

MULTIVESSEL PCI. IN DRUG-ELUTING STENT RESTENOSIS DUE TO STENT FRACTURE, TREATED WITH REPEAT DES IMPLANTATION

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Criteria for case selection:

- ✓ DES Restenosis - Stent Fracture
- ✓ IVUS
- ✓ Venture catheter
- ✓ Rotablator
- ✓ Bifurcation
- ✓ Dissection



CASE REPORT

73 y.o. female patient, presenting with crescendo angina.

Risk factors for IHD: Dyslipidaemia

Hypertension

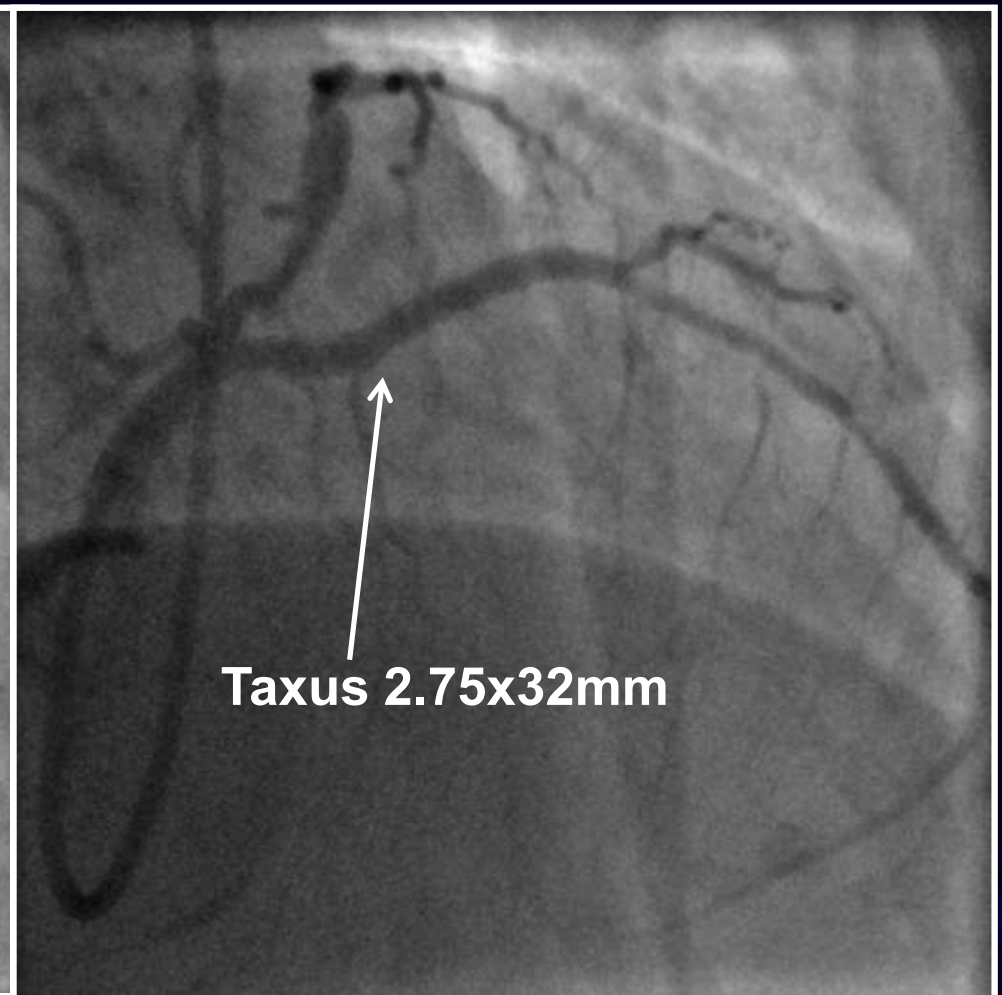
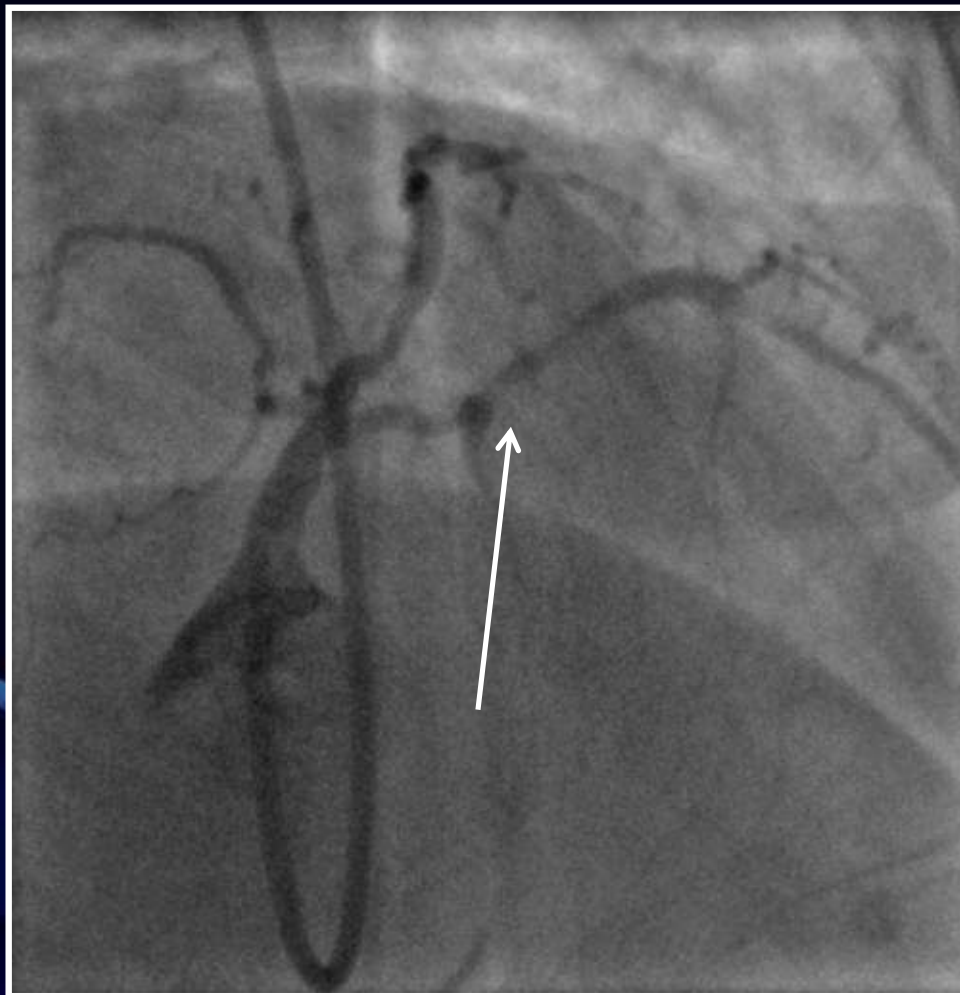
No other significant past medical history

Physical examination unremarkable

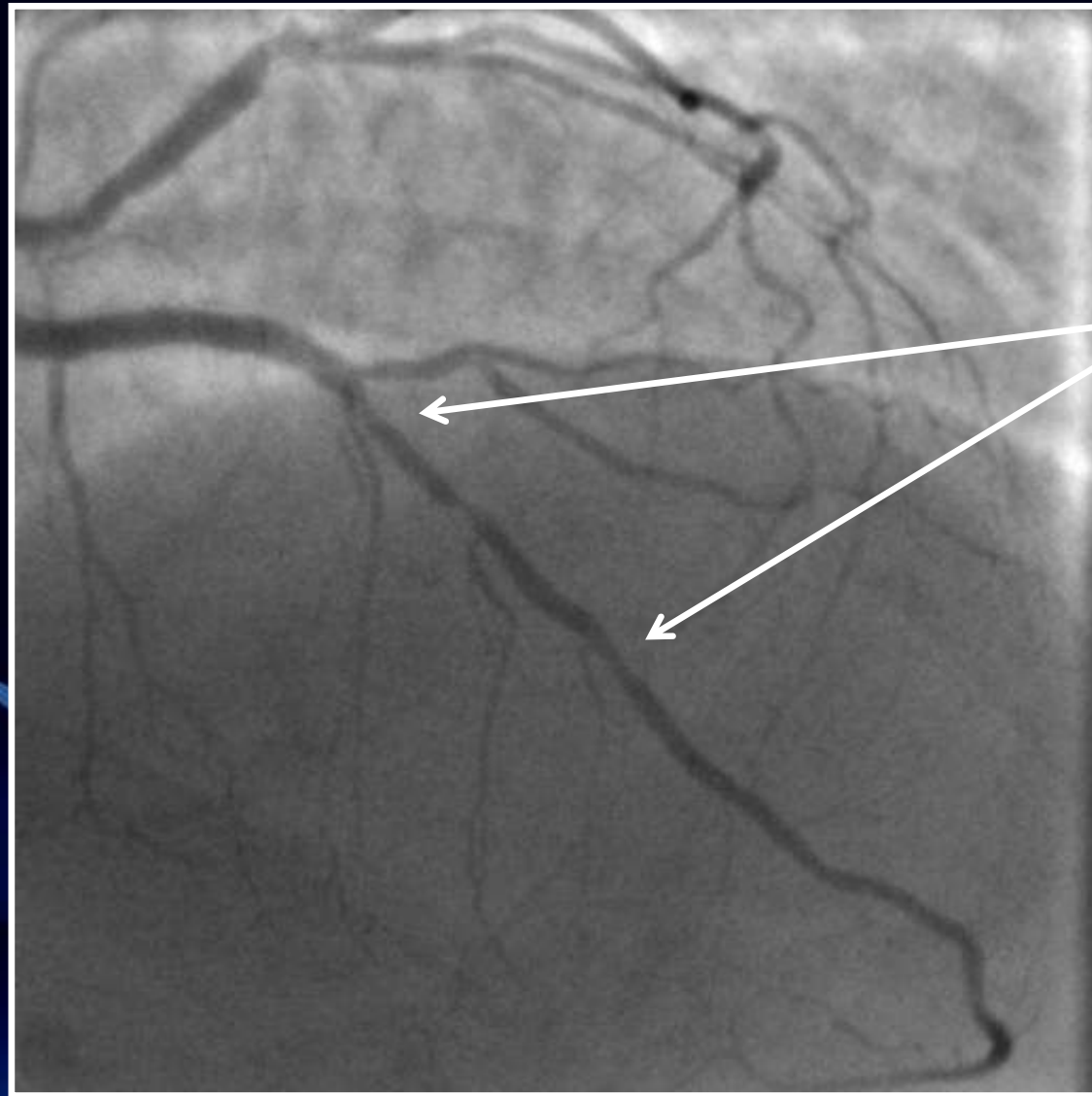
Normal ECG



2007 Significant proximal LAD disease



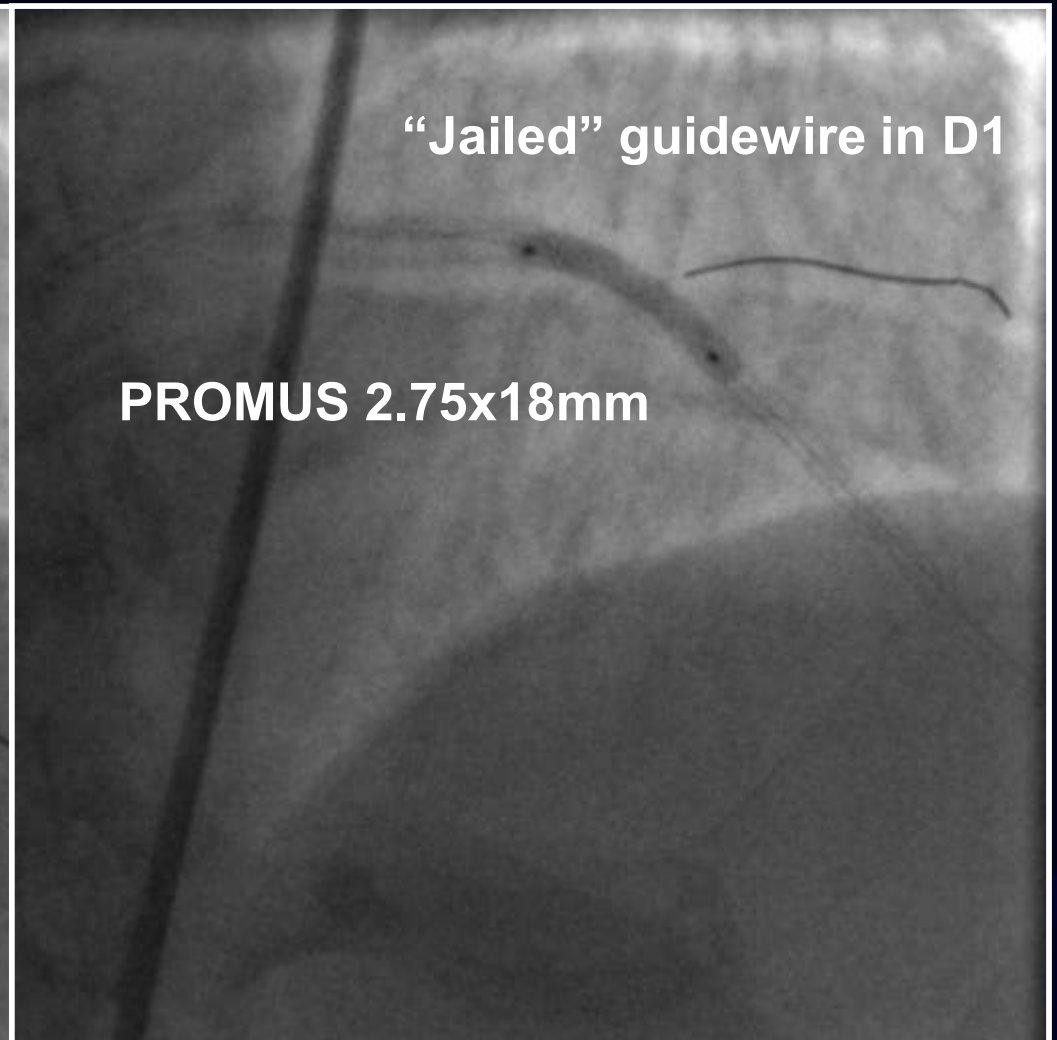
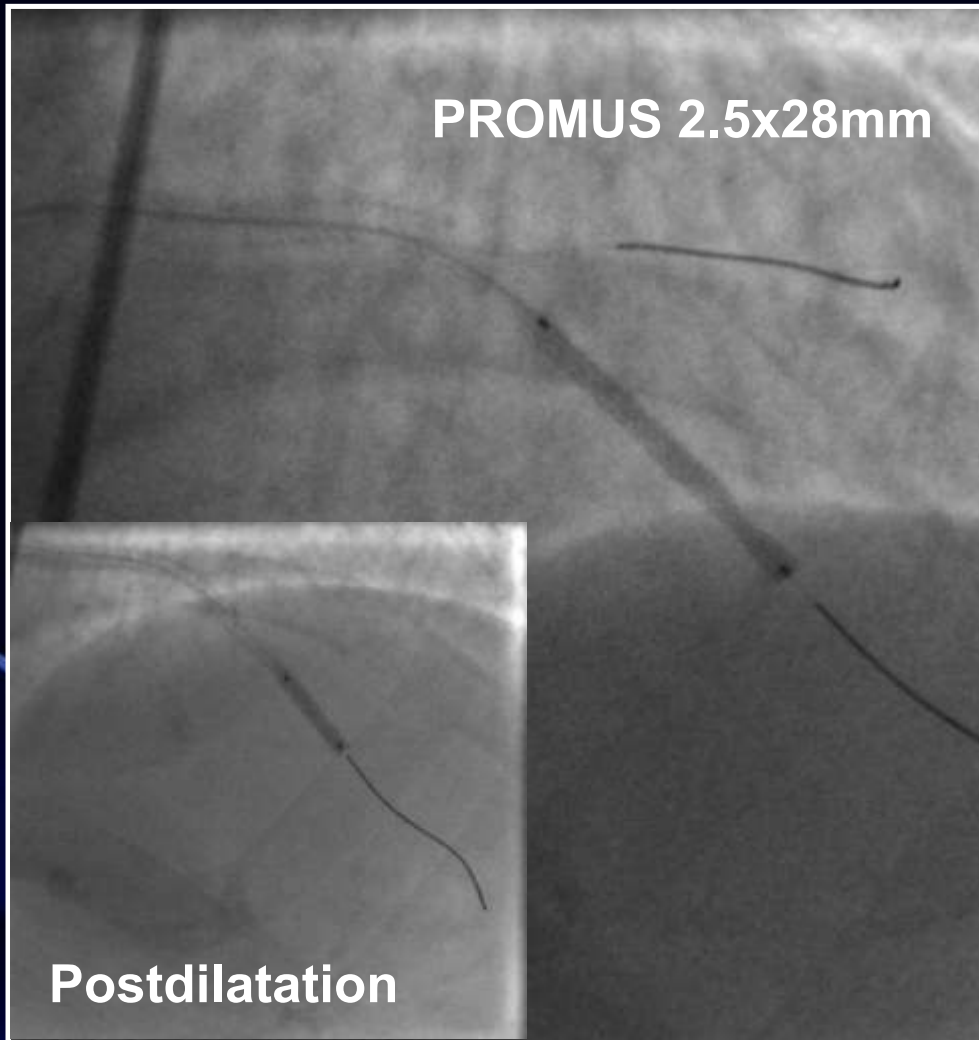
5/2009: recurrent angina of recent onset



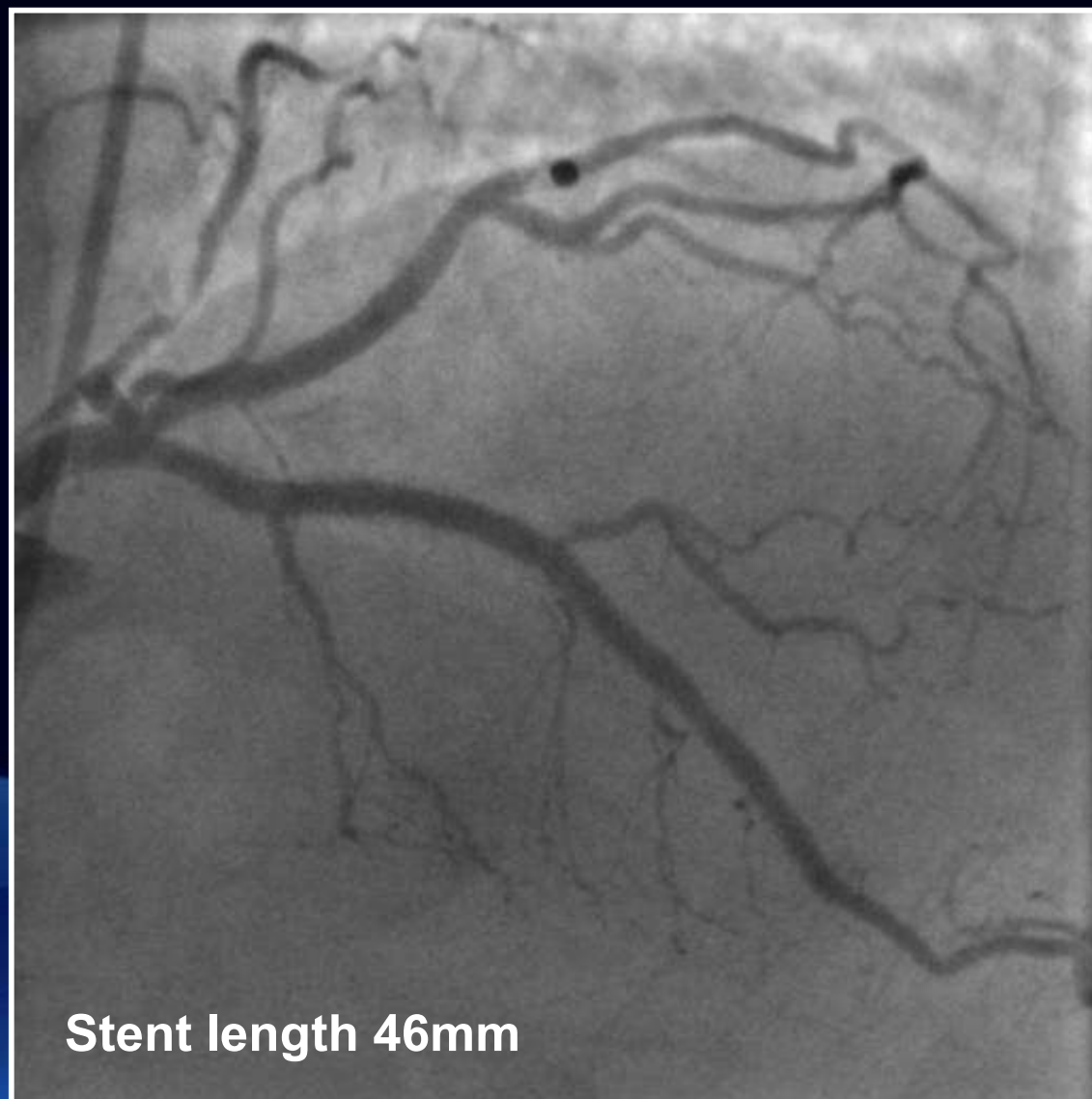
**progression of the disease
with severe lesion in the
mid segment of the LAD
and no restenosis in the
previously implanted stent.**



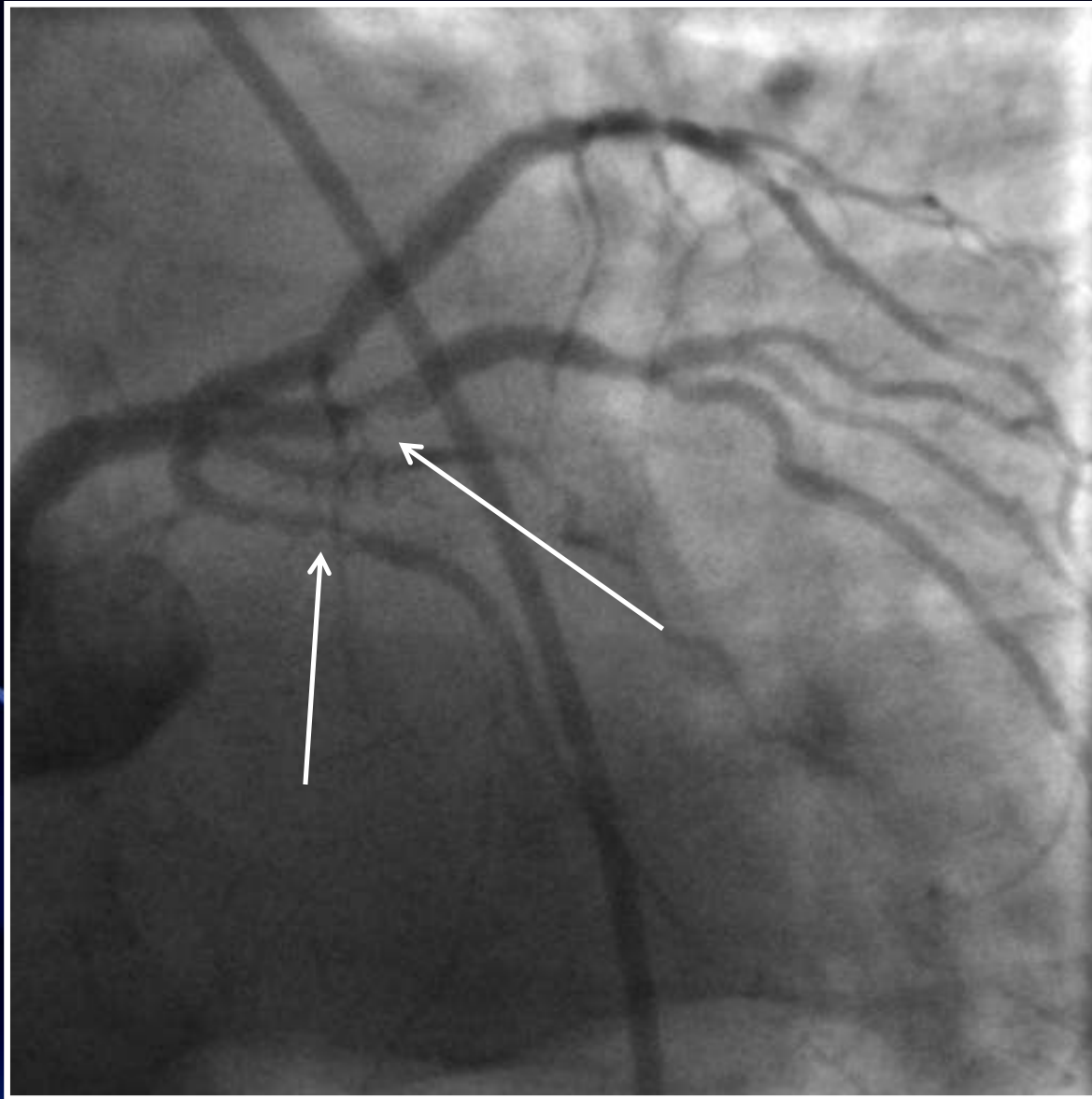
5/2009: PCI - LAD



5/2009: PCI - LAD FINAL RESULT



5/2009

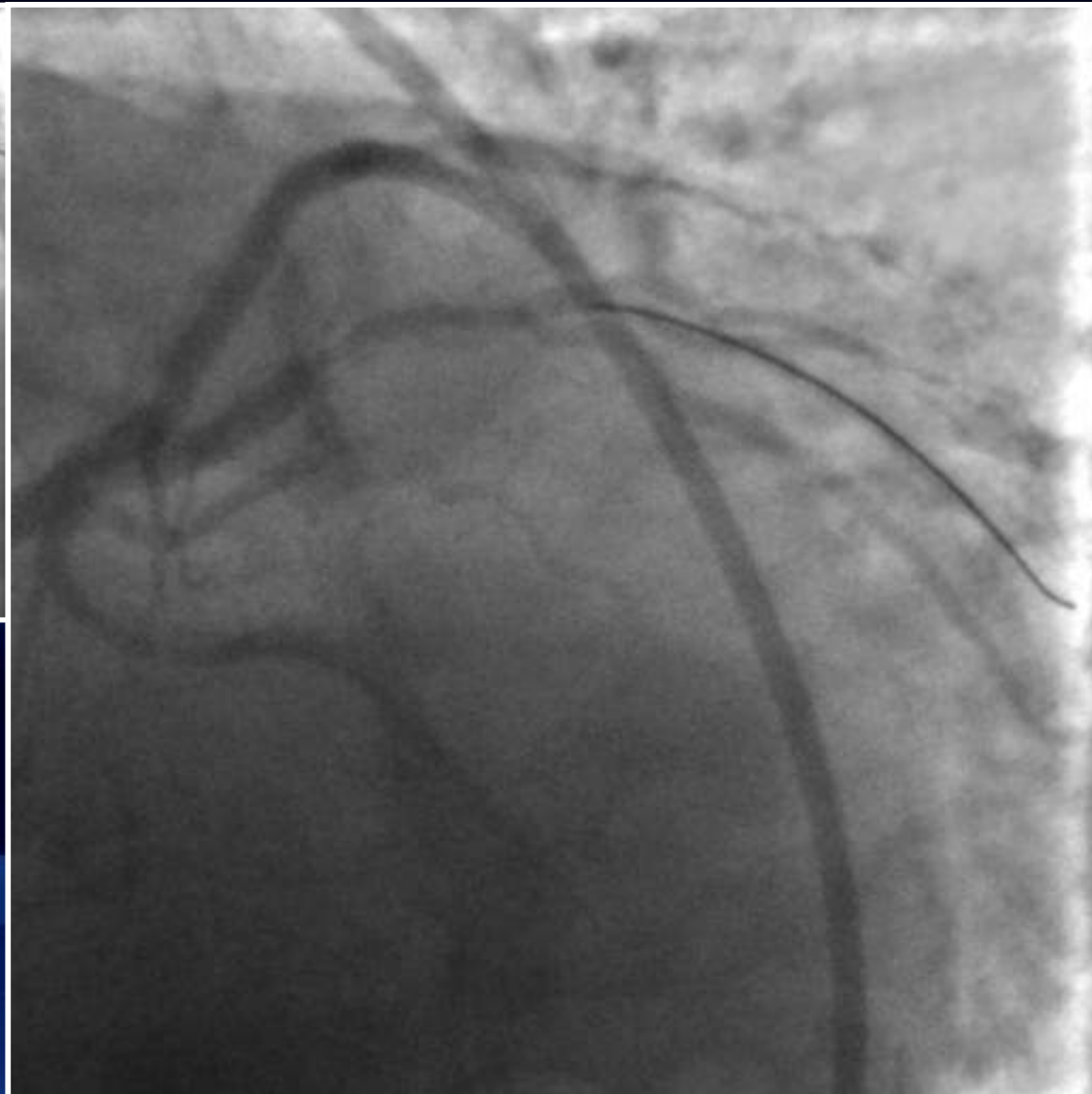
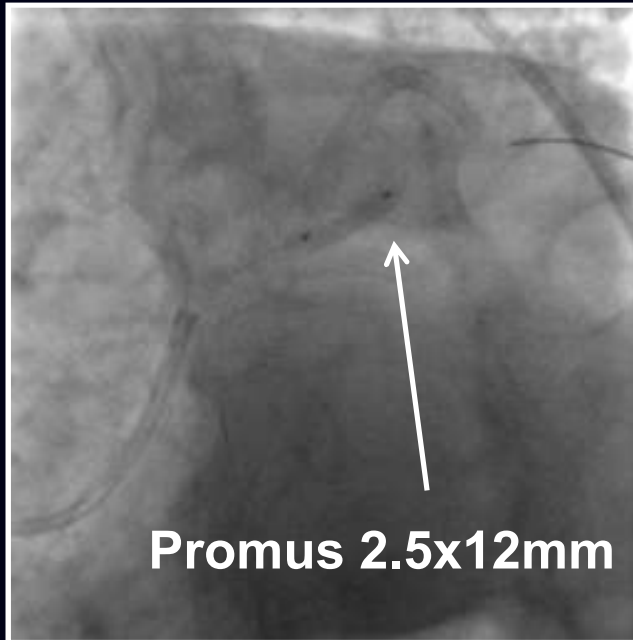


Severe lesion in the intermediate branch and the circumflex artery.



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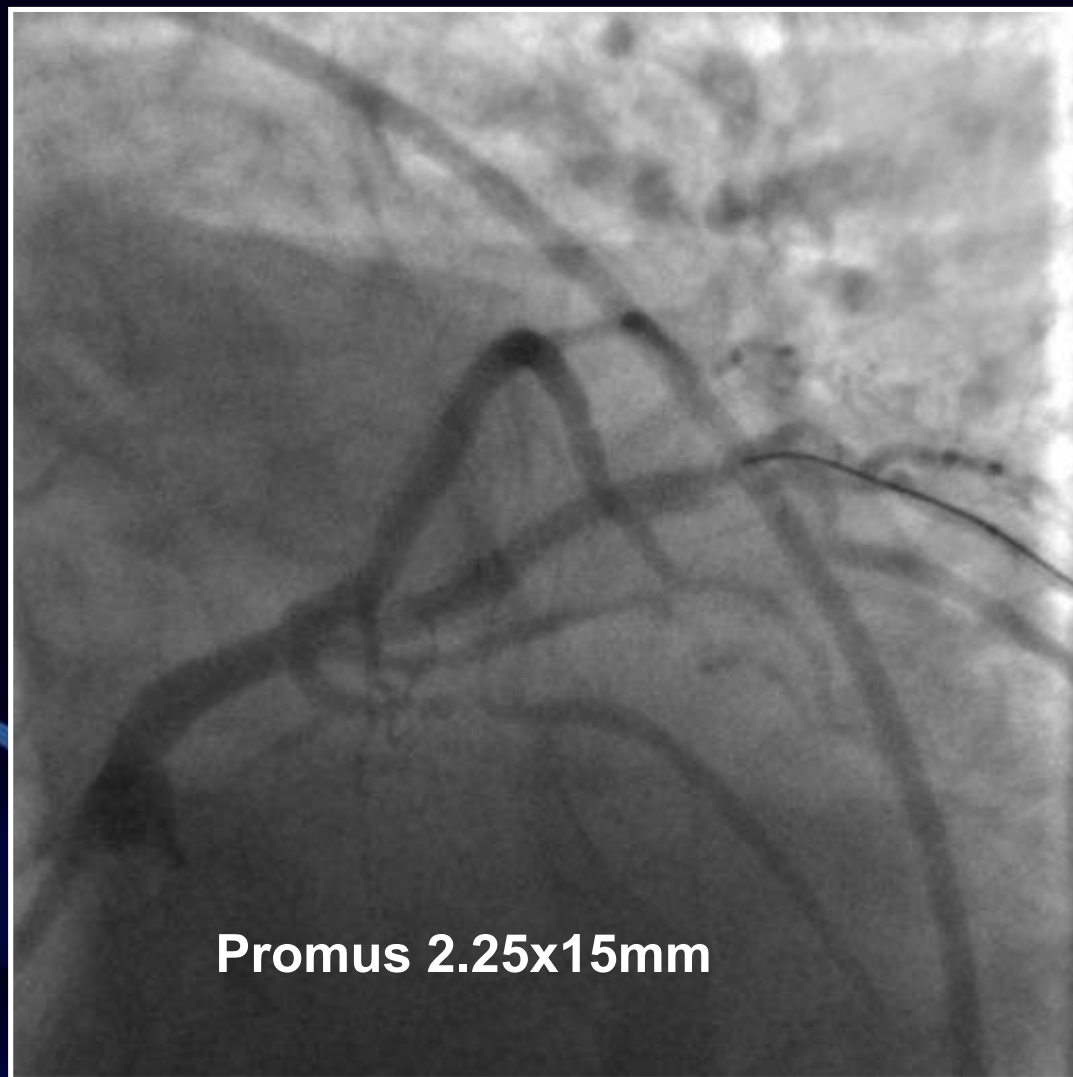
5/2009: PCI-INTERMEDIATE BRANCH



DISSECTION !!!!



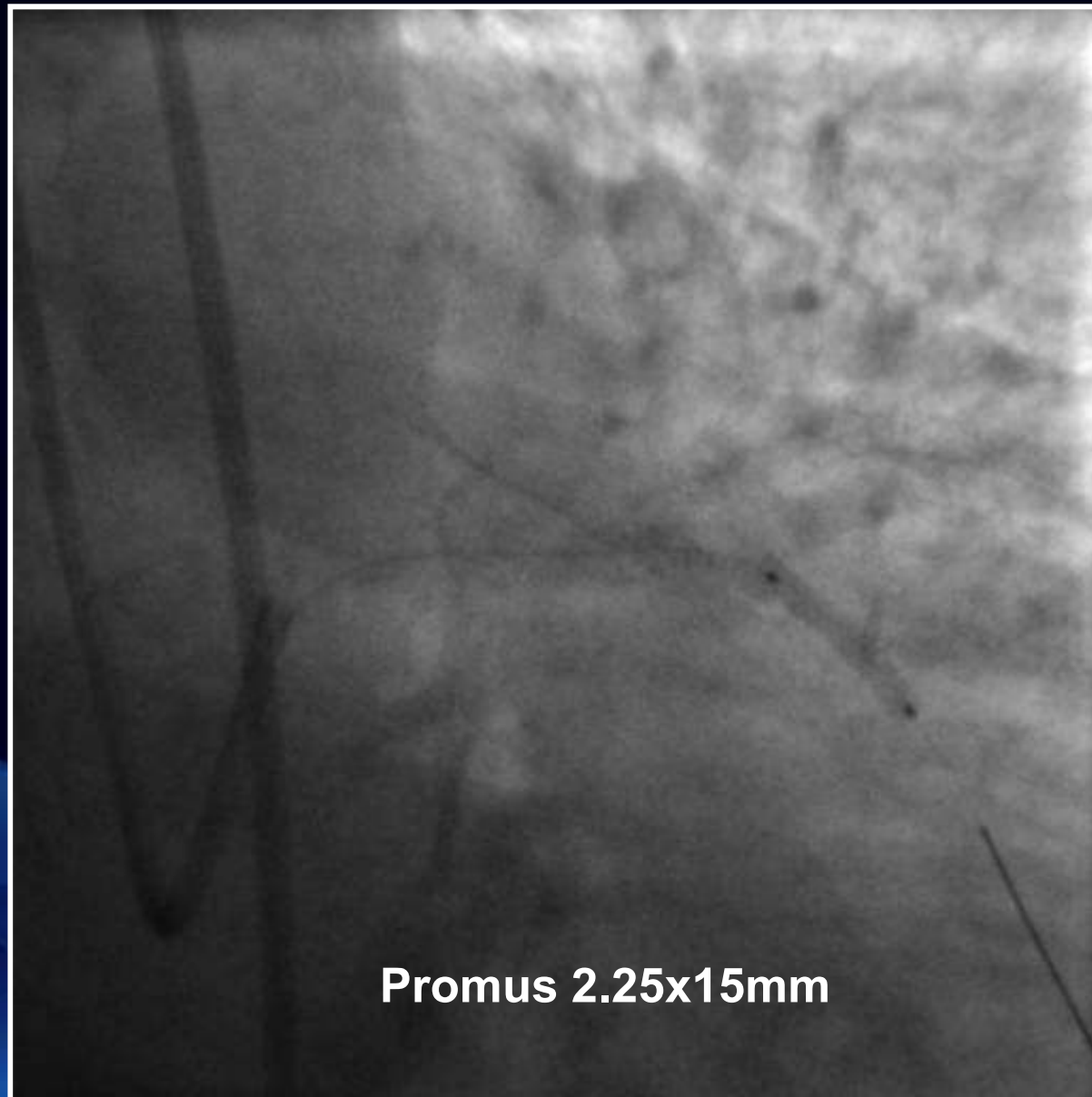
5/2009: PCI-INTERMEDIATE BRANCH



RESIDUAL DISSECTION



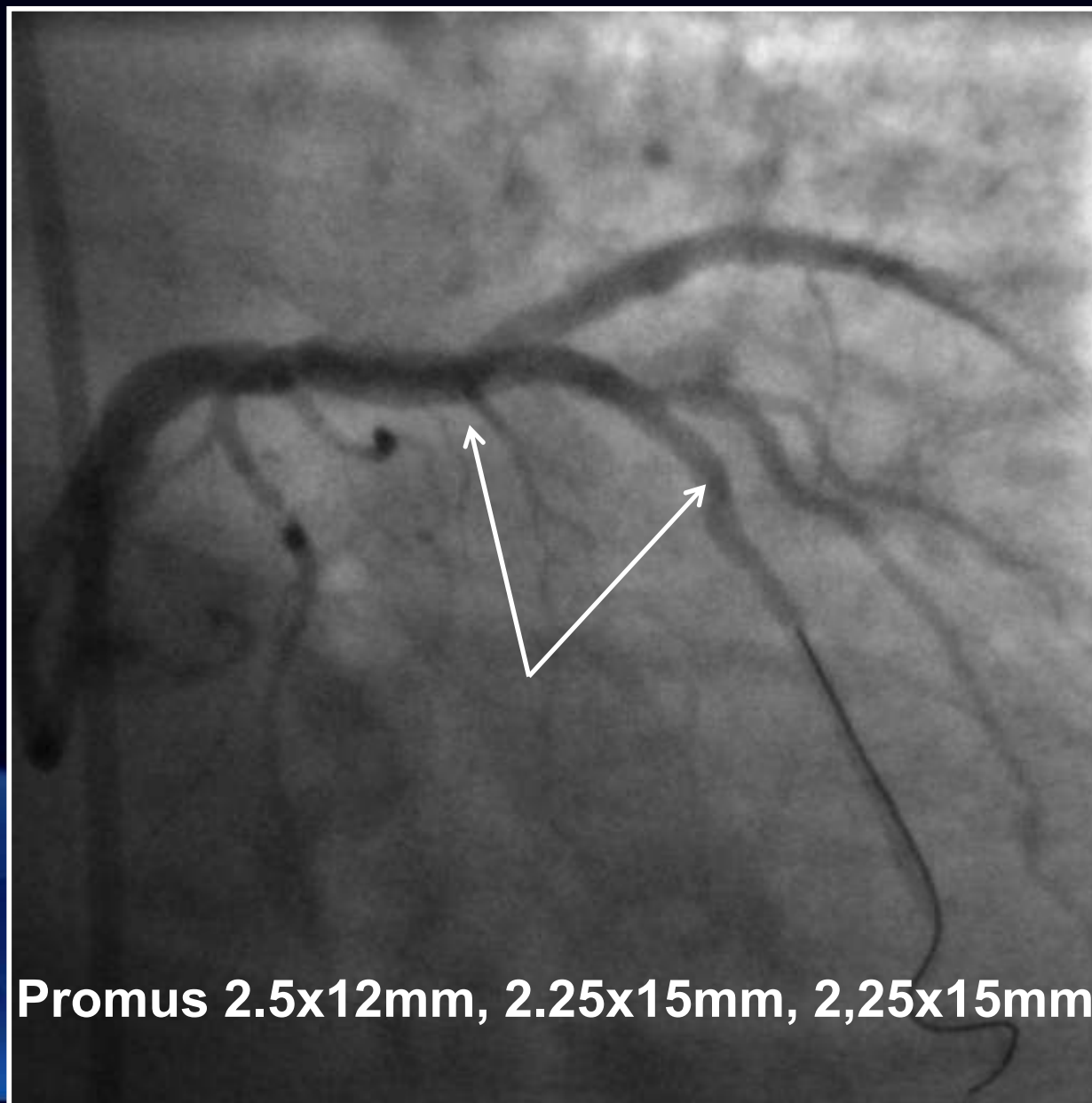
5/2009: PCI-INTERMEDIATE BRANCH



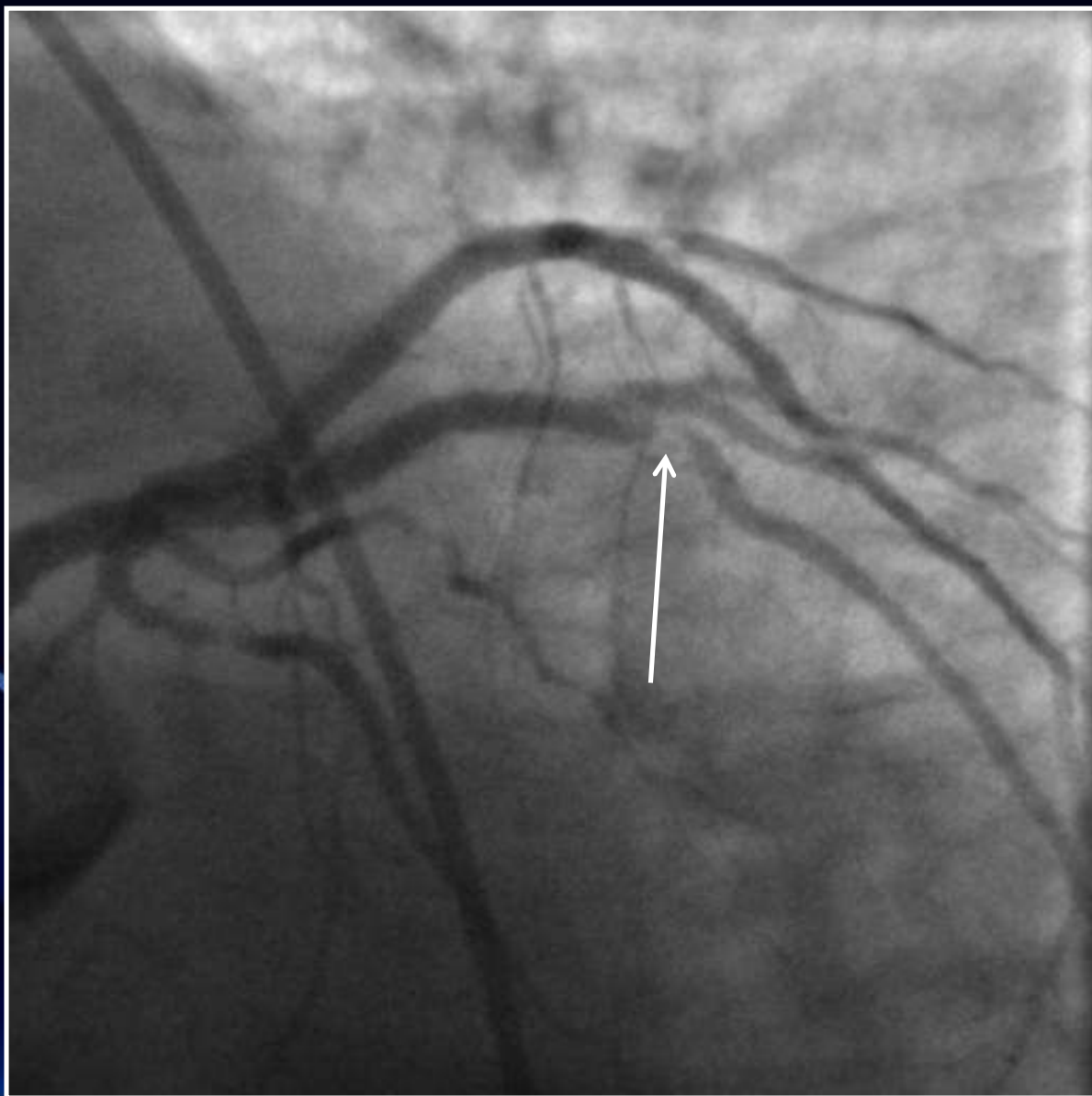
Promus 2.25x15mm



5/2009: PCI-INTERMEDIATE BRANCH FINAL RESULT

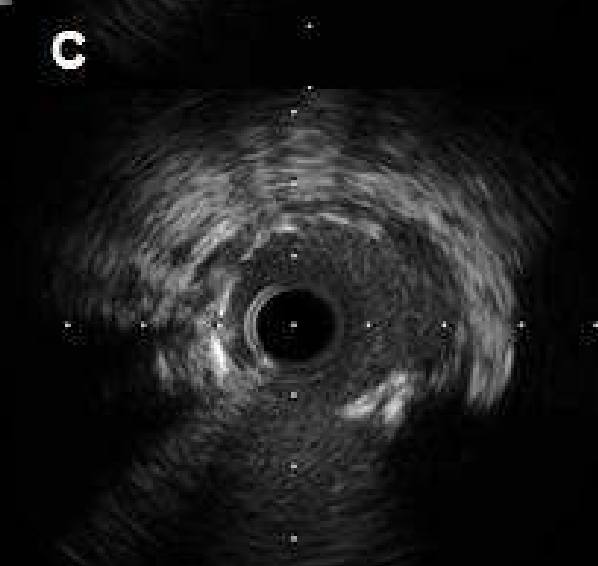
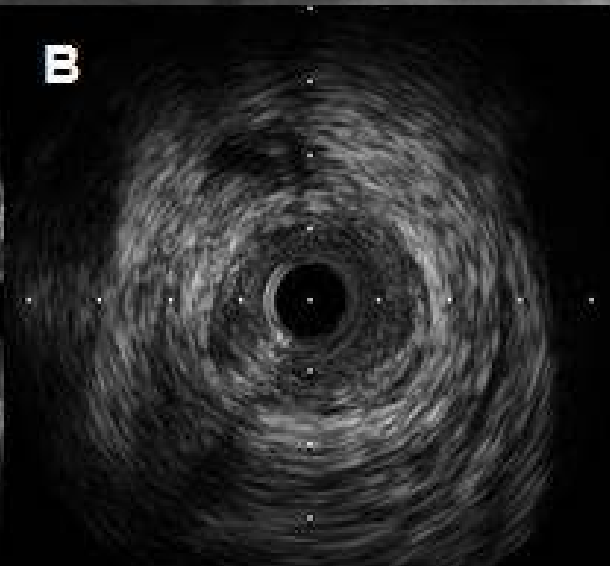
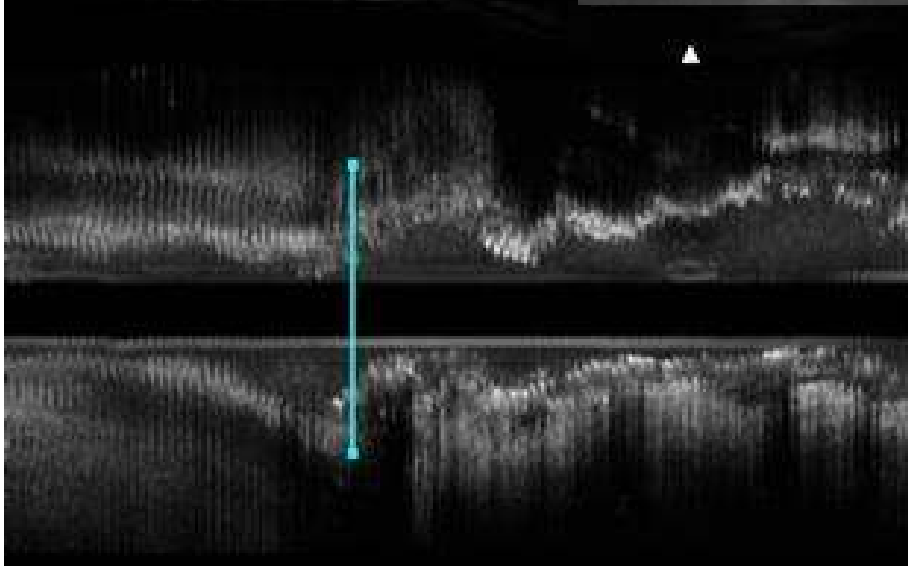
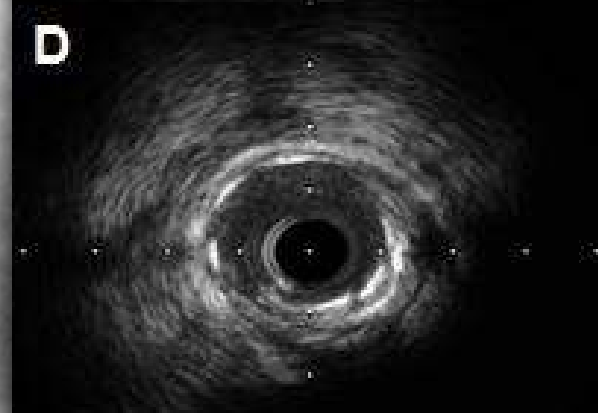
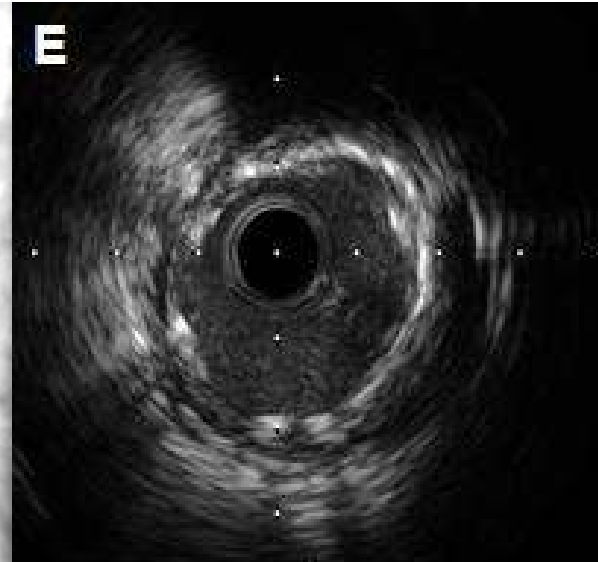
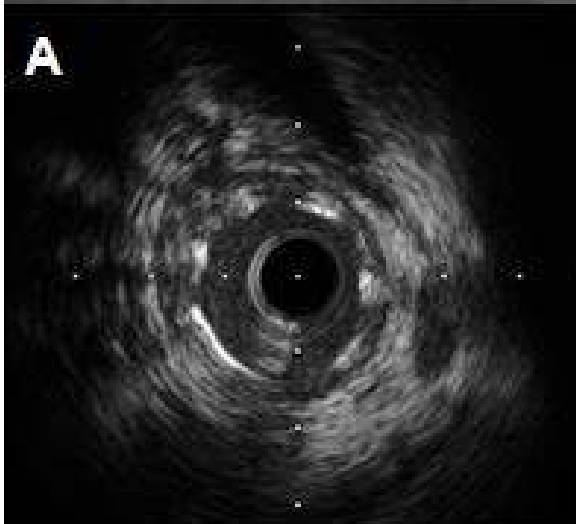
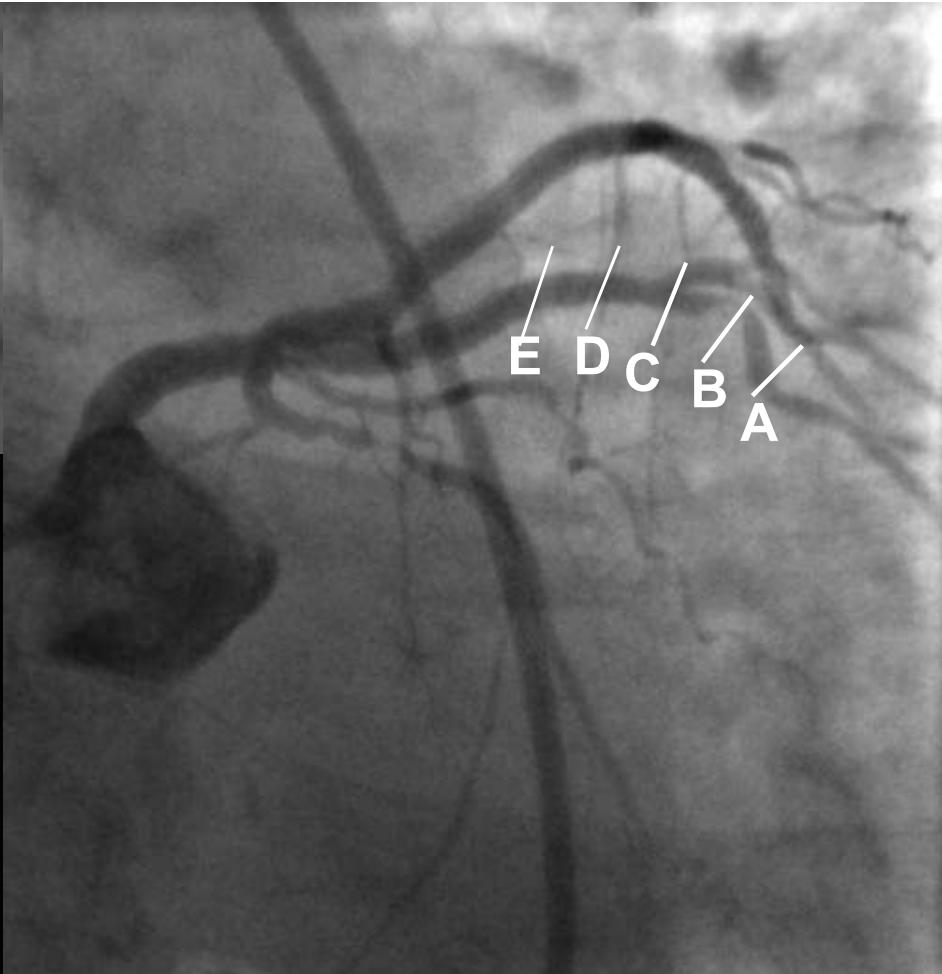
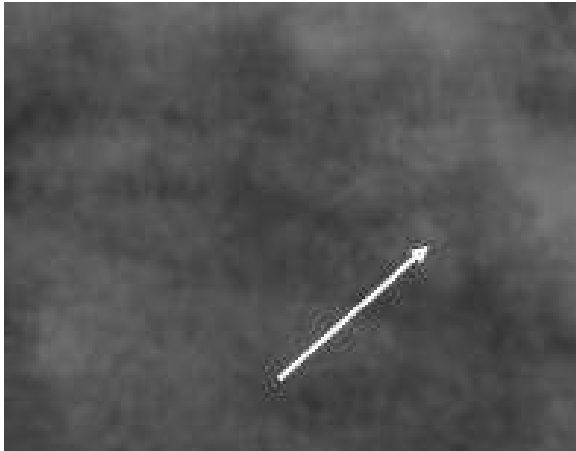


12/2009: recurrent chest pain!!!

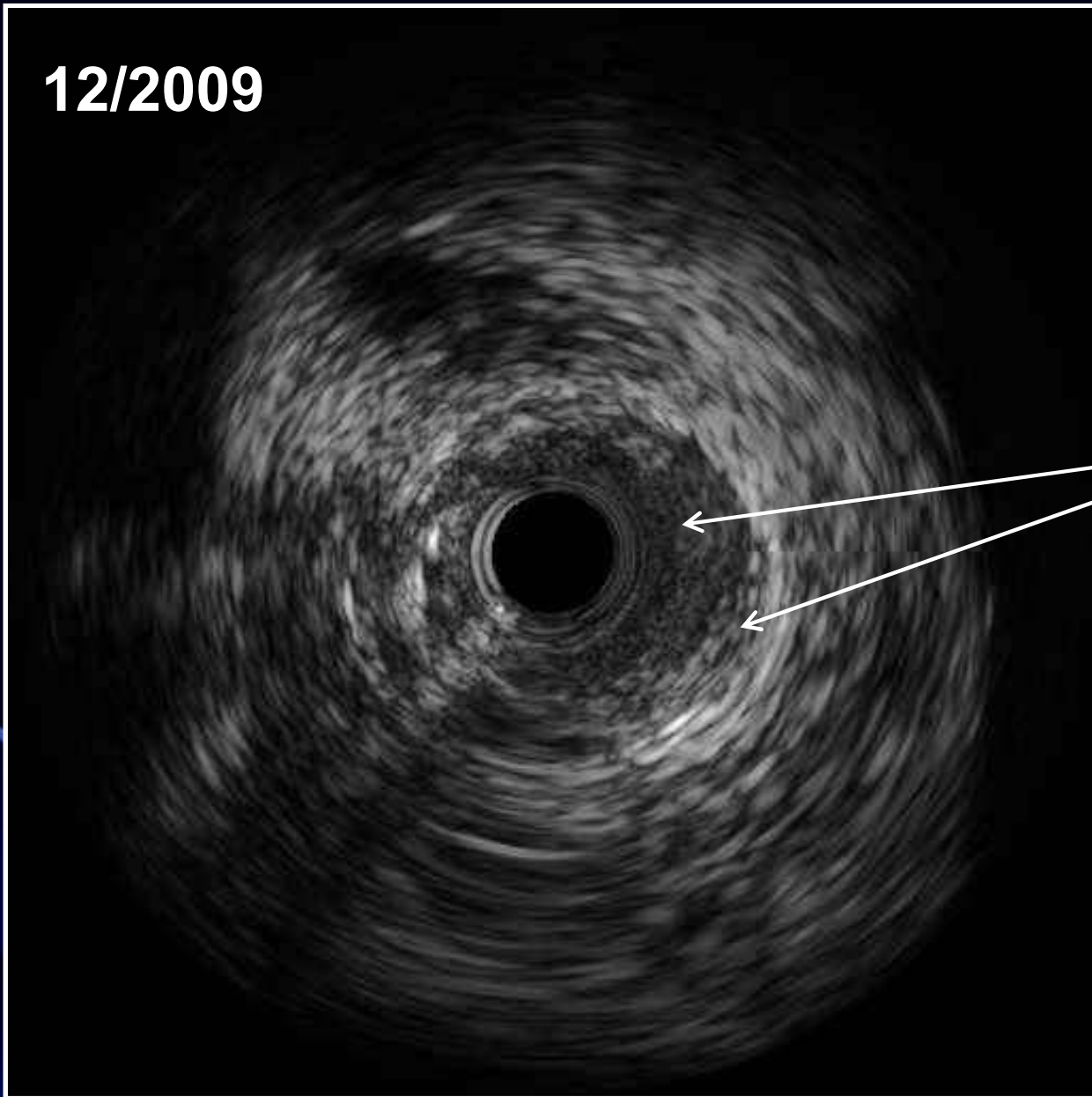


Severe stenosis of the intermediate branch within the stented segment, with stent strut fracture near the distal overlapping site.





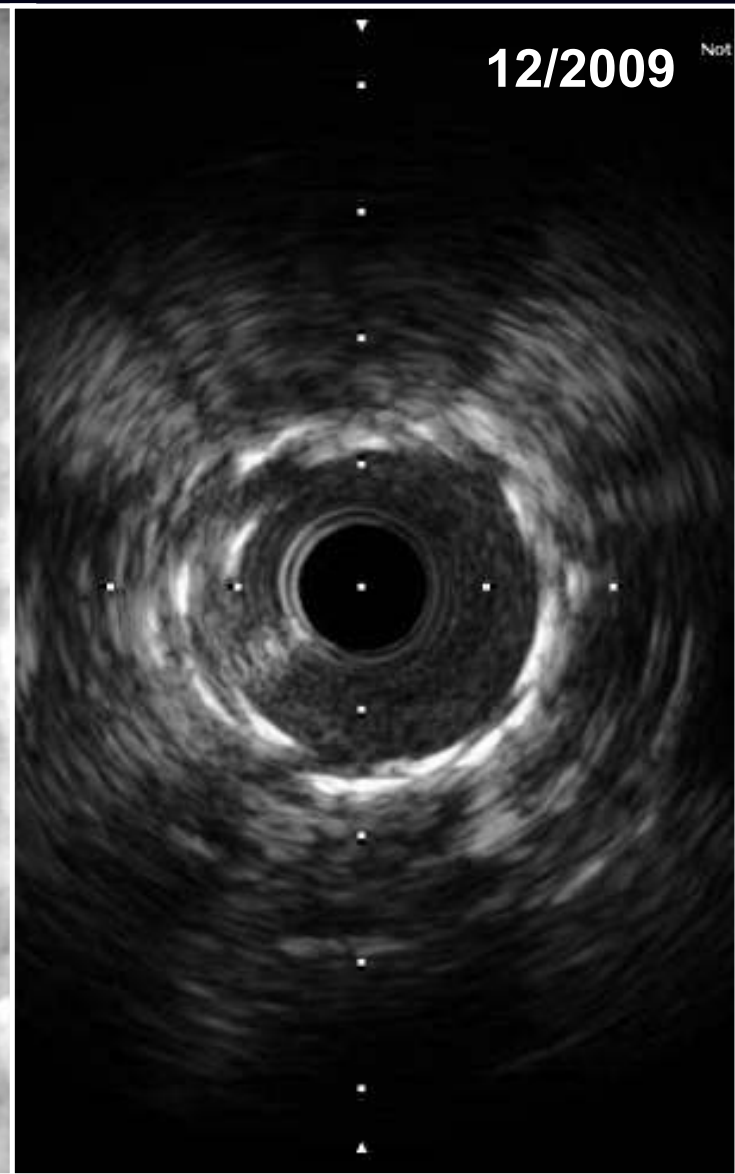
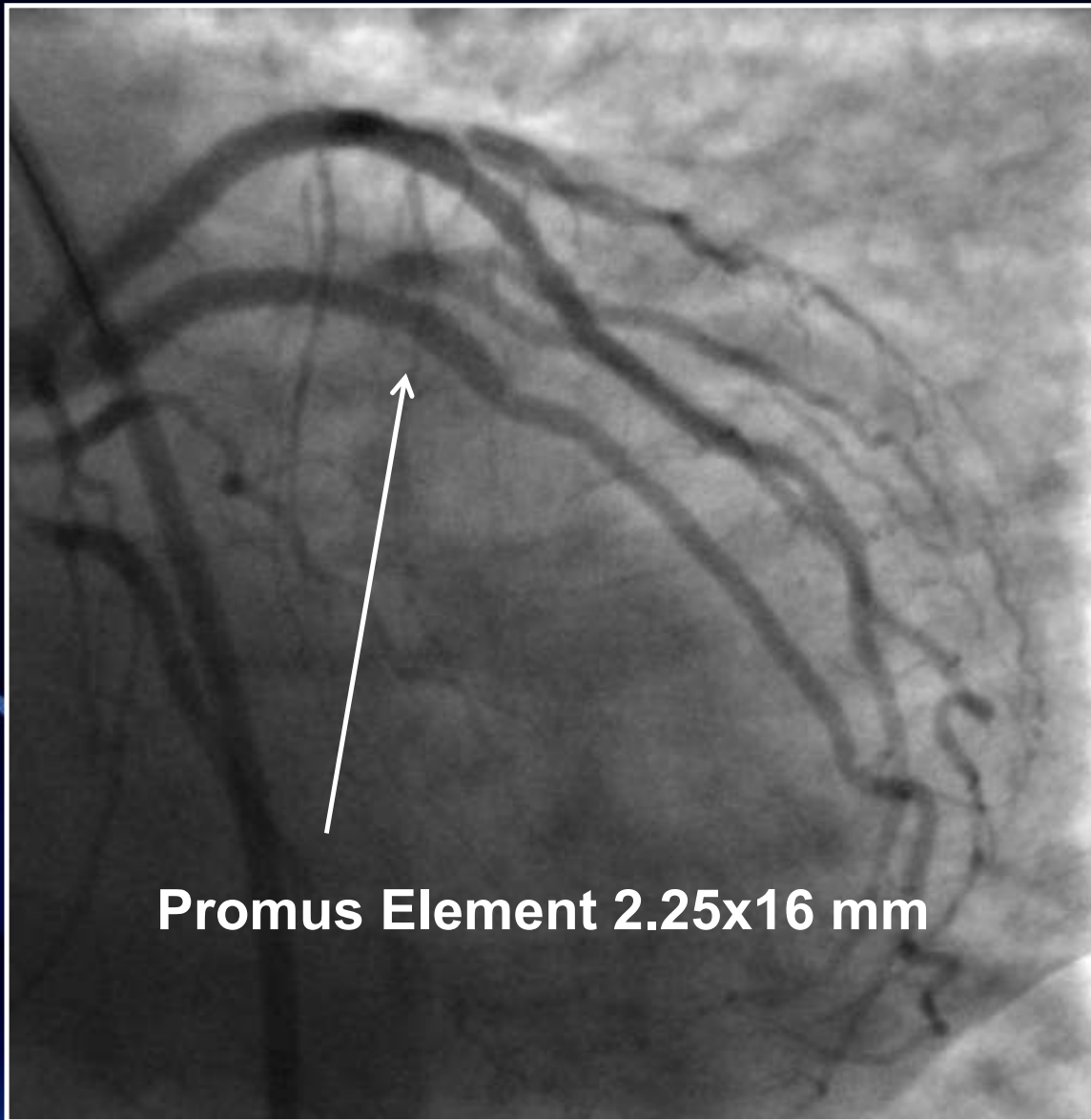
12/2009



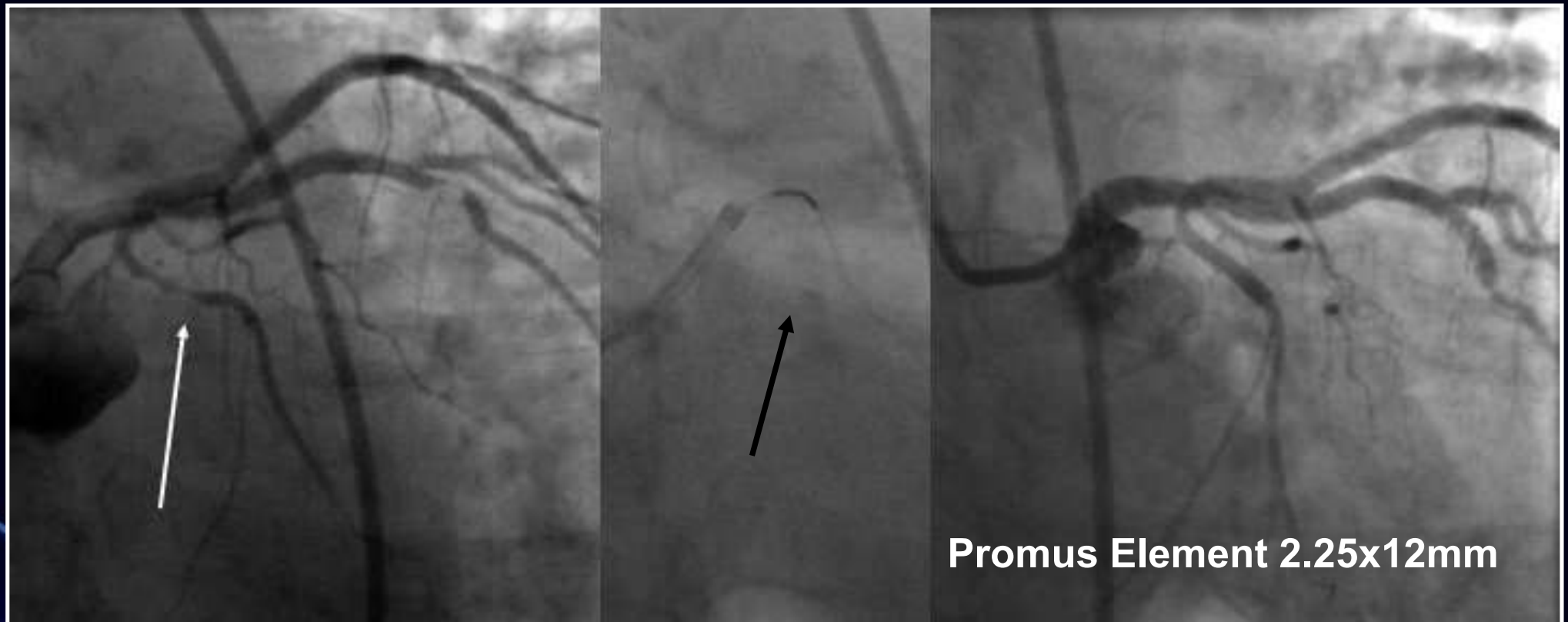
**Significant hyperplasia
and absence of the
metallic stent struts
corresponding to
complete fracture of the
distal stent.**



FINAL RESULT



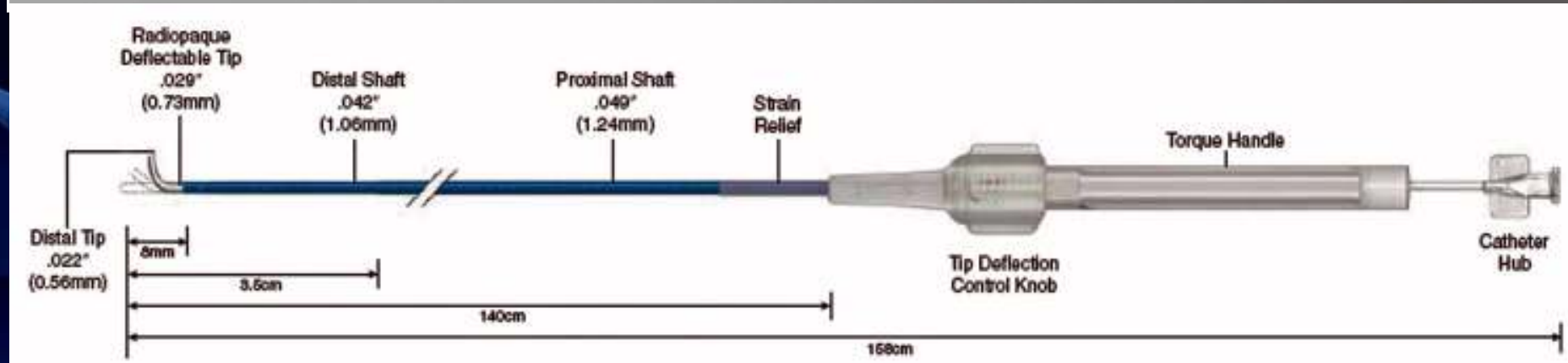
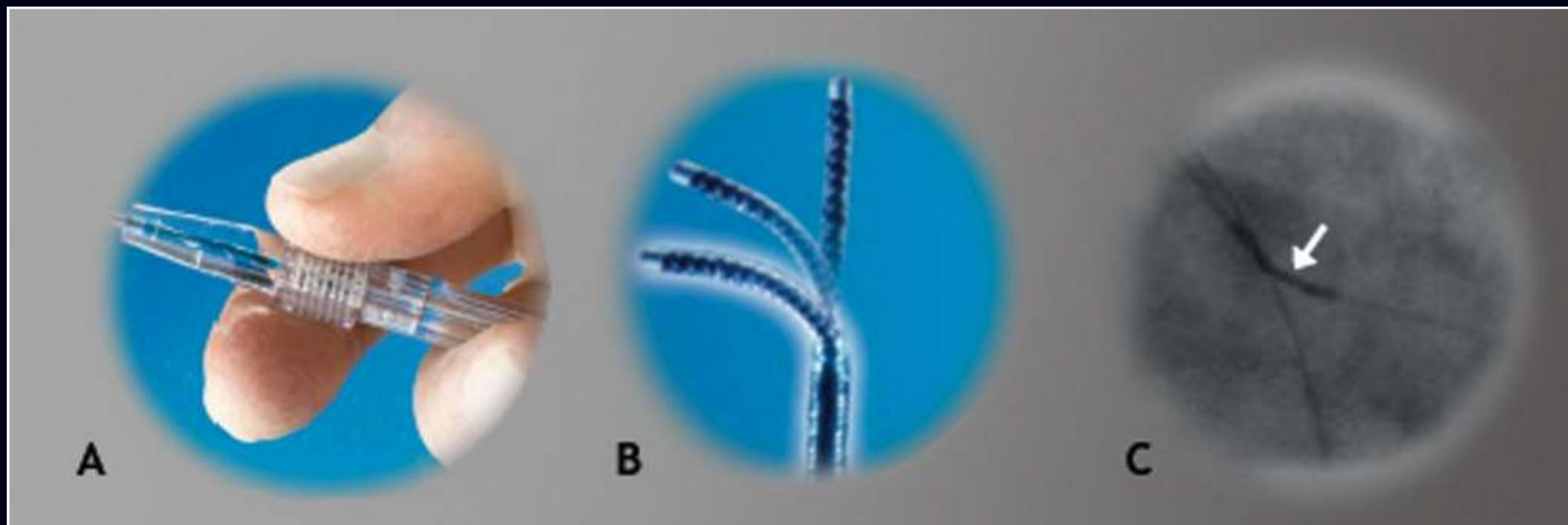
12/2009: PCI-Cx



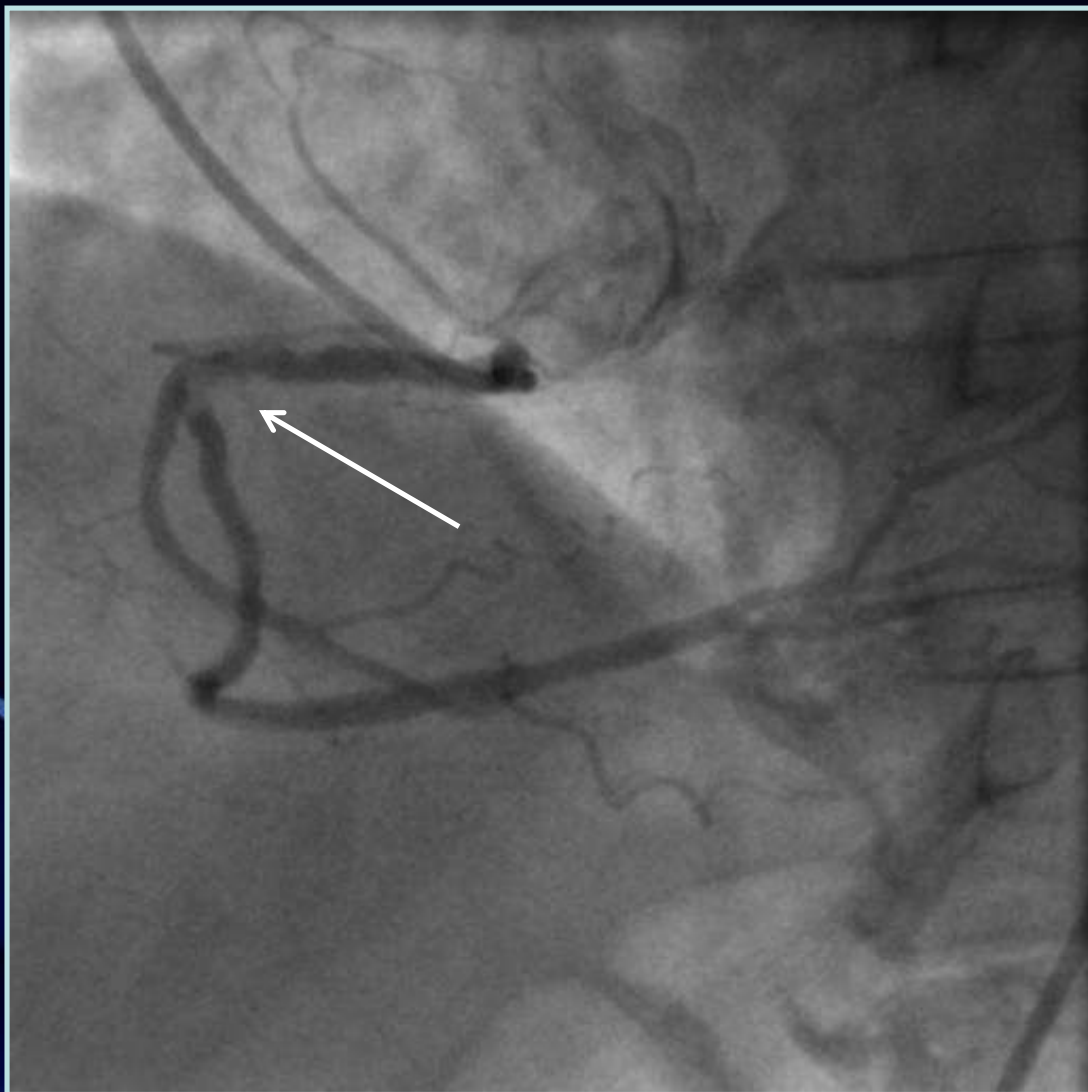
Due to severe tortuosity of the proximal segment of the Cx, the Venture wire control catheter was used, in order to facilitate the passage of the guide-wire.



Venture™ Wire Control Catheter



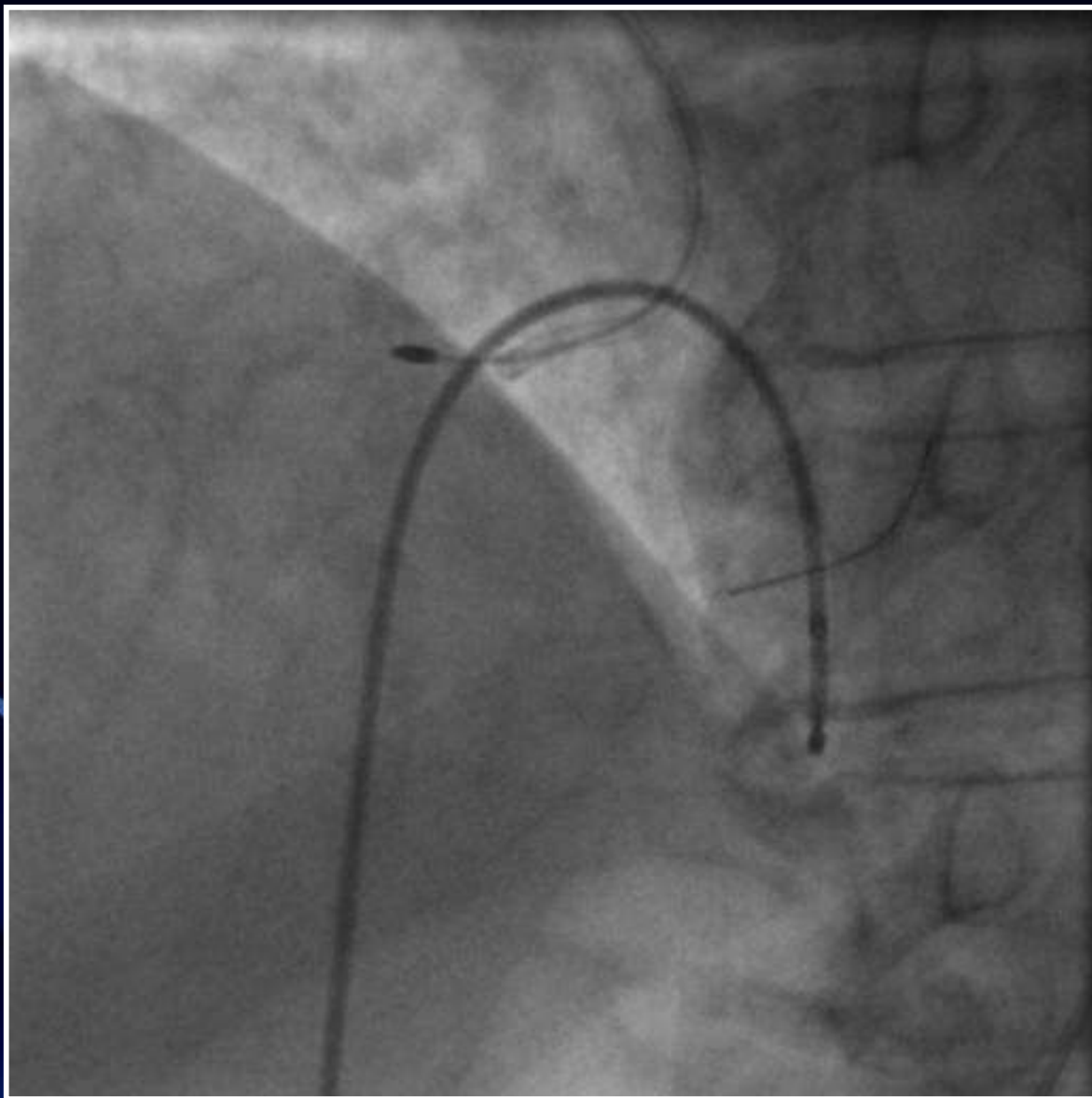
12/2009: PCI-RCA



**RCA severely calcified with angulation at its proximal segment.
Significant stenosis at the bifurcation with an acute marginal branch.**



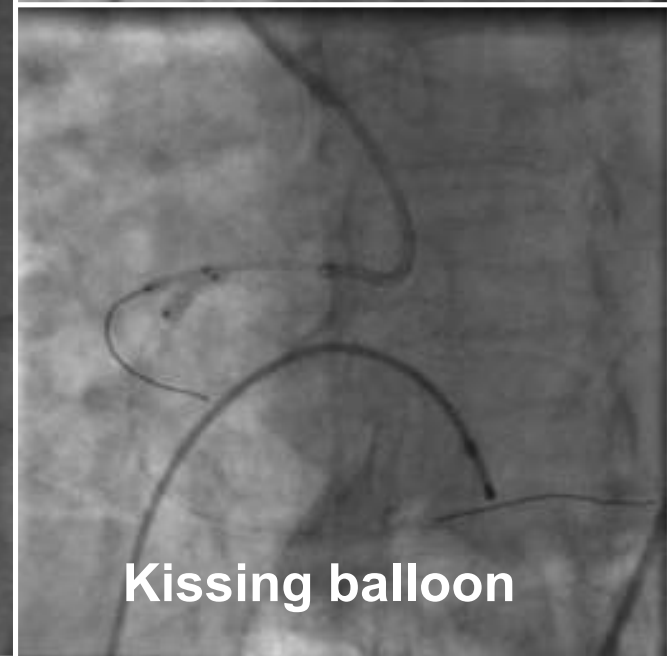
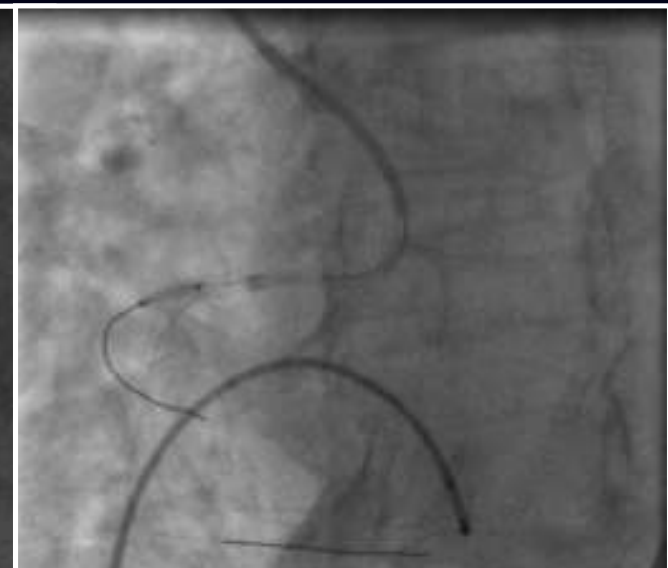
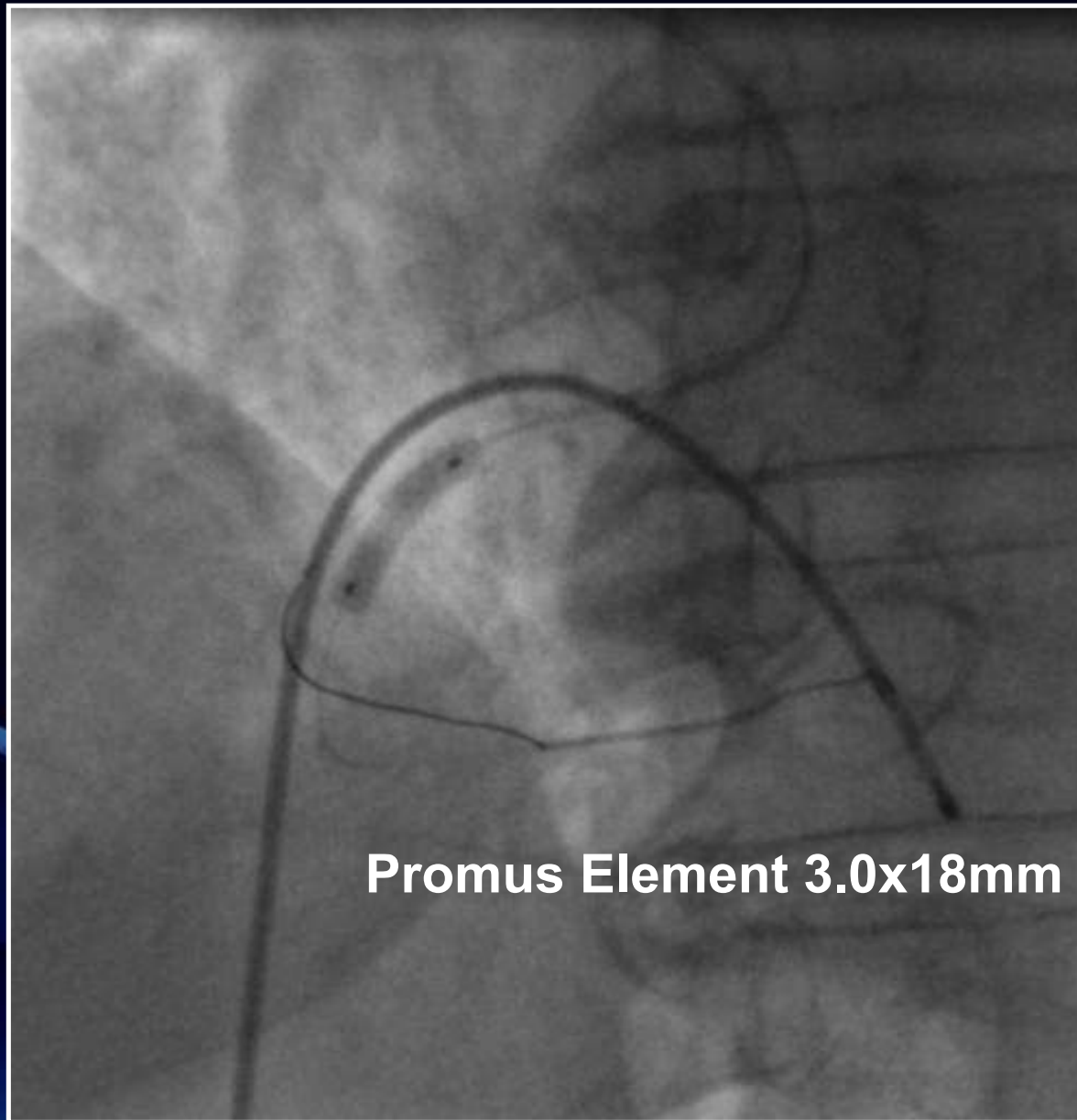
12/2009



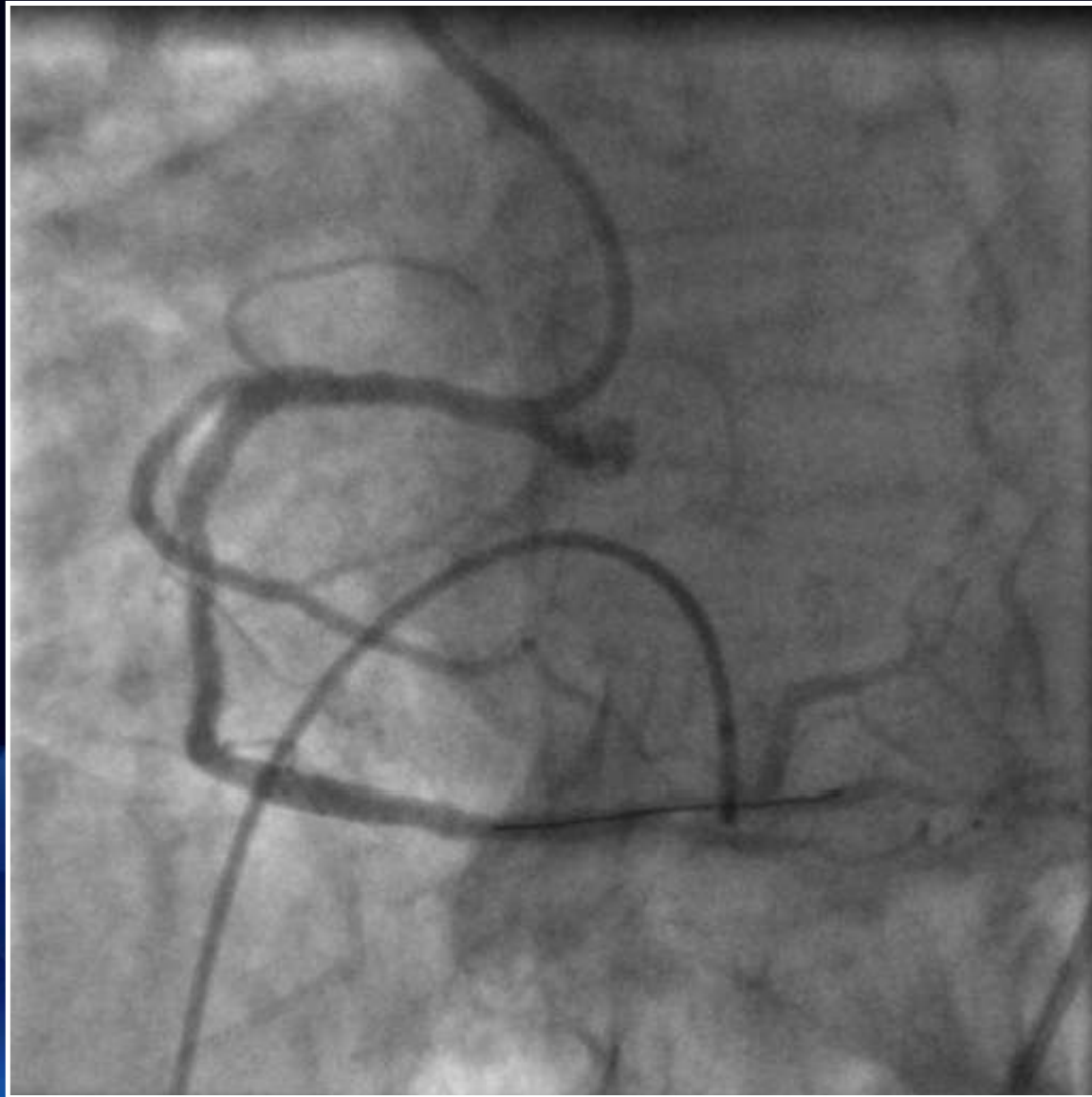
**Due to inability to advance
a balloon, decision was
made to rotablate.
(RA burr size 1.5mm)**



12/2009: PCI-RCA

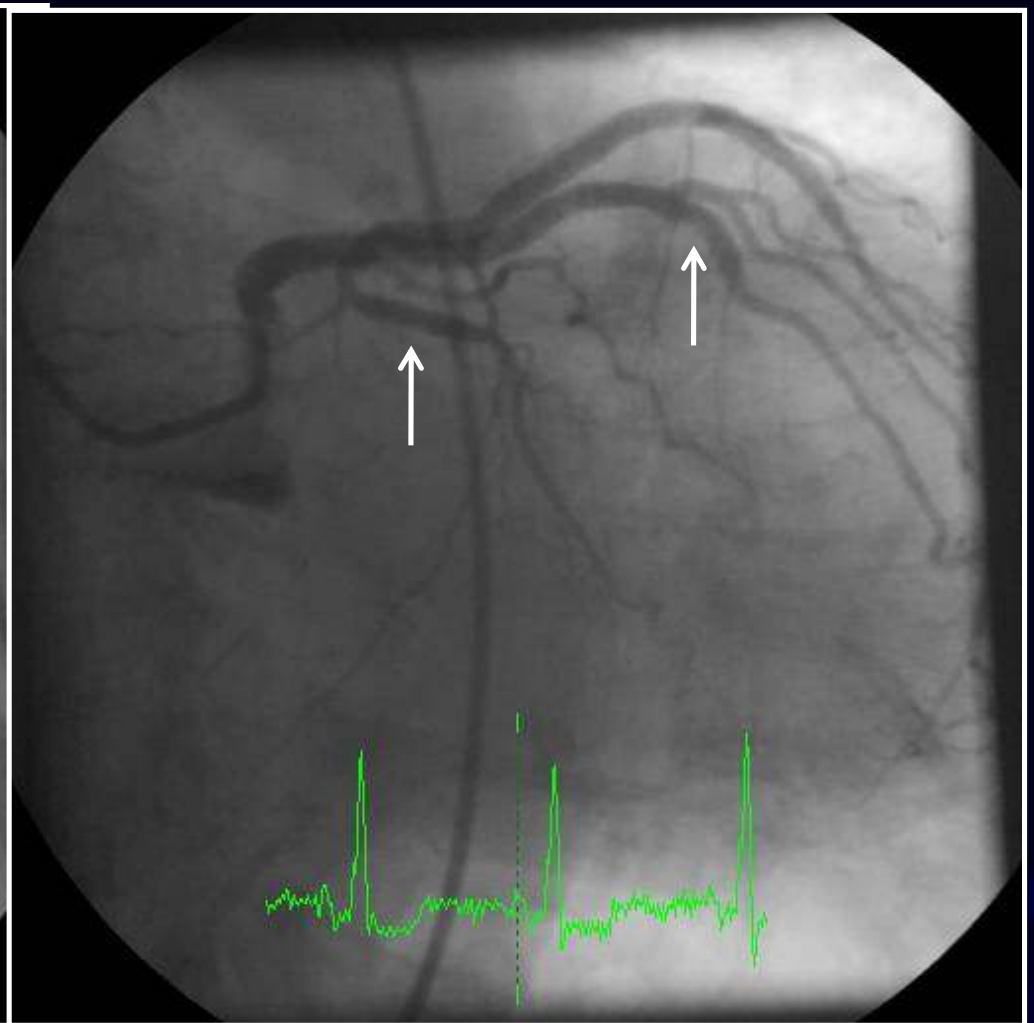
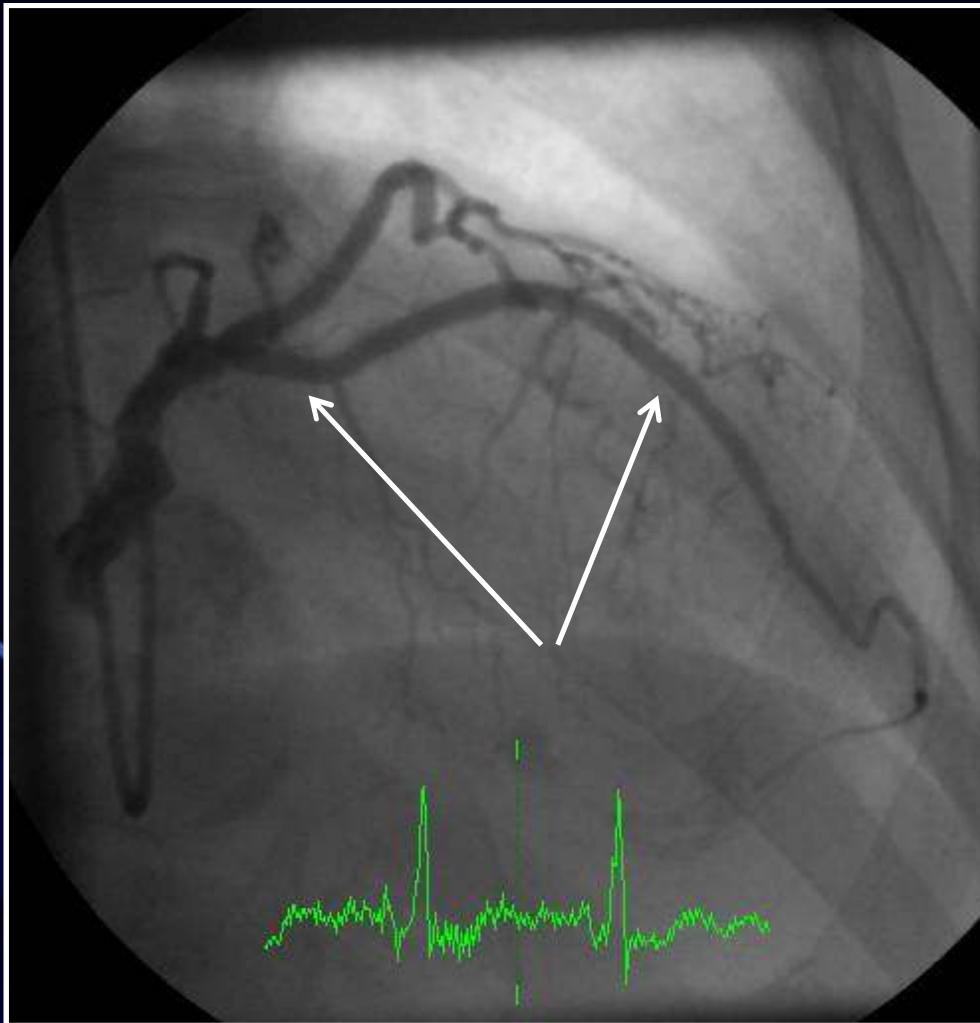


12/2009: PCI-RCA FINAL RESULT

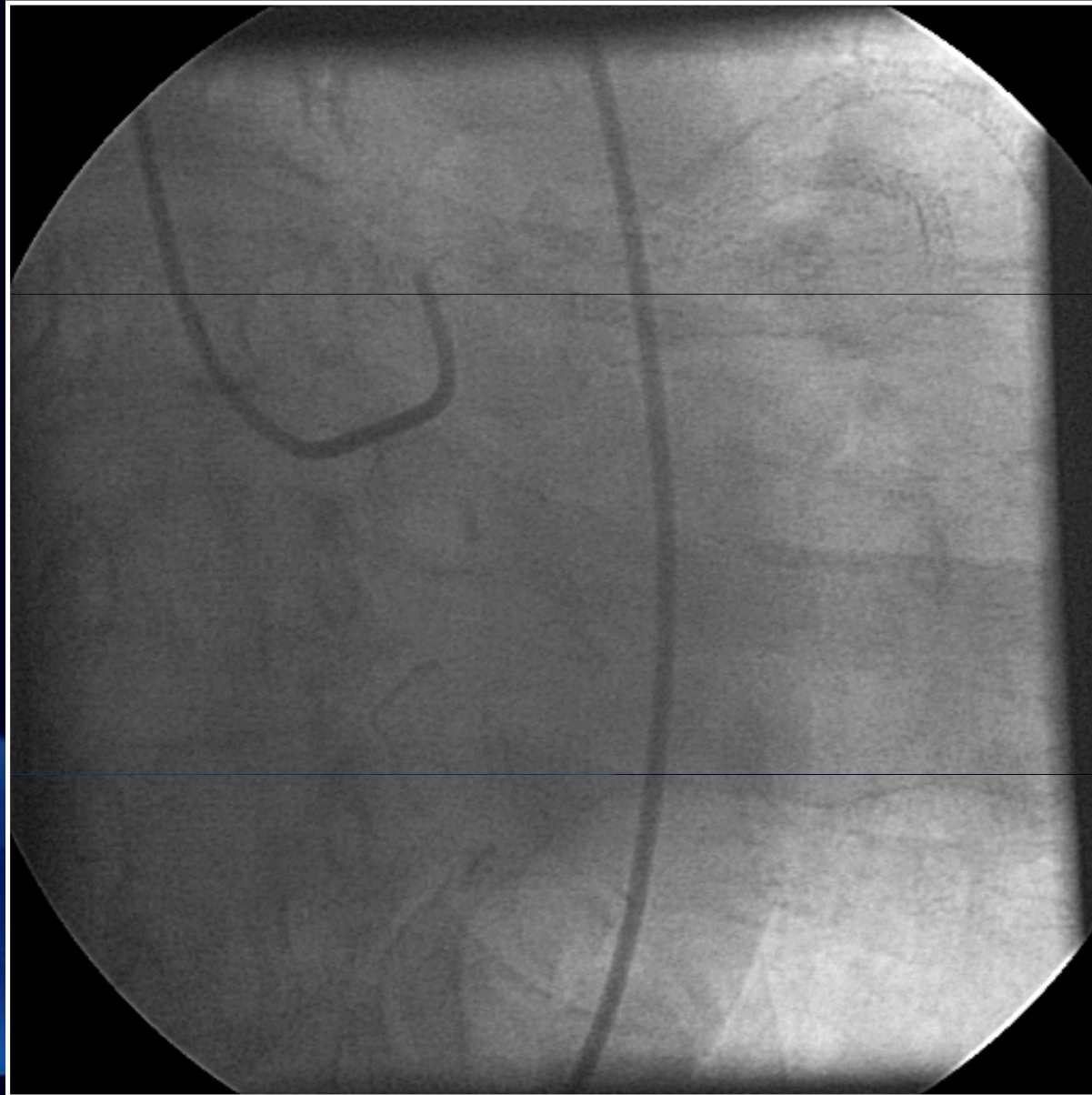


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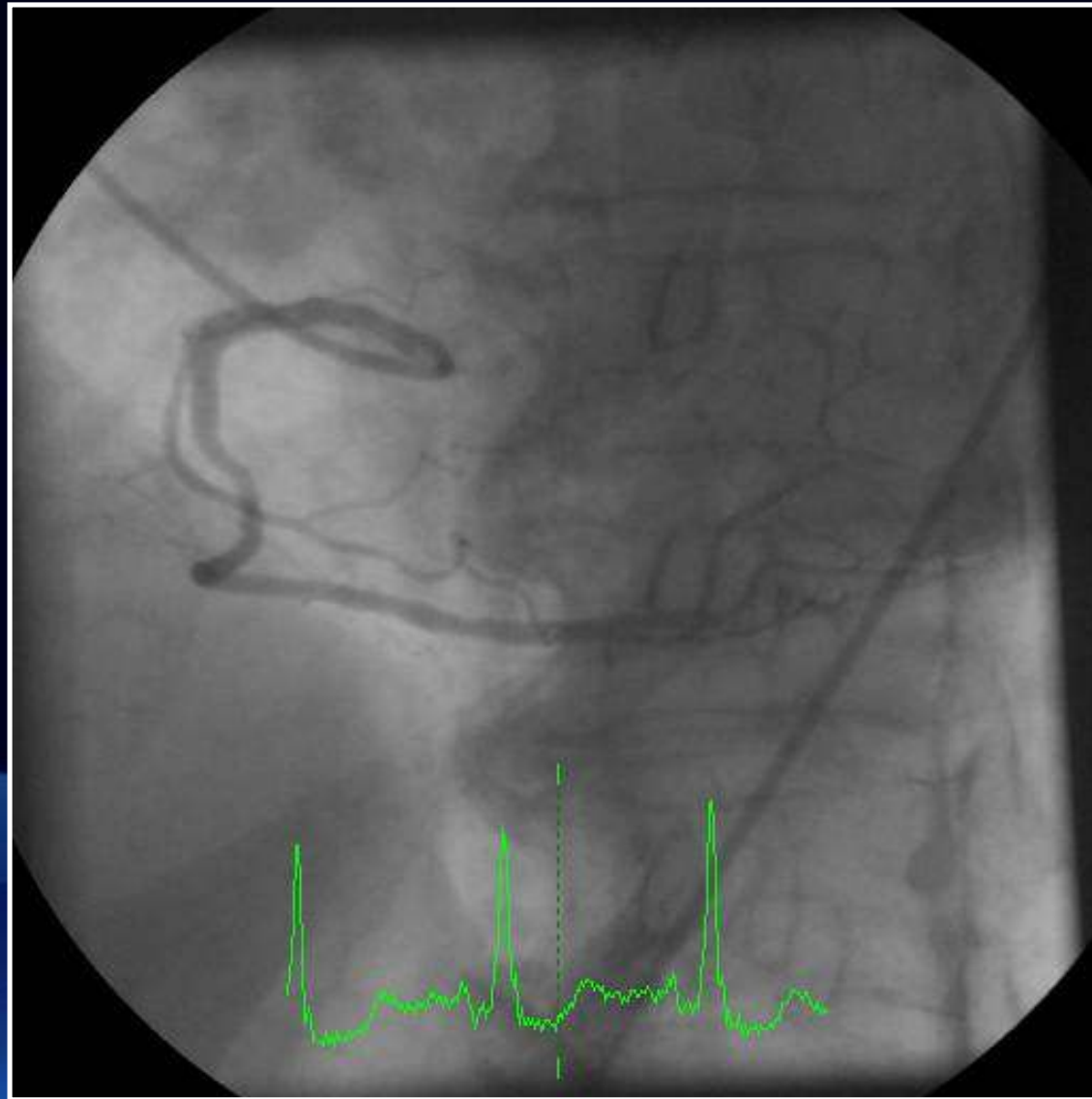
FOLLOW-UP ANGIOGRAPHY (9 MONTHS)



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Coronary stent fracture is a rare but potentially serious complication

The reported incidence of SF in different studies ranges between 0.8% and 7.7%, mainly due to variations

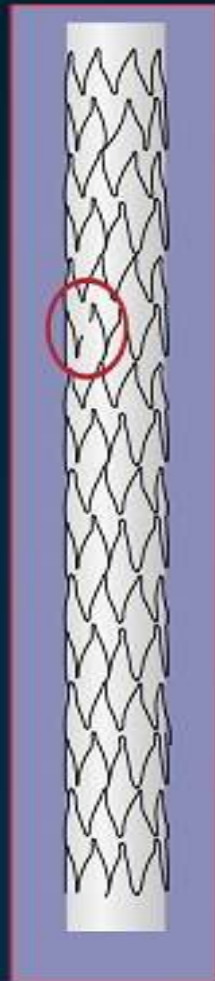
- in the rates of angiographic follow-up
- use of IVUS
- definition of stent fracture and
- differences in the types of stents used

IVUS was more sensitive than fluoroscopy in detecting stent strut fractures in multiple studies

Since IVUS evaluation is not routinely performed during follow-up, stent fracture is likely to be underdiagnosed

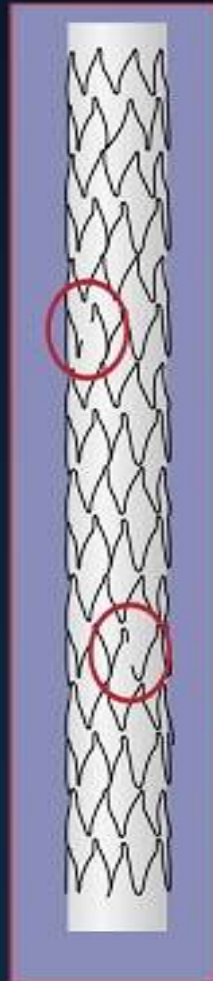


Type I



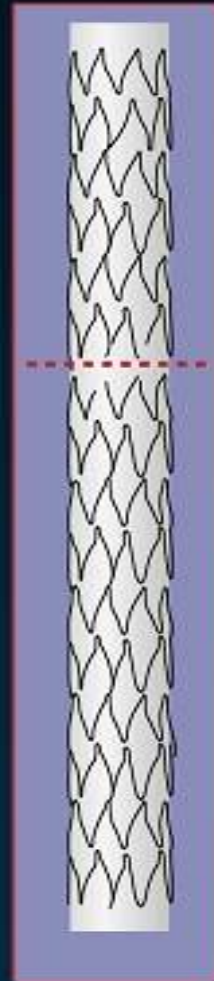
Single strut fracture

Type II



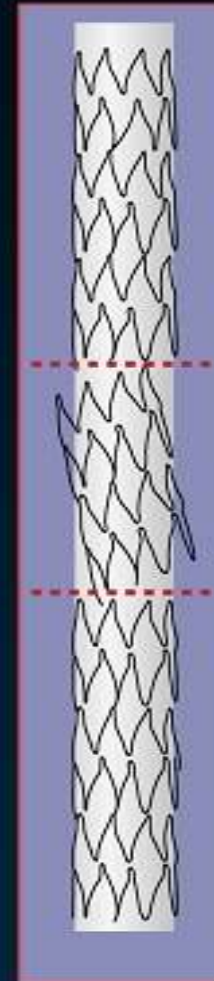
Multiple single stent fractures; different sites

Type III



Multiple stent fractures; complete transverse linear fracture

Type IV



Complete transverse linear Type III fracture with stent displacement



Factors predisposing to (drug-eluting) Stent Fracture

Anatomic

Cardiac motion

Vessel angulation

Right coronary artery

Saphenous vein graft

Procedural

Long stent

Overlapping stent

High pressure

Overexpansion

Stent design

Closed cell



The change in vessel angulation after stent implantation is also associated with the occurrence of SF.

Stent placement often straightens out the vessel; however, the vessel continues to return to its original shape.

The force to return the vessel to its original shape may be stronger if the change in vessel angulation after stent implantation is increased.

Longer stents are subjected to higher radial forces compared to shorter ones, and they may be prone to fracture, especially when placed in tortuous vessels or calcified lesions.



Most studies reported overlapping stents as a significant risk factor for SF, with an average rate of over 60% associated with overlapping stented lesions

The majority of stent fractures occurred within 10 mm from areas of increased rigidity caused by strut overlap.



The majority of DES fracture events have been reported in SESs

The closed-cell design of SES may be more prone to fracture when shear forces are beyond its flexibility.

The closed-cell design of the Cypher stent is more rigid, resulting in more straightening of coronary vessels compared to the open cell Taxus design.

However, it also must be taken into account that the Cypher stent is more radio-opaque and stent fracture may be easier to diagnose by angiography.



✓ **Stent fractures were more commonly reported in the RCA .** The predisposition of the RCA for SF is possibly attributed to the vessel anatomy, due to the excessive tortuosity, angulation, or change of angulation after stent implantation.

✓ **The next most common locations were the LAD, Cx, saphenous vein grafts and the left main stem.**



Clinical Implications

The complications observed with DES fracture include :

- in-stent restenosis and target lesion revascularization,
- stent thrombosis
- myocardial infarction and sudden death
- Patients may remain asymptomatic



While most of the stent fractures have been discovered during follow-up angiography six months or more post-implantation, SF cases have been reported from immediately after to several years after the index procedure

The length of time that a vessel wall is exposed to fractured stent struts may be important and possibly determine clinical outcomes.
An early fracture affects local drug delivery and can lead to focal neointimal hyperplasia.

On the other hand, since significant restenosis was not observed in a significant number of fracture sites, it may be presumed that in these cases, stent strut fracture occurred long enough after implantation so that the drug effect was not compromised .



Management strategies

The management of stent fractures remains controversial.

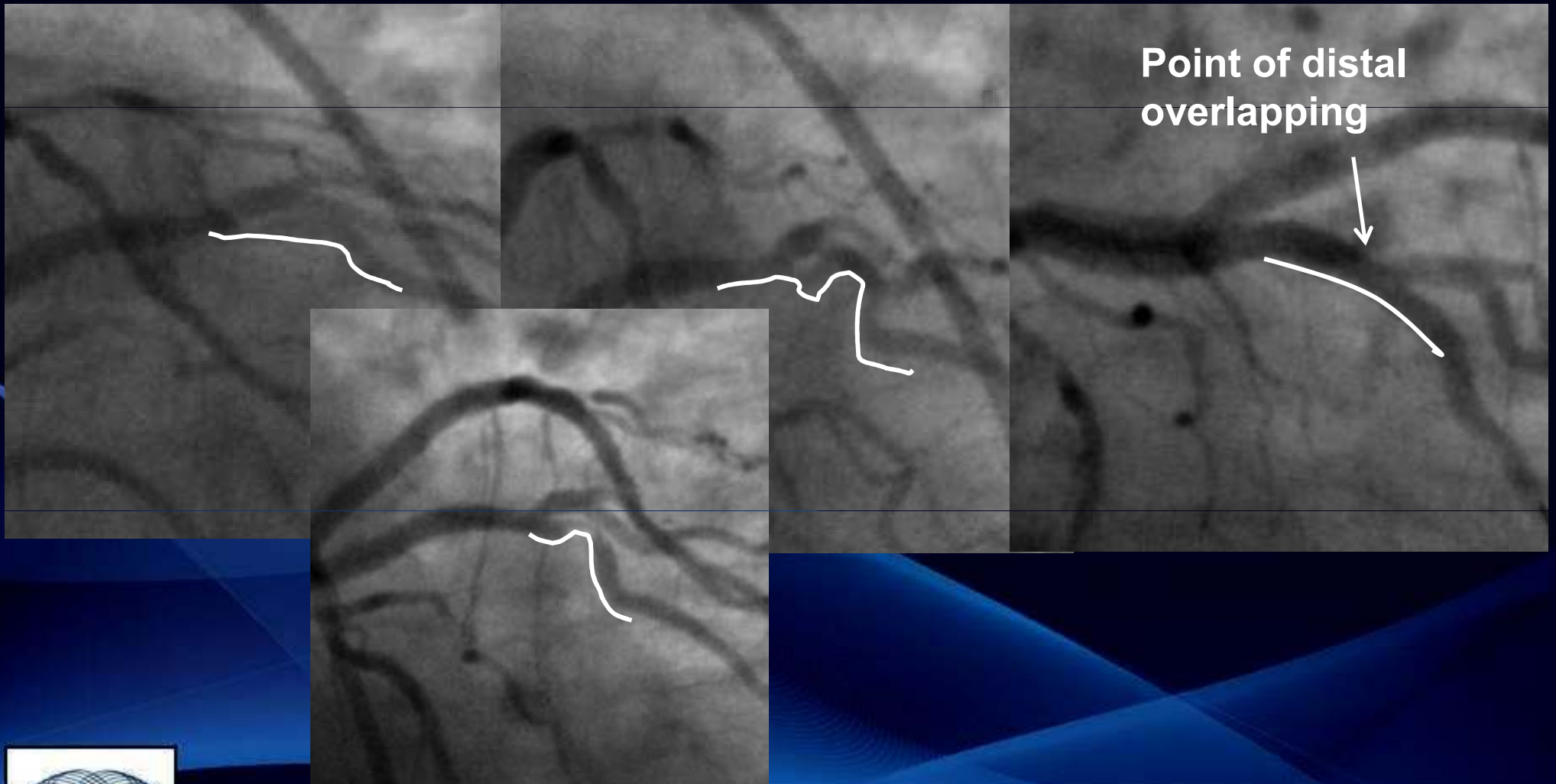
If focal in-stent restenosis occurs, it seems reasonable to repeat percutaneous revascularisation with a short stent.

With repeat stenting there is a possibility of recurrence of SF whereas, on the other hand, the effect of balloon angioplasty on disrupted DESs is unknown.

The use of paclitaxel-eluting stents or other newly developed DESs might be an appropriate selection since their platform is more flexible.



In our case, it seems that the use of three, overlapping stents along with the presence of angulation and increased vessel movement contributed to the fracture. Despite the fact that each of them had relatively short length, the fracture occurred very close to the distal overlapping site, at a point where there was a vessel angulation.



A careful examination of the vessel anatomy, careful selection of the stent length and type and a proper deployment technique is required for special coronary situations in order to reduce the occurrence of this phenomenon.



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ΕΥΧΑΡΙΣΤΩ!



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Definitions Used for Stent Fracture

Classification	Current Report	Allie et al ¹	Scheinert et al ²
Type 0	No strut fracture	-	-
Type I	Single strut fracture or gap between struts greater than 2x normal	Single strut fracture only	Minor – single strut fracture
Type II	Multiple strut fractures with V-form division of the stent	Multiple single stent fractures occurring at different sites	Moderate – fracture >1 strut
Type III	Complete transverse stent fracture without displacement of fractured fragments more than 1 mm during the cardiac cycle	Multiple single stent fractures resulting in complete transverse linear fracture but without stent displacement	Severe – complete separation of stent segments
Type IV	Complete transverse stent fracture with abundant movement and displacement of fractured fragments of more than 1 mm during the cardiac cycle	Complete transverse linear type III fracture with stent displacement	-

¹ Allie et al Endovascular Today 2004; July/August: 22-34

² Scheinert et al J Am Coll Cardiol 2005; 45:312-315

* Type 5 implies spiral fracture of stent



Stent Fracture: Discussion

Risk factors for Stent fracture – “Ultra-complex lesions”:

- RCA > LAD >> Circ
- Very diffuse and complex disease
- Long stented segments (long stents)
- Multiple overlapping stents
- Angulated vessel segments / tortuosity
- Mobile vessels (flexion, extension, torsion)
- Suboptimal initial angiographic results
 - likely relating to vessel rigidity/calcification and diffuse disease

