

# New Indications for CTO Recanalization

*Barry D. Rutherford, MD*



# The Efficacy & Safety of the “Hybrid” Approach to CTO: Insights from a Contemporary Multicenter Registry and Comparison with Prior Studies

- January 2012-August 2013; 497 pts at 5 high-volume centers compared to prior studies of  $\geq 100$  CTO pts (18,536 pts)

	Hybrid Approach N=497	Std Approach N=18,536	P-value
Technical Success	91.5%	76.5%	<0.001
Procedural Success	90.7%	75.2%	<0.001
Death	0.4%	0.4%	0.96
MACE	1.8%	2.0%	0.72
Q-wave MI	1.0%	0.6%	0.28
CVA	0%	0.1%	0.45
Perforation per lesion	3.2%	2.7%	0.49
Tamponade	0.4%	0.5%	0.76
Bleeding	0.6%	0.7%	0.72

# **The Efficacy & Safety of the “Hybrid” Approach to CTO:** *Insights from a Contemporary Multicenter Registry and Comparison with Prior Studies*

## **Conclusions:**

- **Efficacy of CTO-PCI has significantly improved**
- **Experienced operators across various hospitals**
- **High success rates achieved without incurring increased rates of complications**

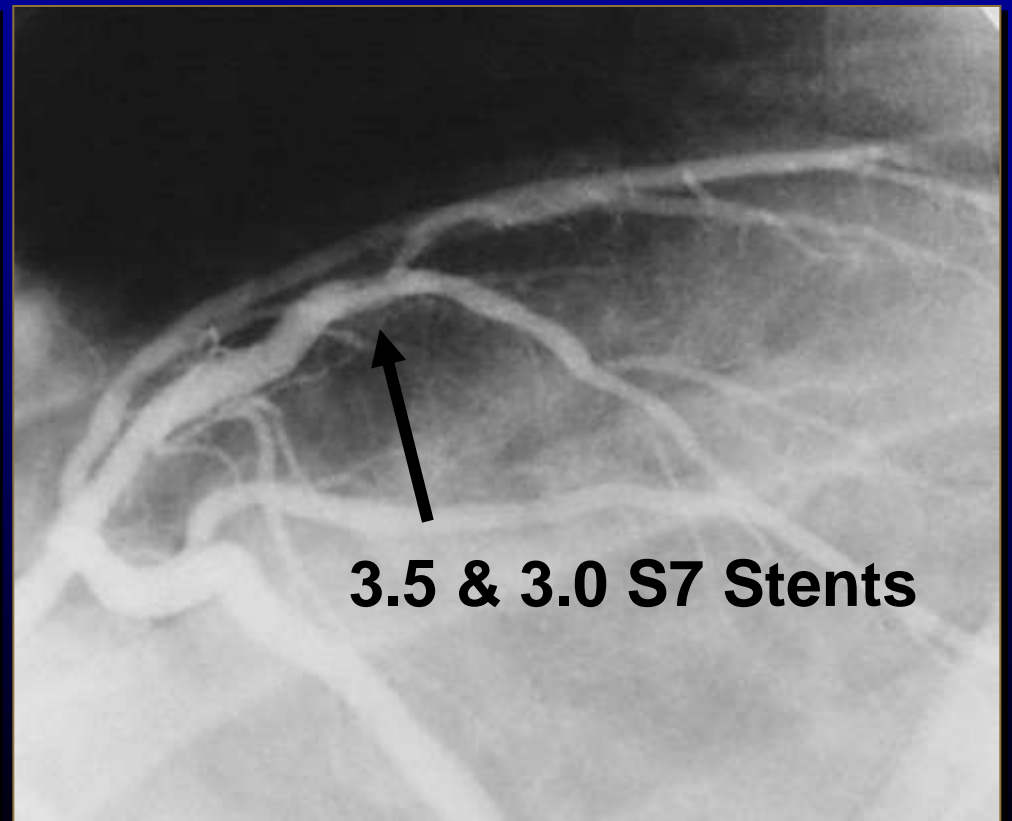
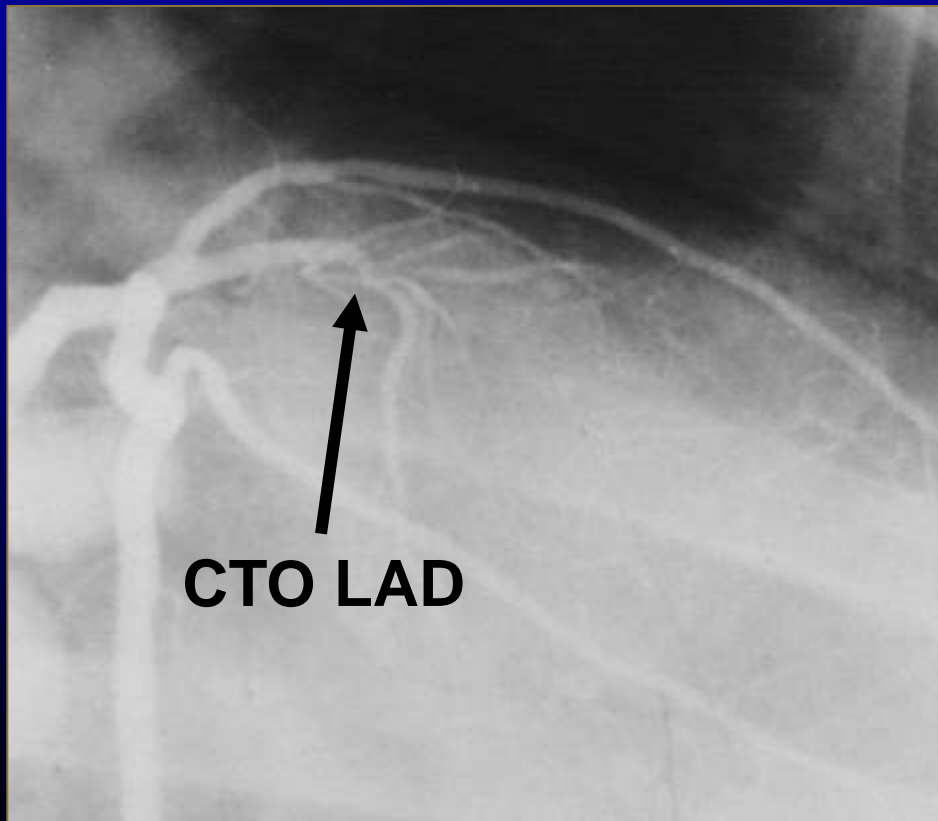
# **New Indications for CTO Recanalization**

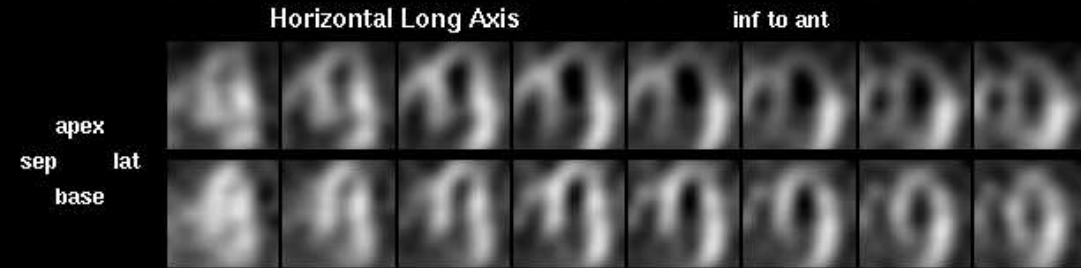
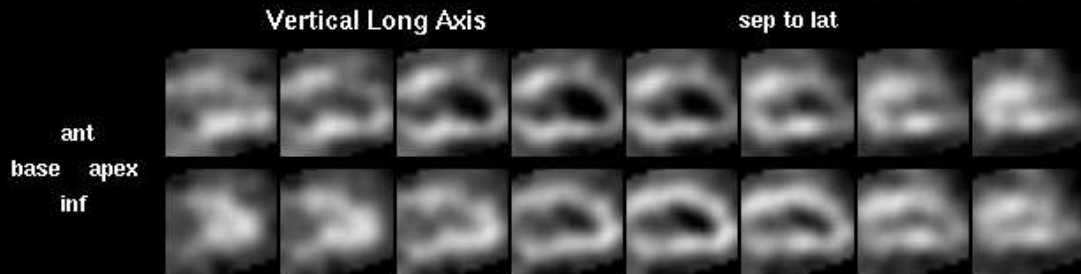
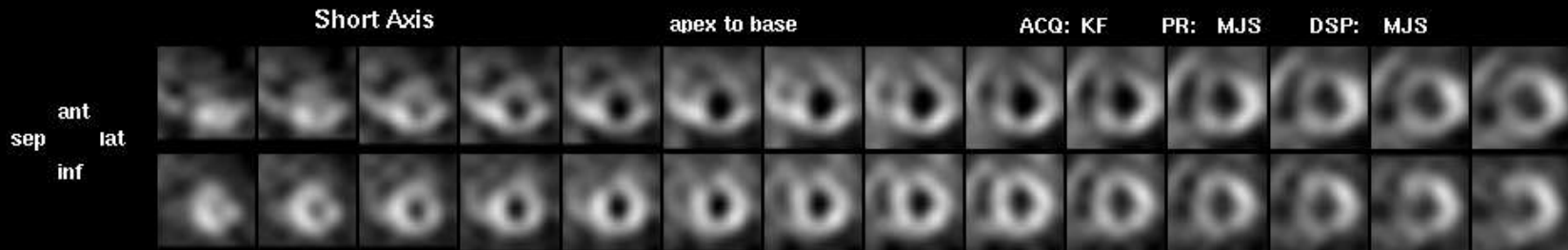
## ***Indications:***

- **Asymptomatic or mild symptoms in a patient with  $\geq 10-12\%$  ischemia in the distribution of CTO**
- **Post-STEMI patient with CTO of non-IRA**
- **Pre-renal transplant patient**
- **Pre-cardiac transplant patient**
- **Pre-ICD assessment**
- **Surgical turndowns**

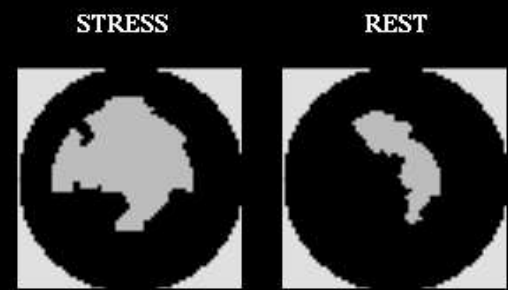
# Assess Degree of Ischemia in CTO Territory

*J.S. 48-Year-Old Male  
6-Month Post Anterior MI; June 2000*





PERFUSION



63	LAD%	23
0	RCA%	0
0	LCX%	0
38	TOTAL%	15

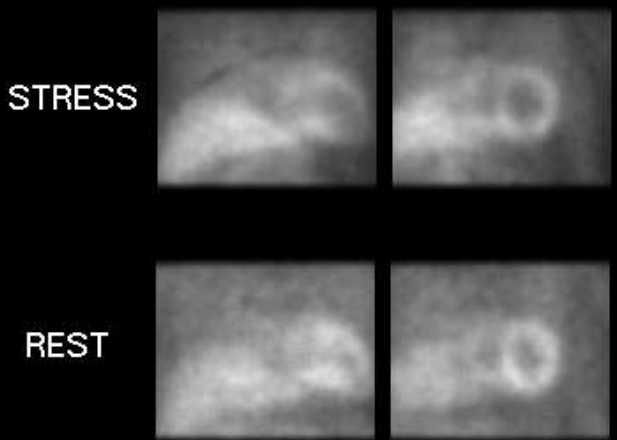
MOCO/TID= 1.13

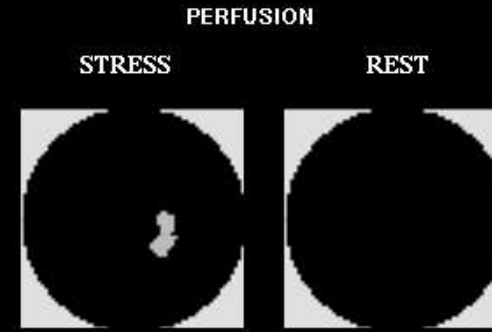
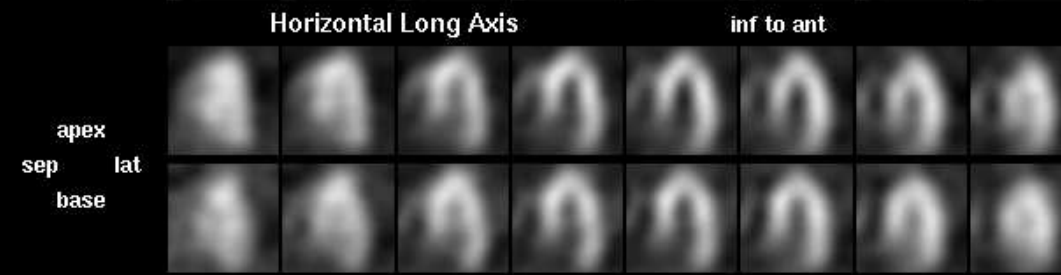
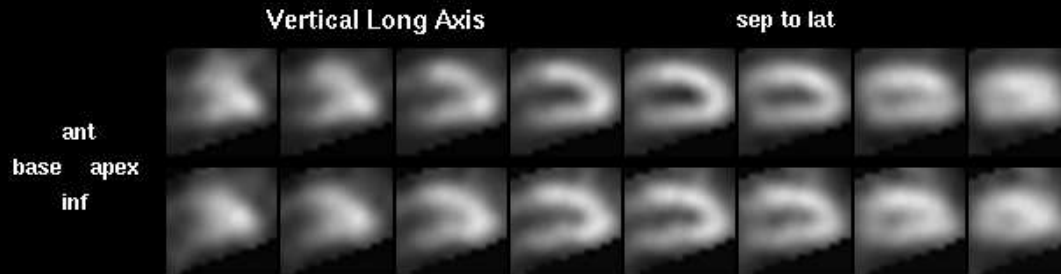
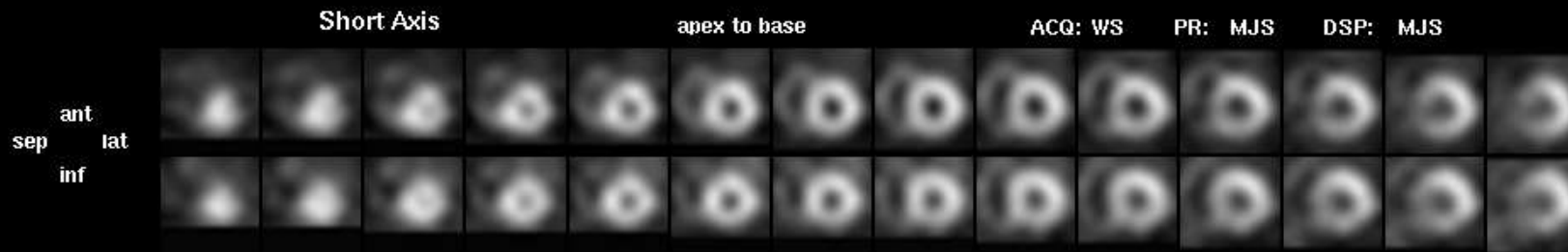
FUNCTION

0.60 LUNG/HEART RATIO

**LVEF 32%**

**20 Jun 00 JS**





0	LAD%	0
0	RCA%	0
0	LCX%	0
3	TOTAL%	0

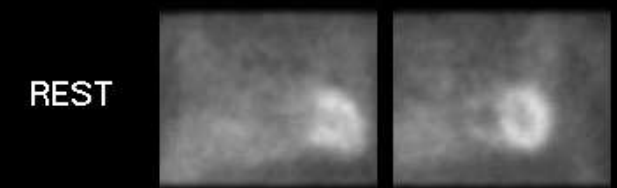
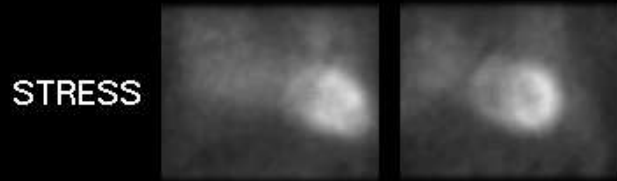
MOCO TID= 1.01

FUNCTION

0.50 LUNG/HEART RATIO

**LVEF 52%**

**30 Aug 01 JS**



# 67-Year-Old Attorney, Type 2 Diabetes *History*

**07/2008: MPI stress test:** localized region of ischemia, inferiorly, inferoseptally and inferolaterally; post stress EF 63%; achieved 8 METS of activity; there were no high risk prognostic markers.

Agatston Score 1328

No active symptoms, however pt. led a very sedentary existence

**10/2010:** Patient denies chest pain, shortness of breath, palpitations or pre-syncope, but still has very sedentary lifestyle

**Risk Factors:** Type 2 diabetes with complicating retinopathy, cataracts, peripheral neuropathy and renal insufficiency, Dyslipidemia, former tobacco abuse



# **67-Year-Old Attorney, Type 2 Diabetes**

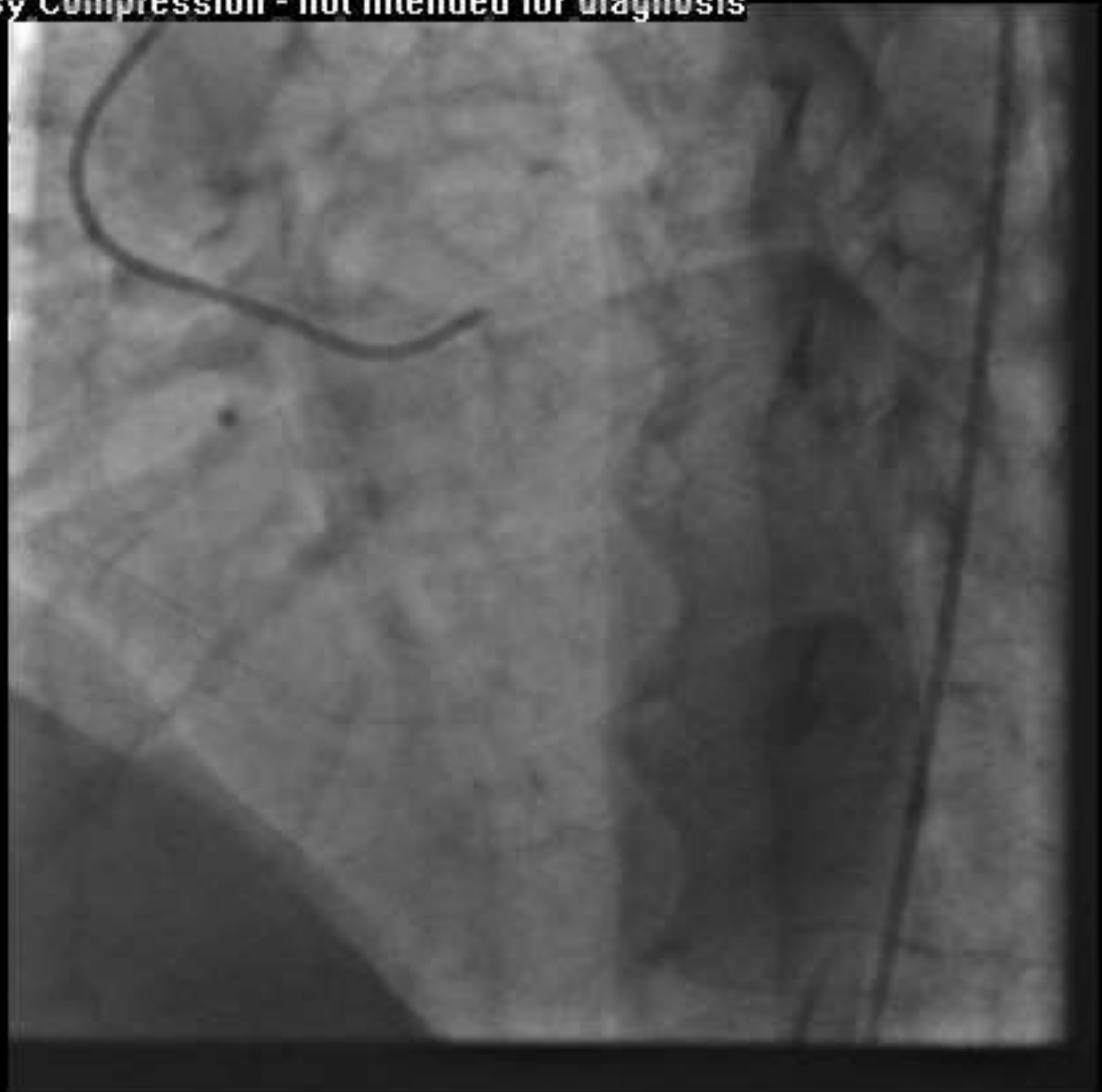
## ***History***

**10/28/10: PET CT:** Large area of intense ischemia, inferiorly, inferoseptally and inferolaterally; 11% of LV mass was ischemic, 9% infarcted  
Post stress EF fell to 49% with akinesis developing throughout the inferior, inferoseptal and inferolateral walls with transient dilatation of the LV  
The ischemic burden and LV decompensation are significantly worse compared to the study of 2008

**67-Year-Old  
Attorney,  
Type 2  
Diabetes**

**Diagnostic  
Angiogram  
11-17-10**

**Stenting of  
LAD and  
LCX-OM**



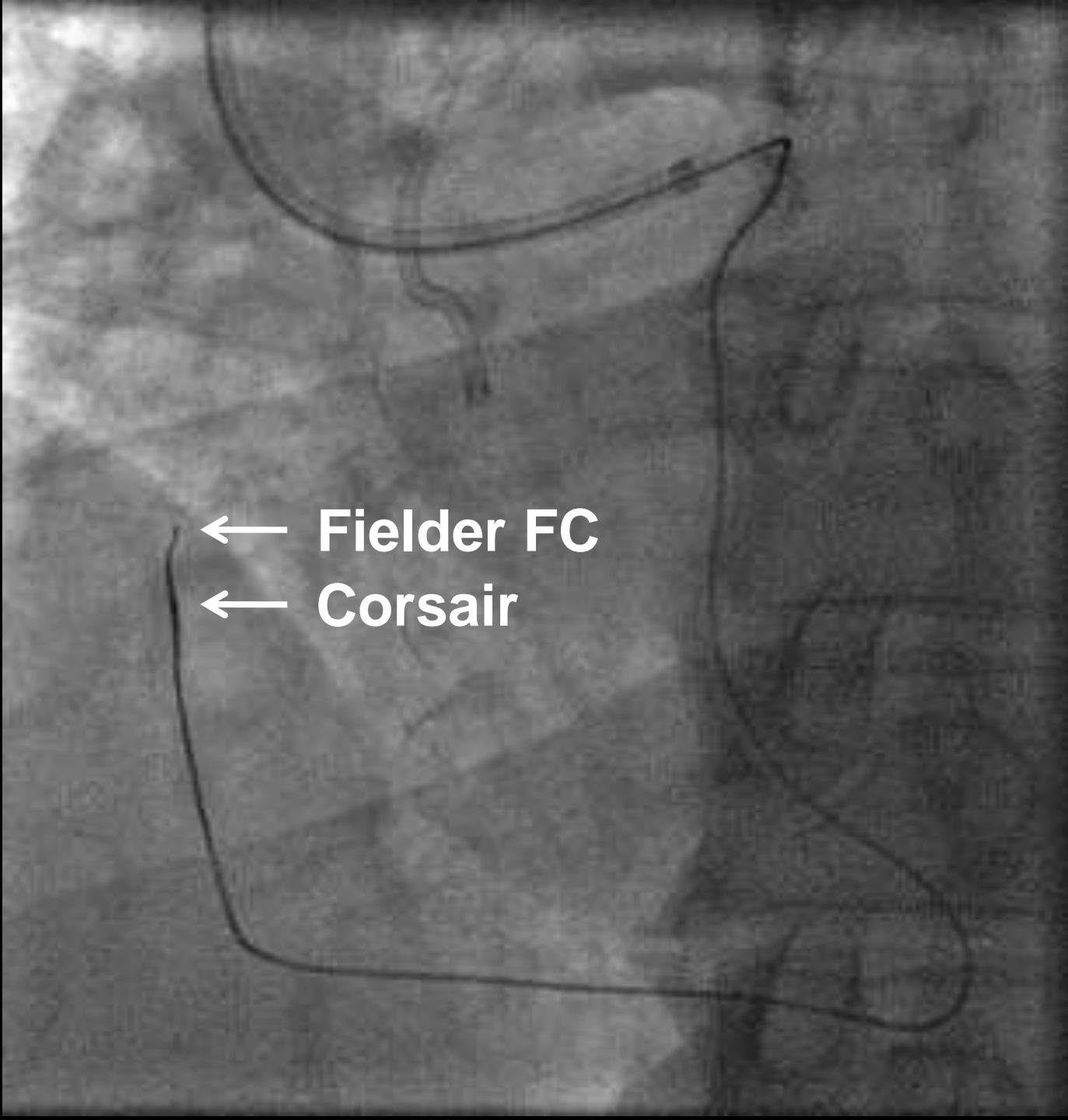


**67-Year-Old  
Attorney,  
Type 2  
Diabetes**

**Stenting of  
RCA CTO  
12-8-10**

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Type 2  
Diabetes**

**Stenting of  
RCA CTO  
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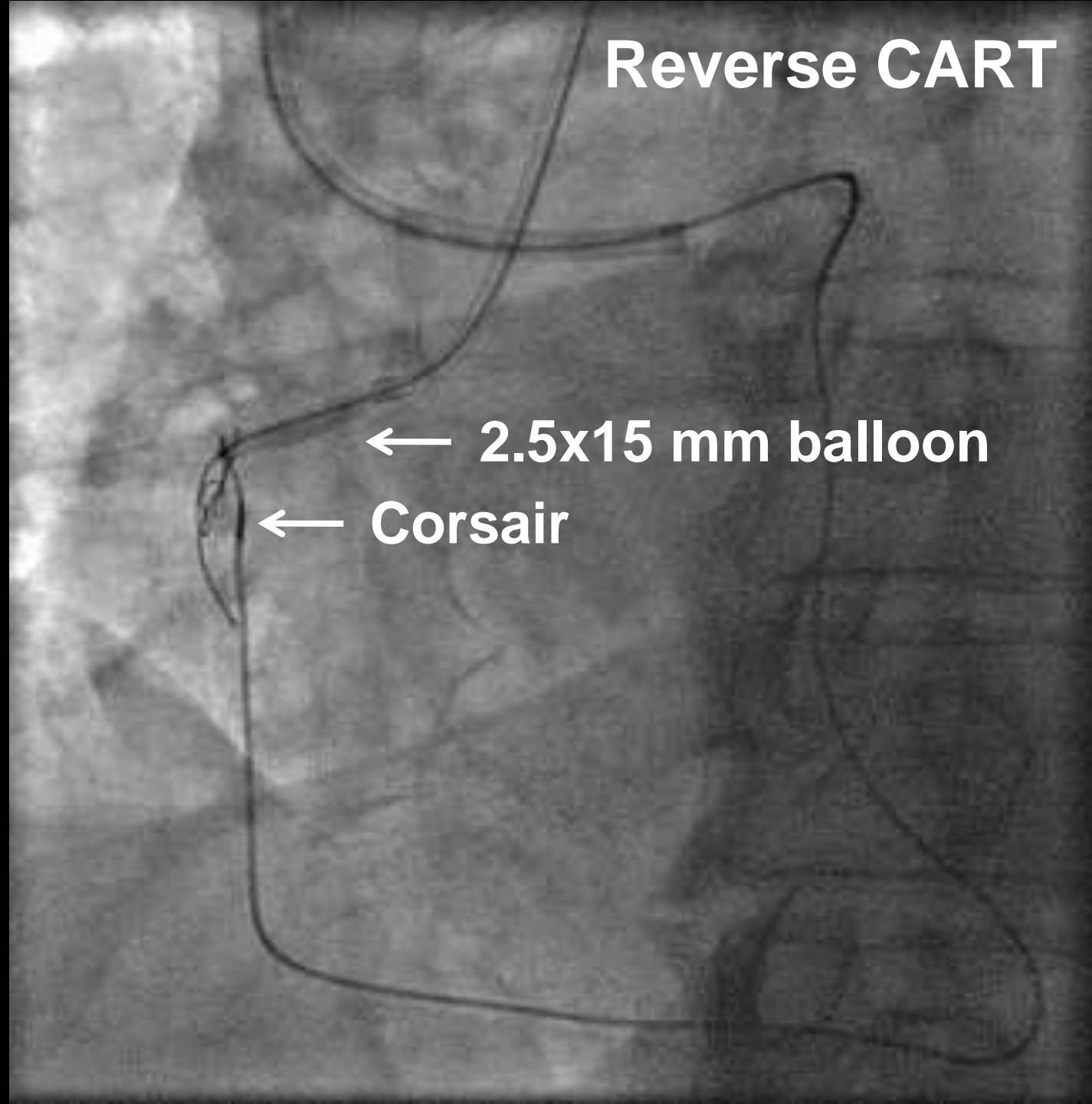


← Fielder FC  
← Corsair

Reverse CART

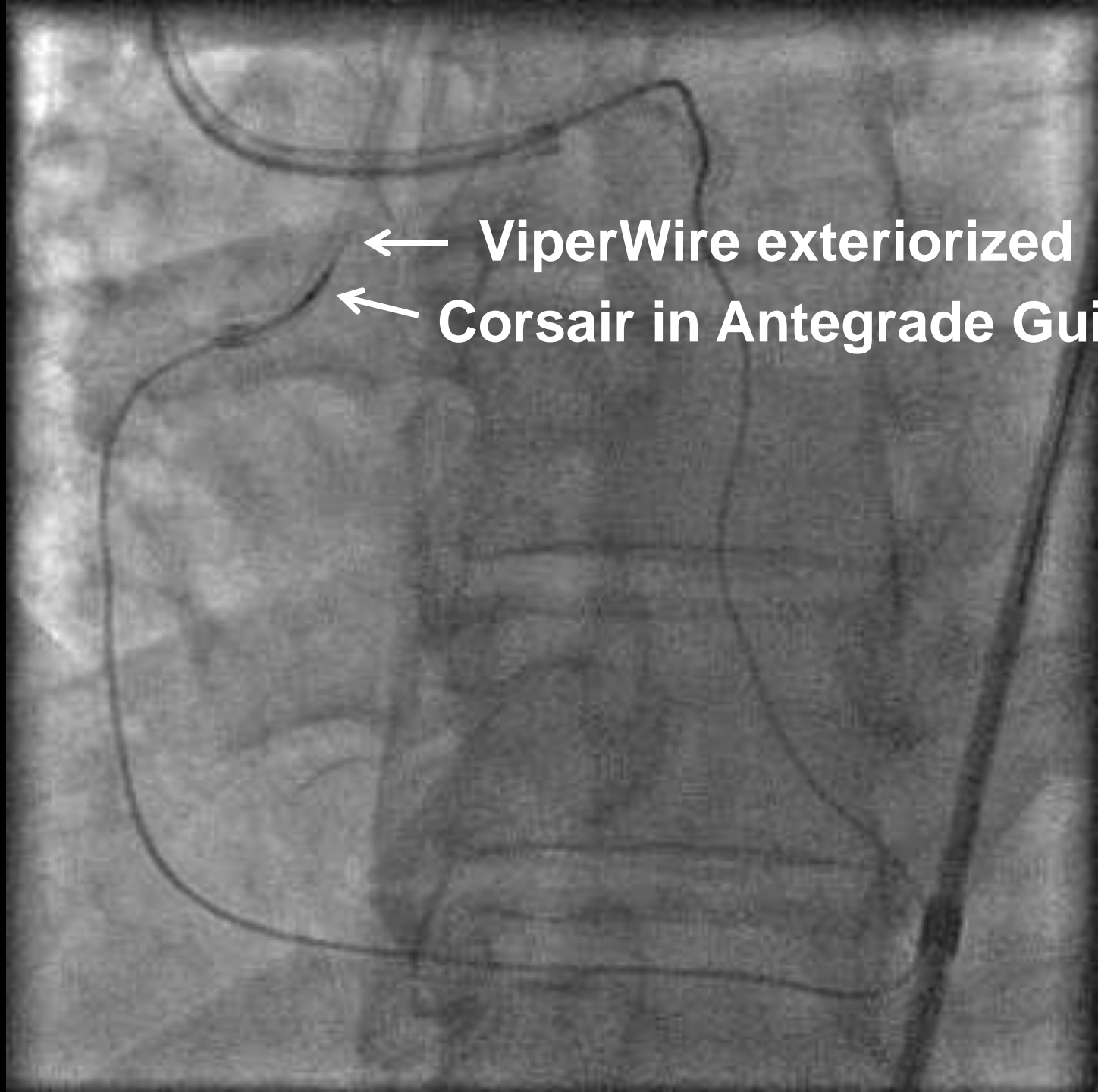
**67-Year-Old  
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**Stenting of  
RCA CTO  
12-8-10**



**67-Year-Old  
Attorney,  
Type 2  
Diabetes**

**Stenting of  
RCA CTO  
12-8-10**



← ViperWire exteriorized  
← Corsair in Antegrade Guide

Lossy Compression - not intended for diagnosis



**67-Year-Old  
Attorney,  
Type 2  
Diabetes**

**Stenting of  
RCA CTO  
12-8-10**

# **67-Year-Old Attorney, Type 2 Diabetes**

## ***Follow-up: 14 Months***

- November 2011** **Coronary SPECT:** No significant residual ischemia; normal global and regional LV systolic function; Post stress EF >75%; achieved 10.4 METS. No LV dilatation post stress.  
Patient now exercising 1-2 hours per day;  
Weight decreased 25 lbs. No chest pain, shortness of breath or other cardiac symptoms
- July 2014** 3.5 years of follow-up  
Looks years younger  
Asymptomatic  
Normal SPECT scan



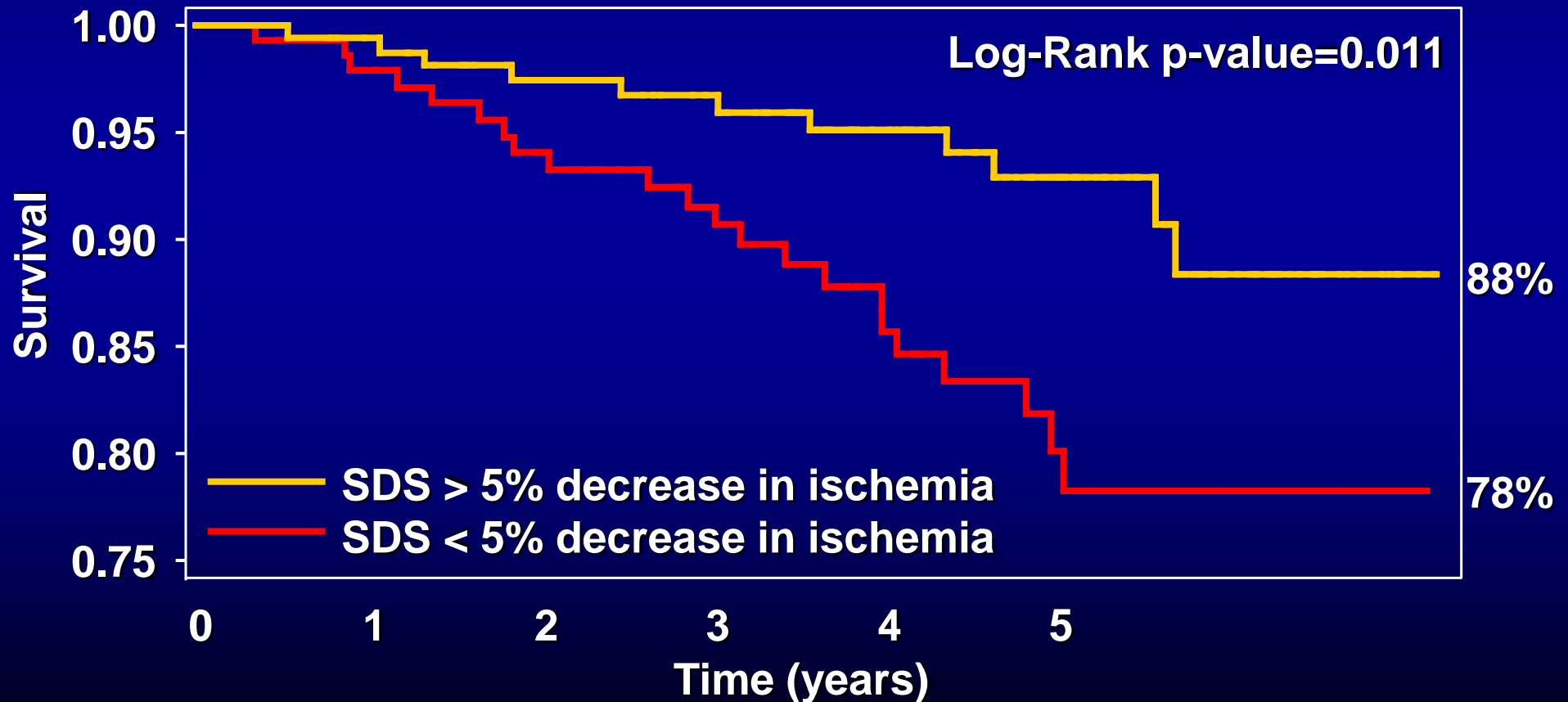
# Changes in Myocardial Ischemic Burden Following PCI in CTO

**MAHI PCI Registry – CTO PCI Pts Cross-linked with MPI Database**  
**301 Pts Included with MPI before & after CTO attempt (12 mths)**

	MPI Before n = 301	MPI After n = 301	p- value
Summed Difference Score (SDS)	10.5 ± 9.5	5.5 ± 5.1	<0.001
% Myocardium Ischemic	13.1 ± 11.9	6.9 ± 6.4	<0.001
LVEF	56.6 ± 15.0	57.5 ± 17.2	NS
LAD SDS	4.0 ± 5.0	2.1 ± 2.9	<0.001
LCX SDS	2.9 ± 3.5	1.7 ± 2.5	<0.001
RCA SDS	3.6 ± 4.3	1.7 ± 2.3	<0.001

# Changes in Myocardial Ischemic Burden Following PCI in CTO

*MAHI PCI Registry – CTO PCI Pts Cross-linked with MPI Database*  
*301 Pts Included with MPI before & after CTO attempt (12 mths)*



# Changes in Myocardial Ischemic Burden Following PCI in CTO

*MAHI PCI Registry – CTO PCI Pts Cross-linked with MPI Database  
301 Pts Included with MPI before & after CTO attempt (12 mths)*

## *Receiver Operating Characteristic (ROC) Curves*

- Initial ischemic burden of **12.5%** was identified as the optimal threshold to predict a  $\geq 5\%$  decrease in ischemia (80% sensitivity, 80% specificity)
- Initial ischemic burden of  **$\leq 6.25\%$**  was identified as the optimal cutoff associated with an increase of  $\geq 5\%$  in ischemia

# **New Indications for CTO Recanalization & Long Term Benefits**

## ***Evaluation of LV Function***

***Pre renal transplantation***

***Pre cardiac transplantation***

***Pre ICD evaluation***

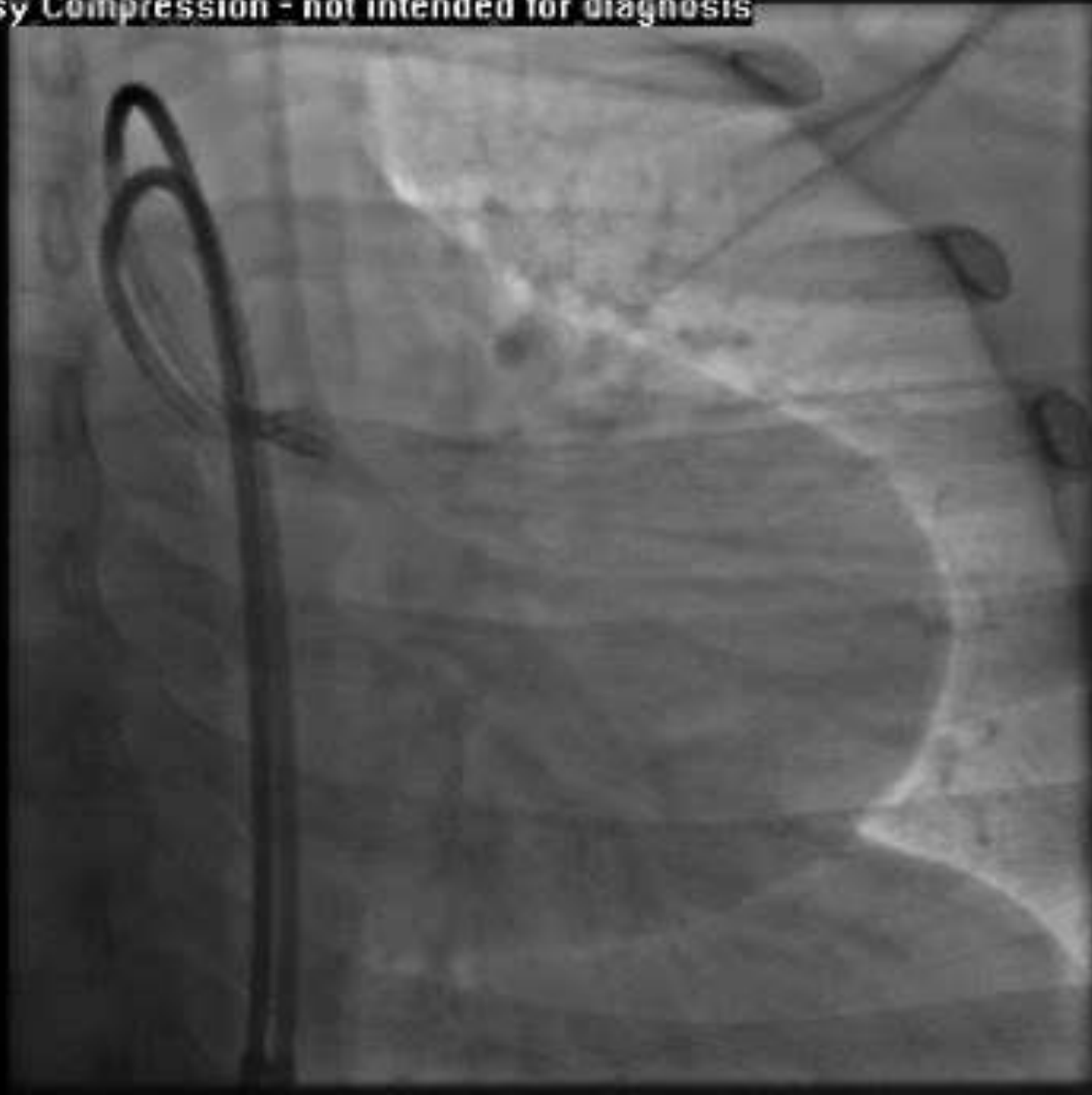
***Surgical turndown***

# **CTO PCI Prior to Renal Transplantation**

- **22 year old female with IGA nephropathy and end-stage renal disease on peritoneal dialysis since 2013**
- **Potential renal transplantation, not currently a candidate secondary to cardiomyopathy**
- **LVEF 37%, Calcium score 0**
- **CTA of the coronaries showed a patent left main and LAD, but the circumflex and right coronaries were not well visualized**
- **Cardiomyopathy was thought to be non-ischemic**
- **Episode of ventricular tachycardia during hemodialysis catheter placement in 2013**
- **No initial recommendation for coronary angiogram**

**22-Year-  
Old  
Female**

**Lossy Compression - not intended for diagnosis**



## 50-Year-Old Male

### *CTO of RCA and Functional CTO of LAD*

<b>History:</b>	<b>Oct 2011:</b> Presented to local hospital with dyspnea, chest pain, pulmonary congestion, edema, BNP 600, Creatinine 1.7
<b>Risk Factors:</b>	Hypertension; Diabetes – 20 yrs, Renal Insufficiency; Heavy cigarette intake – 2 pk/day for 30+ yrs
<b>Exam:</b>	6'1", 163 lbs, BP 160/90, S3 and S4 gallop, bilateral rales
<b>Meds:</b>	ASA 325 qd, Ibuprofen 200 mg 4X qd, Lisinopril 10 mg qd; Furosemide 40 mg qd; Metformin HCl 500 mg bid
<b>EKG:</b>	NSR, LVH, anterior repolarization abnormality
<b>Cardiac MR</b>	LVEF 20%, Basal-to-mid lateral akinesis and basal-to-mid anterior/anteroseptal akinesis <b>Viability:</b> Anterolateral/inferolateral subendocardial infarct (<25%) Anteroseptal/subendocardial infarct (<25%) All walls are <u>viable</u> .
<b>Cor. Angio:</b>	11-10-2011

Lossy Compression - not intended for diagnosis

**50-Year-  
Old Male**

**11-10-11**

**CTO of  
RCA and  
Functional  
CTO of  
LAD**





**50-Year-Old Male**  
**CTO of RCA and Functional CTO of LAD**

***Surgical Opinion:***

***“graftable acute marginal branch...  
...unlikely that we would be very gratified with grafts to the LAD  
or distal RCA. Furthermore, in conjunction with his severe LV  
dysfunction and fairly diseased vessels, it is unlikely that he  
would have significant myocardial recovery...”***

***“...may benefit from high risk stenting to the LMCA to improve  
flow the LCX marginal branch”***

***“...consider evaluation for cardiac transplantation”***

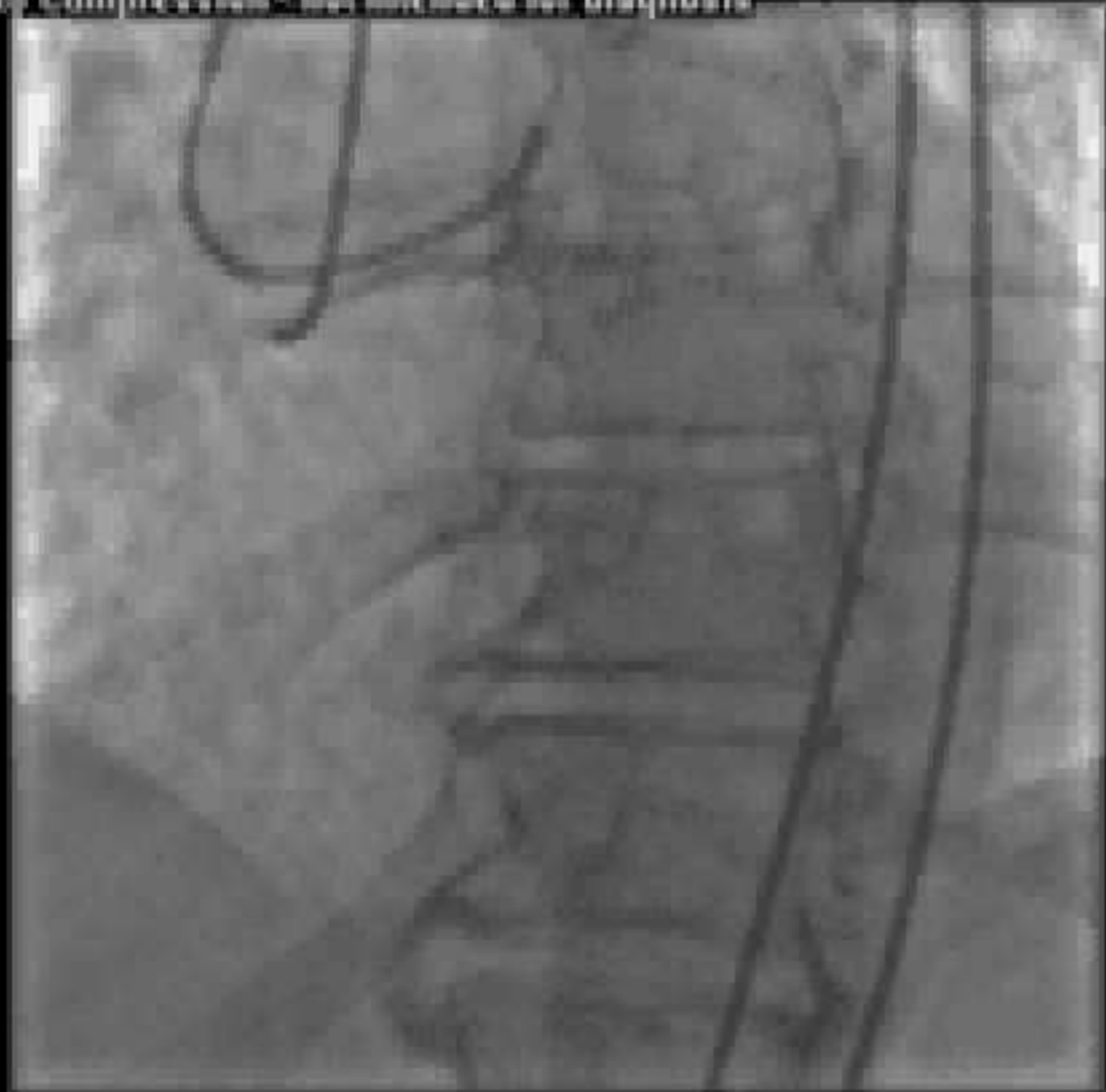
**SURGICAL TURNDOWN**

**50-Year-  
Old Male**

**12-13-11**

**CTO of  
RCA and  
Functional  
CTO of  
LAD**

**Surgical  
Turndown  
LVEF 20%**



**50-Year-  
Old Male**

**1-26-12**

**CTO of  
RCA and  
Functional  
CTO of  
LAD**

**Surgical  
Turndown  
LVEF 20%**



## **50-Year-Old Male**

### ***CTO of RCA and Functional CTO of LAD***

**June 2012** LVEF 35%  
ICD placed

**December 2012** LVEF 49%  
Patient stable but persisting CRF

**July 2014** Stable, continuing problems with CRF

**February 2015** 4-years post PCI, stable EF 45%

# **New Indications for CTO Recanalization**

## ***Conclusions***

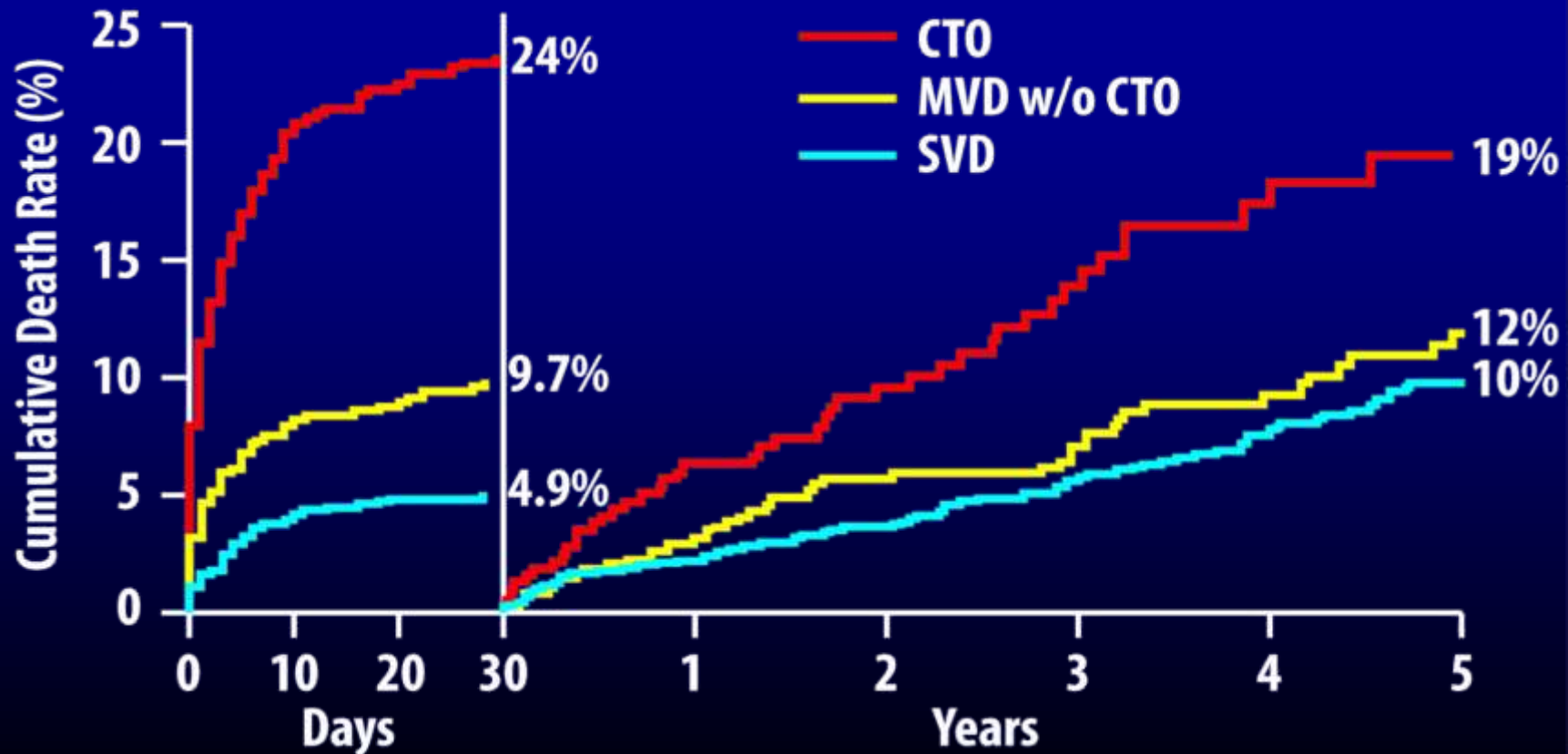
- **Evaluation of the degree of ischemia in CTO territory is essential for predicting long term results**
- **Consider all post-STEMI patients with a CTO of a non-IRA for revascularization**
- **Re-evaluation of the coronary anatomy in pts being evaluated for cardiac or renal transplantation, ICD placement, or are surgical turndowns. Goal of complete revascularization with PCI to improve LV function and thus long term survival**

# Evaluation of the Effect of a Concurrent CTO on Long-Term Mortality and LVEF in Pts After Primary PCI in AMI

3277 STEMI pts 1997-05. SVD 65%, MVD 23%, MVD + CTO 13%

**Endpoint:** Survival at 5 yrs, LVEF at 12 mths (median F/U 3.1 yrs)

## Landmark Survival Analysis

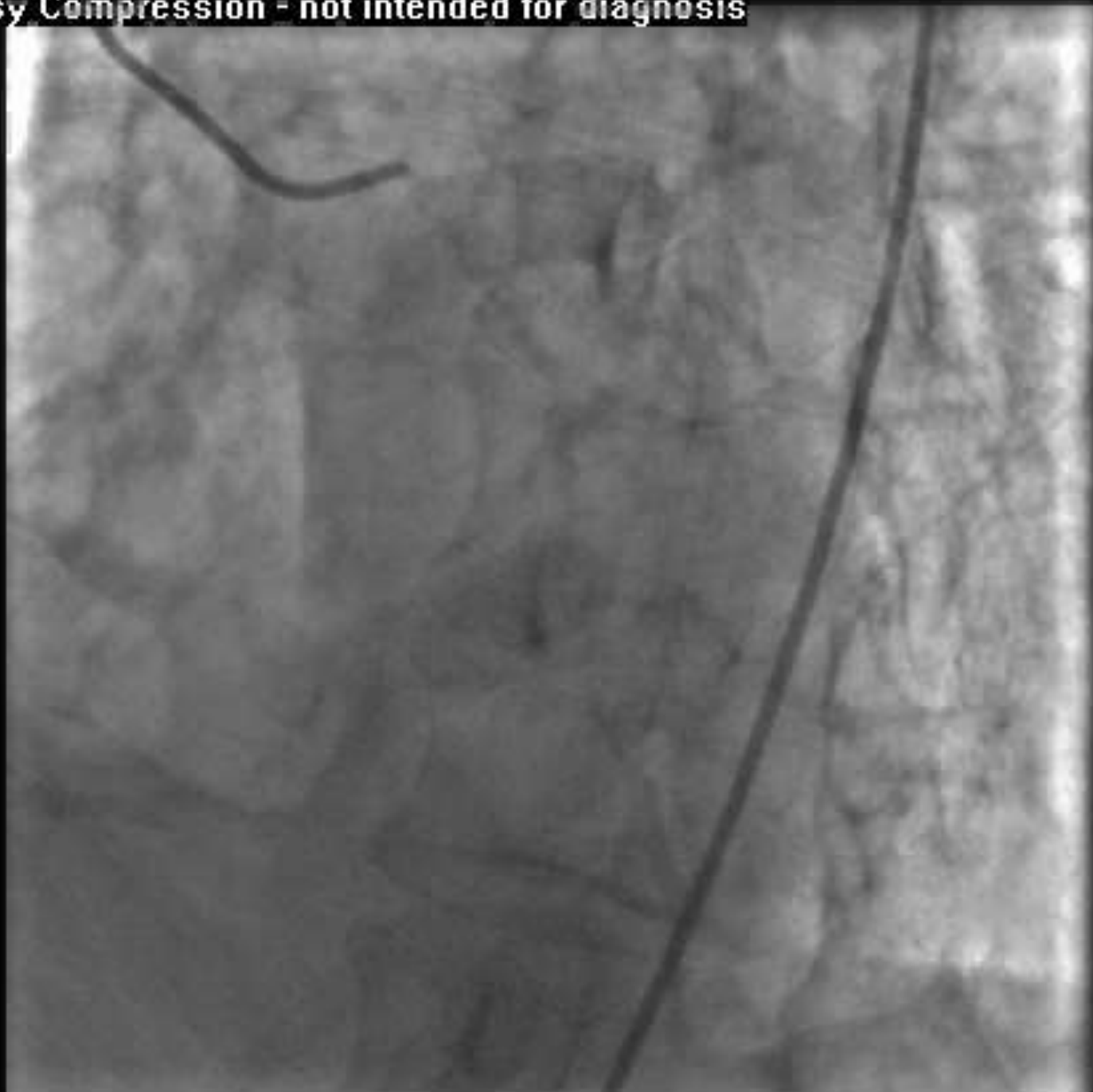


# 64-Year-Old Male Farmer: 6/4/14

- Patient unloading a tractor from truck. Tractor rolled over patient causing multiple rib fractures and a traumatic hemothorax requiring a chest tube with return of 1500 cc of sanguinous fluid.
- Severe facial trauma with fracture of the orbit, maxilla and multiple mandible fractures, fracture of temporal bone, sternum and fractured nasal bones
- No previous history of coronary artery disease, however, troponin level was 11.0; EKG repolarization changes with no major ST segment elevation.
- **Echocardiogram:** severely reduced LV function, EF 20%. Akinetic anterior and inferior walls

Lossy Compression - not intended for diagnosis

**64-Year-Old Male  
Farmer  
6-23-14**





# **64-Year-Old Male Farmer**

## ***Follow-up March 2015***

- **Patient fully recovered, working full-time on his farm**
- **Facial bones completely healed**
- **“New teeth”**
- **LVEF 42%**

Lossy Compression - not intended for diagnosis

**64-Year-  
Old Male  
Farmer  
7-10-14**

