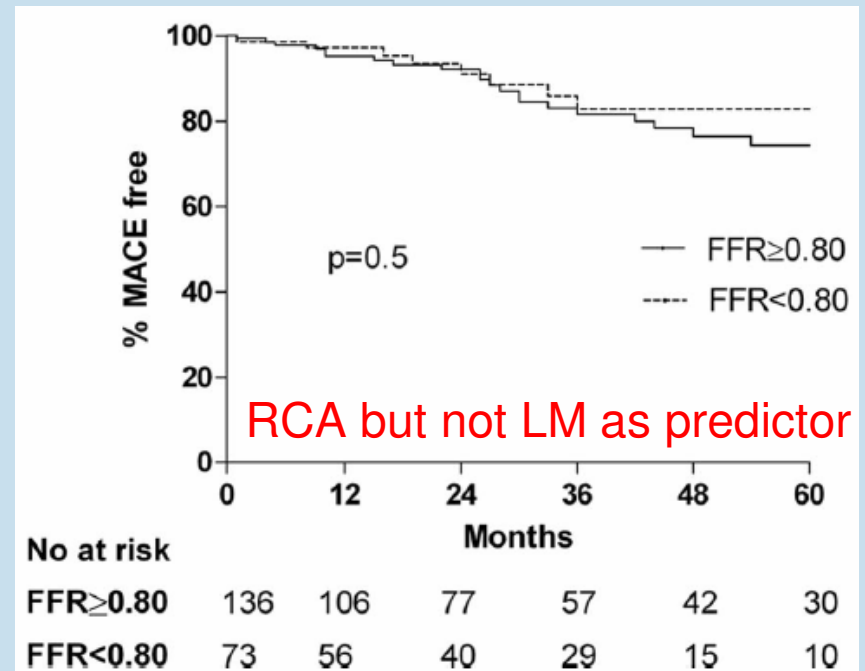
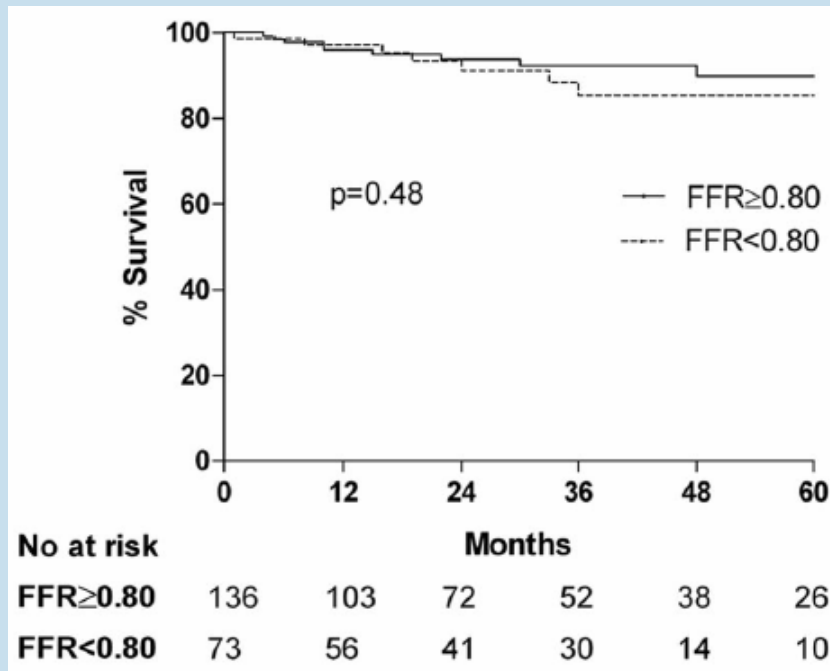
6% DS >50% but FFR >0.80  
23% DS <50% but FFR <0.80



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# Intermediate LM Stenoses: 4.How Valuable is the FFR?

Hamilos Circ 2009;120: 1505: 213 Pts: 5Y F/U



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# Fractional Flow Reserve

## FFR Never Lies, but there are Pitfalls:

- Falsely Elevated FFR:
  - IC Adenosine, Caffeine : IV adenosine
  - Wedged-Engaged Guiding catheter ( $P_a$  ventricularization and/or decreased hyperemia)
  - Acute phase of ACS: temporary microvascular “paralysis”
- Electronic drift: ALWAYS finish the FFR by a measurement in the guiding catheter

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Kern Circ 2006;114:1321  
Koolen CCI 2008:72: 248

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# Fractional Flow Reserve

FFR Never Lies, but there are Pitfalls:

- Falsely Reduced FFR:
  - FFR wire induced spasm (i.c. nitro)
  - FFR wire induced plicature or “accordion” effect
- Electronic drift: ALWAYS finish the FFR by a measurement in the guiding catheter

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Kern Circ 2006;114:1321  
Koolen CCI 2008;72: 248

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# Fractional Flow Reserve

FFR Never Lies, but there are Limitations:

- Significant LAD and/or LCX disease:
  - FFR in the “N” vessel
  - If both, and LM “PCI-able”, PCI of LAD and LCX and retest for the LM after, otherwise CABG
- Hemodynamic instability
- Does not evaluate coronary spasm

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Kern Circ 2006;114:1321  
Koolen CCI 2008:72: 248

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# So...

Unless there is isolated LM disease + unequivocal clear non-invasive evidence of ischemia,

Because QCA is unreliable,

And

Because FFR (and possibly IVUS) is correlated and predictive of cardiac event rates,

The use of FFR to assess the significance of intermediate LM stenoses (and other vessel stenoses) is highly recommended

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## Or In Conclusion...

FFR Is a Must for Intermediate LM Lesions, to insure that the right diagnosis is made and the right decision is taken for each patient!

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