



CTO-PCI: Antegrade Wire Escalation - Expert's Secret

# Antegrade Wire Escalation

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# Background

- Antegrade Wire Escalation (AWE) is the basis of CTO-PCI.
- AWE is the essential in any method of CTO recanalisation.

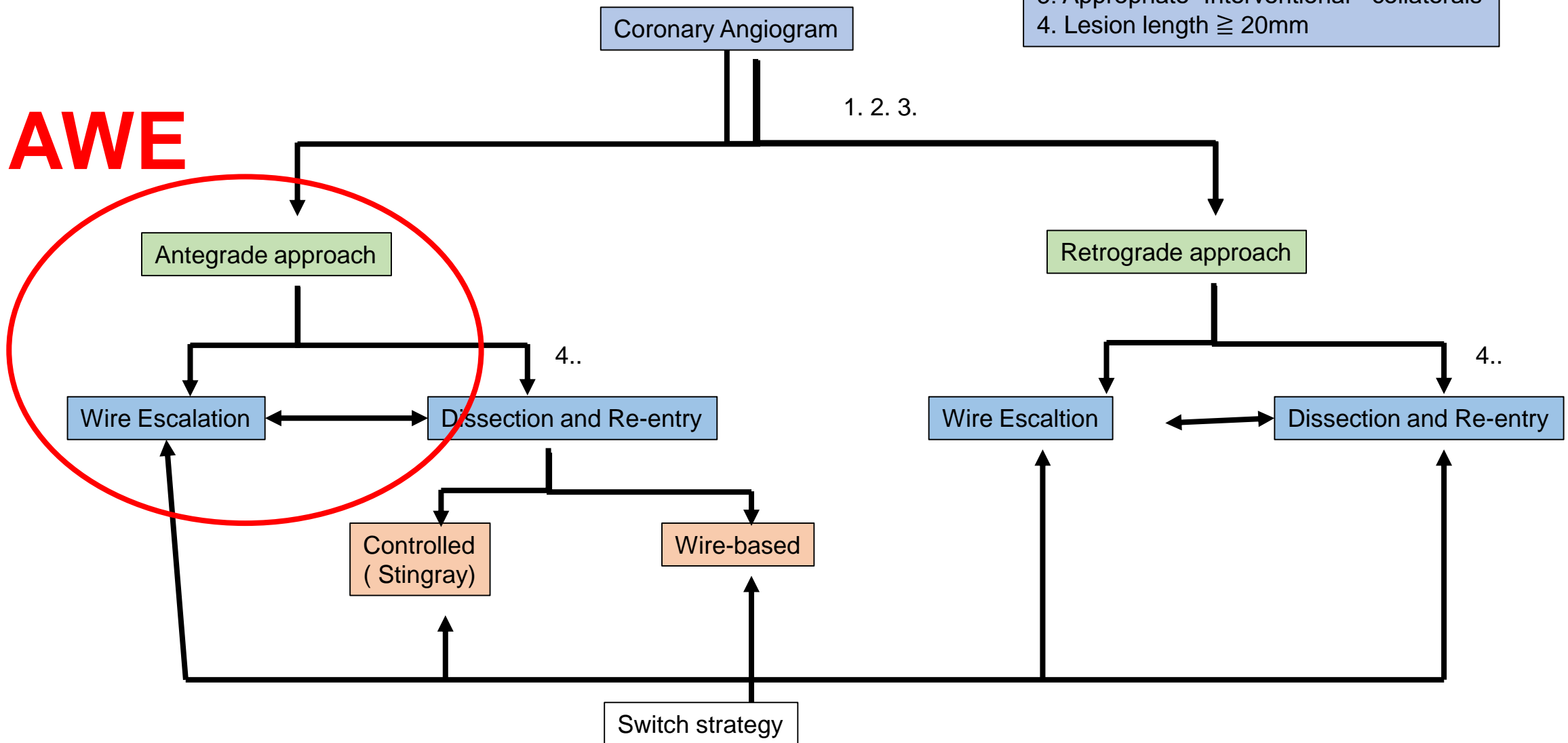
# Procedural Issues in CTO-PCI

- Thorough Reading Angiogram
- Visualization of collateral
- Guiding Catheter Selection
- **Wire Selection and Handling**
- Techniques for getting Backup Force
- Preparation: Dilatation, Stenting, Debulking

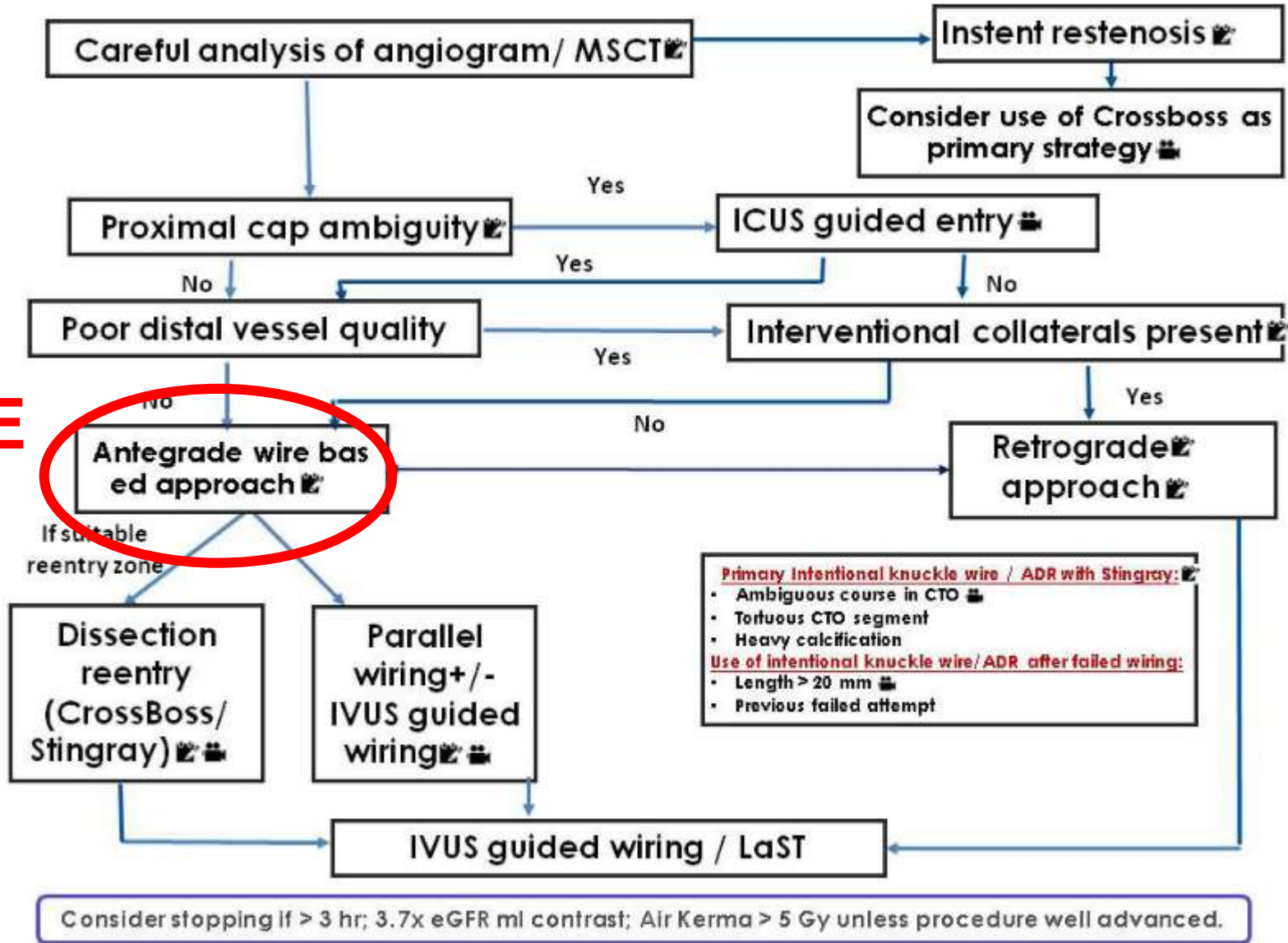
# Hybrid Algorithm

- 1. Proximal cap ambiguity
- 2. Diseased distal landing zone / distal cap at bifurcation
- 3. Appropriate "Interventional" collaterals
- 4. Lesion length  $\geq 20$ mm

**AWE**

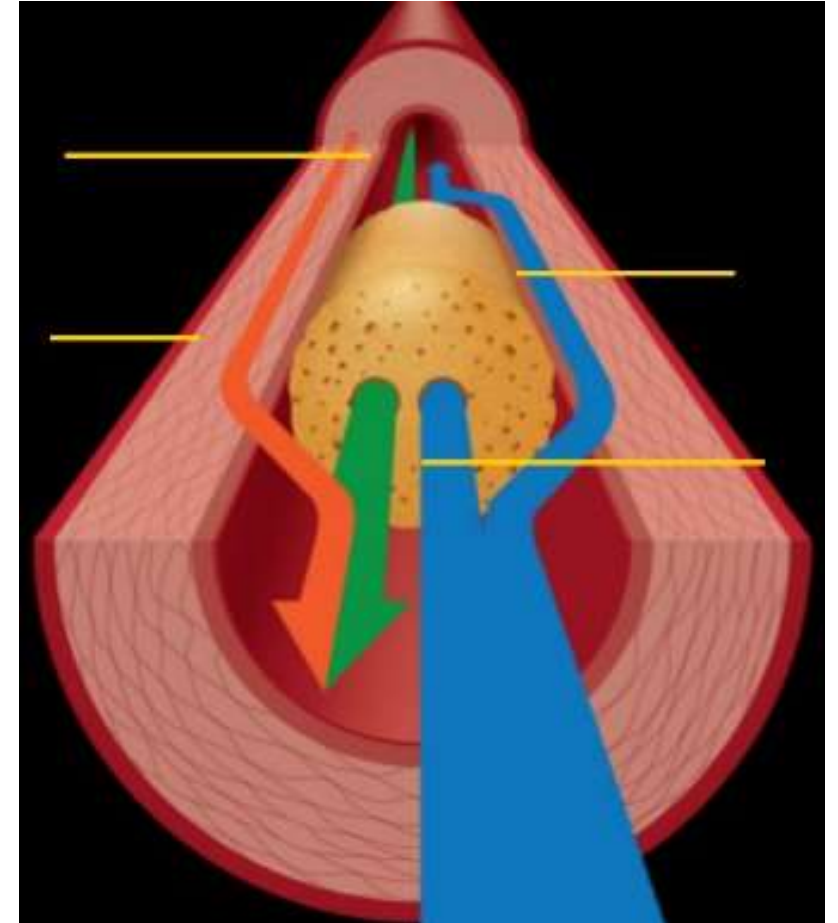
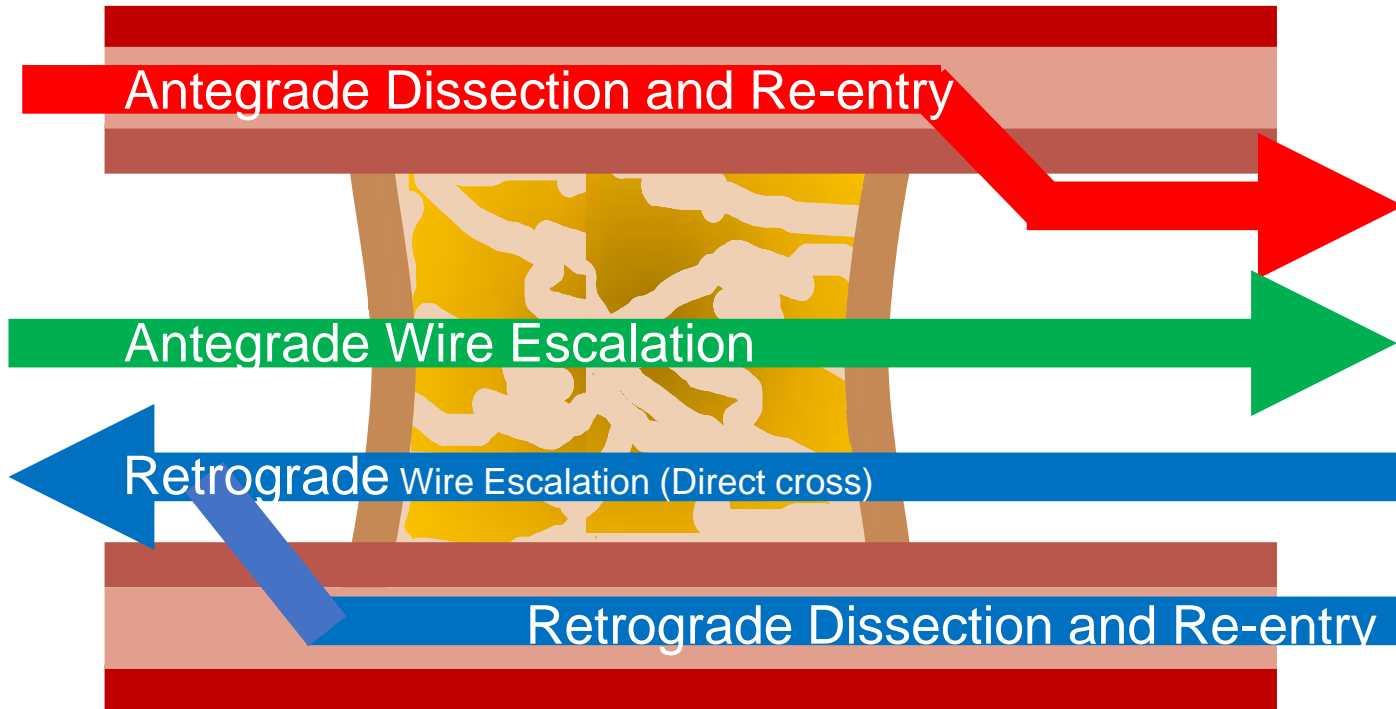


**AWE**

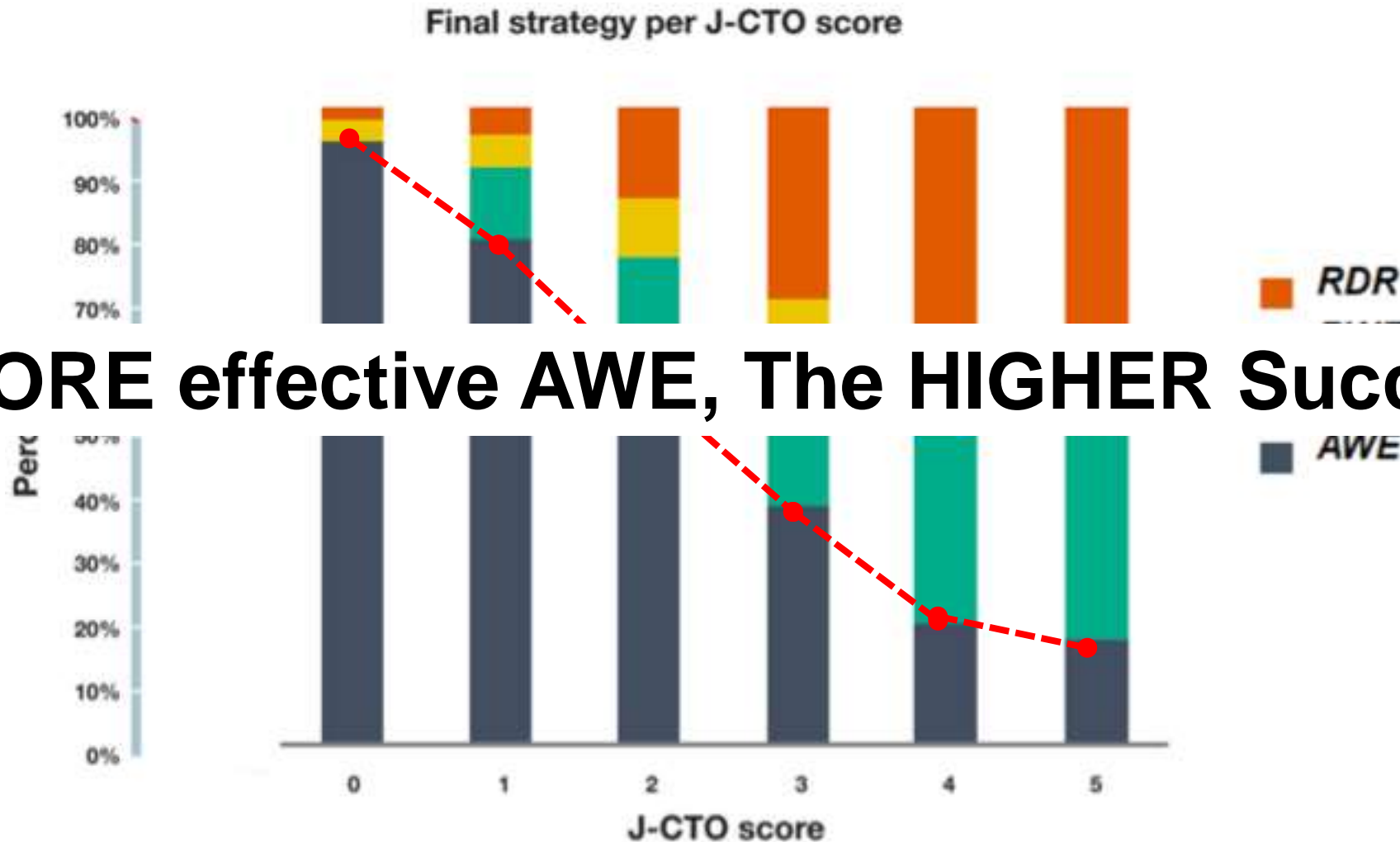




# AWE



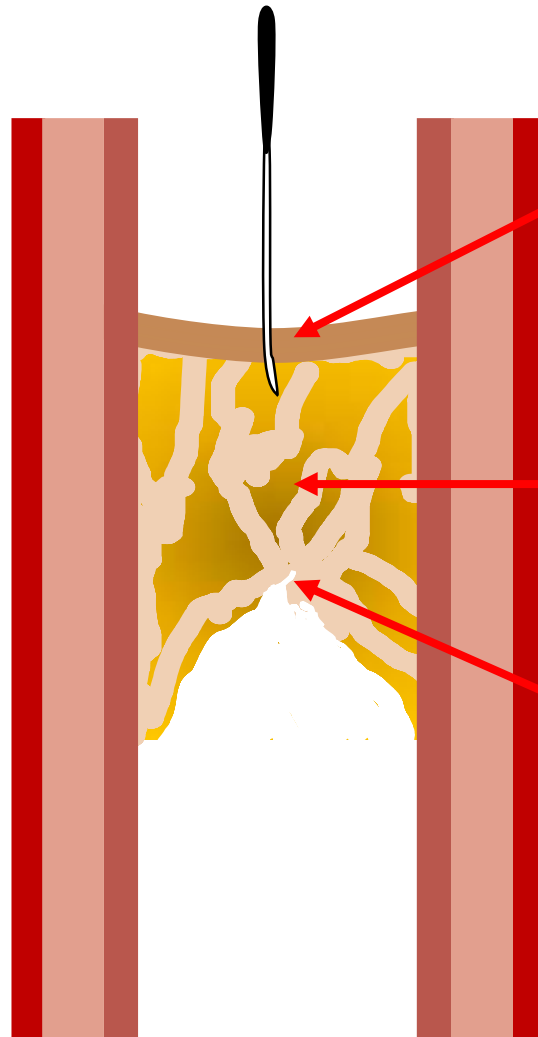
The **MORE** complex the CTO,  
The **LESS** effective AWE will be.



The **MORE** effective AWE, The **HIGHER** Success Rate.



# How to achieve successful AWE



## **STEP 1**

Penetration of Proximal Cap or  
Micro Channel Tracking

## **STEP 2**

Intimal Tracking of CTO-Body

## **STEP 3**

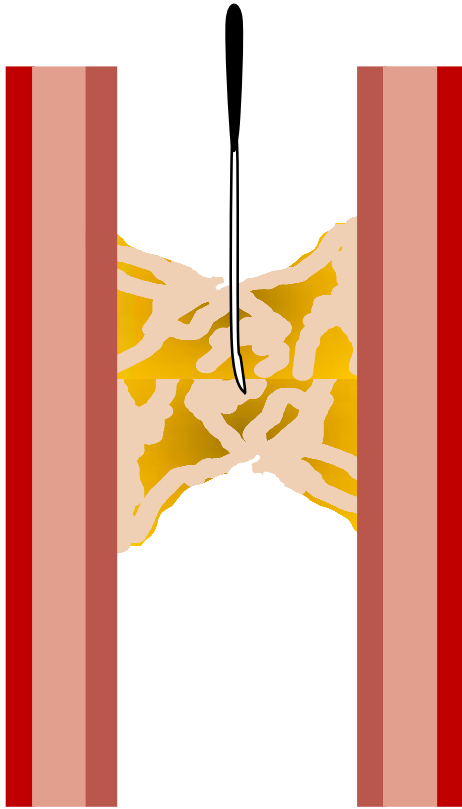
Penetration of Distal cap,  
Advance to Distal True Lumen

# Proximal and Distal Cap Morphology

## Abrupt ? Tapering?

①

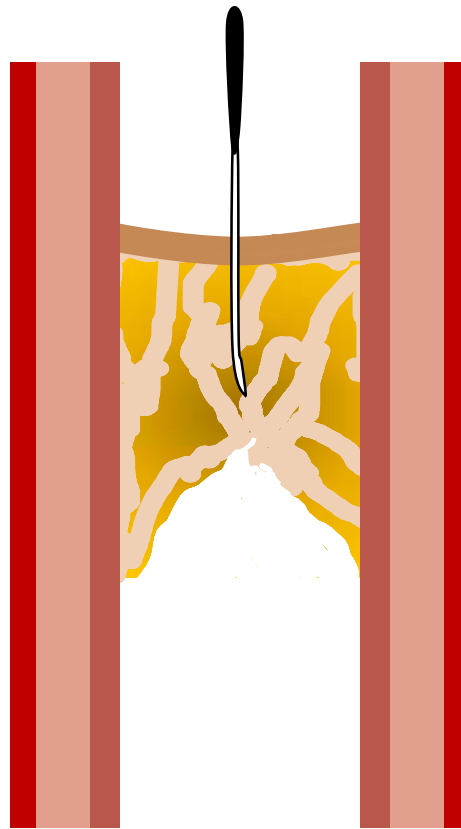
Proximal cap?  
⇒ Micro channel



Distal cap?  
⇒ Micro channel

②

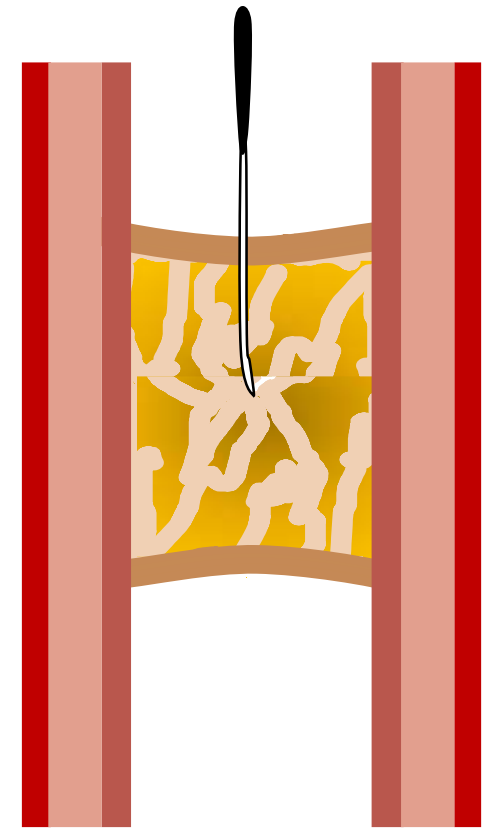
Proximal cap  
⇒ Penetration



Distal cap?  
⇒ Micro channel

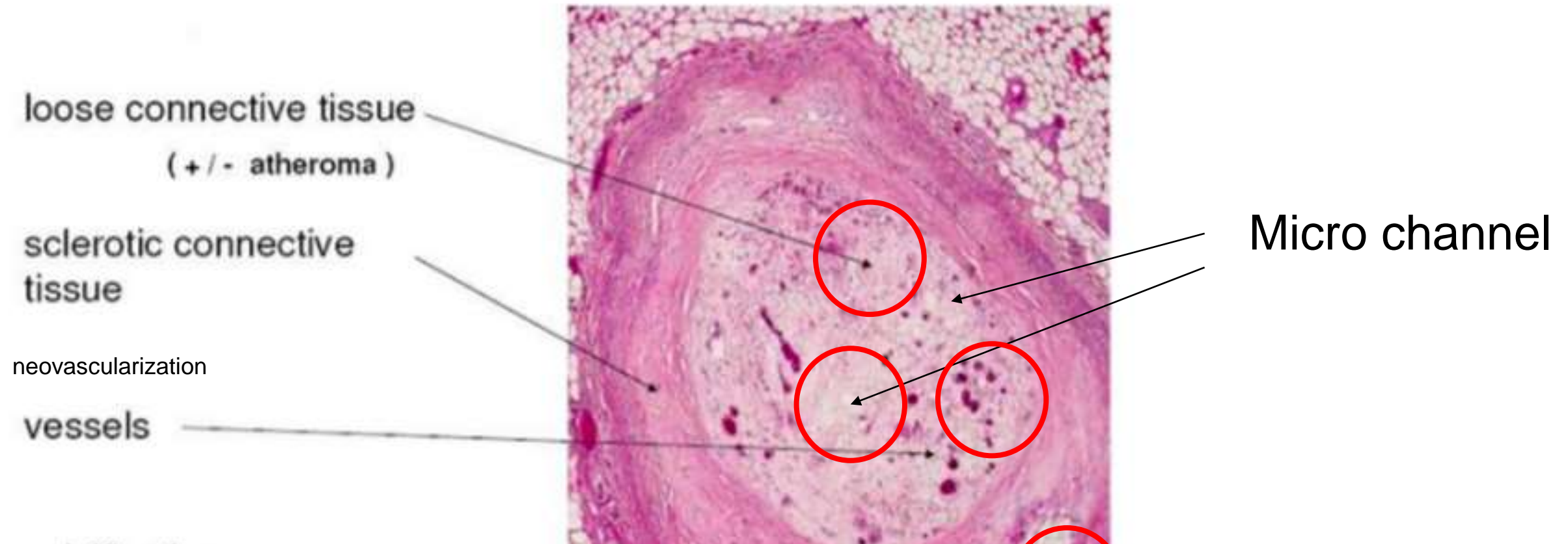
③

Proximal cap  
⇒ Penetration



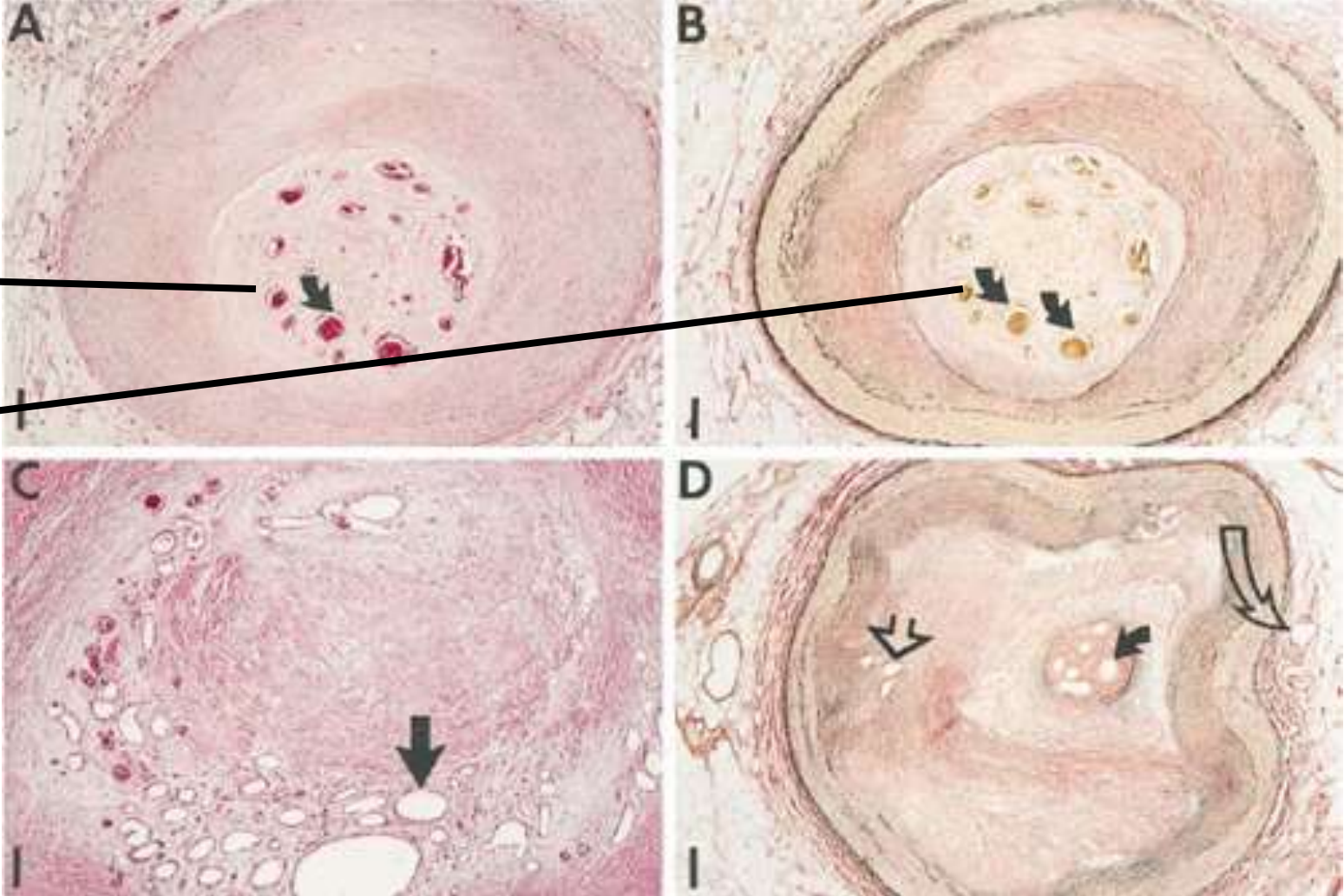
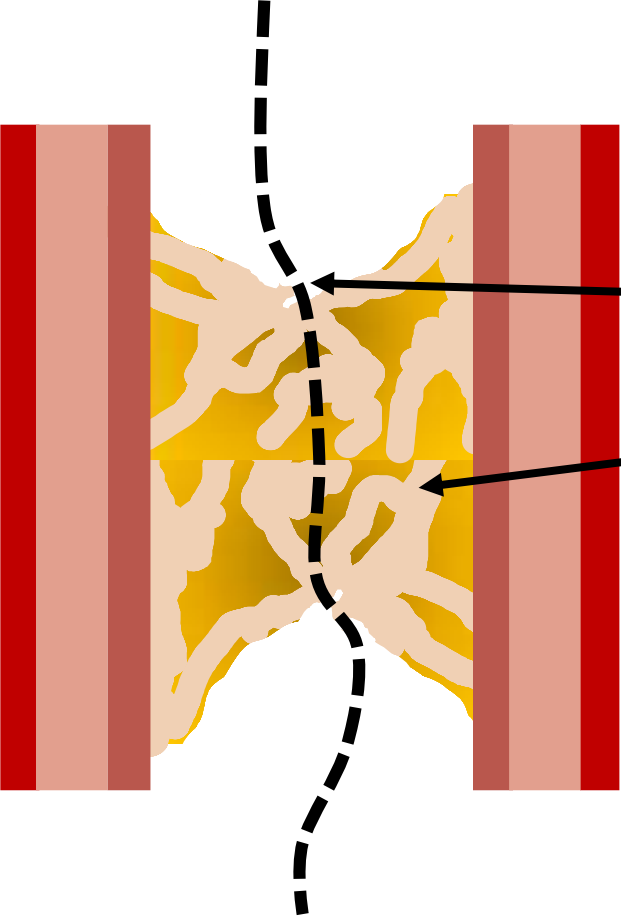
Distal cap  
⇒ Penetration

# Vessel Pathology



Appropriate wire selection according to the morphology and procedural situation is important.

# Micro Channel



Histological average size is 200 $\mu$ m (0.008 inch)

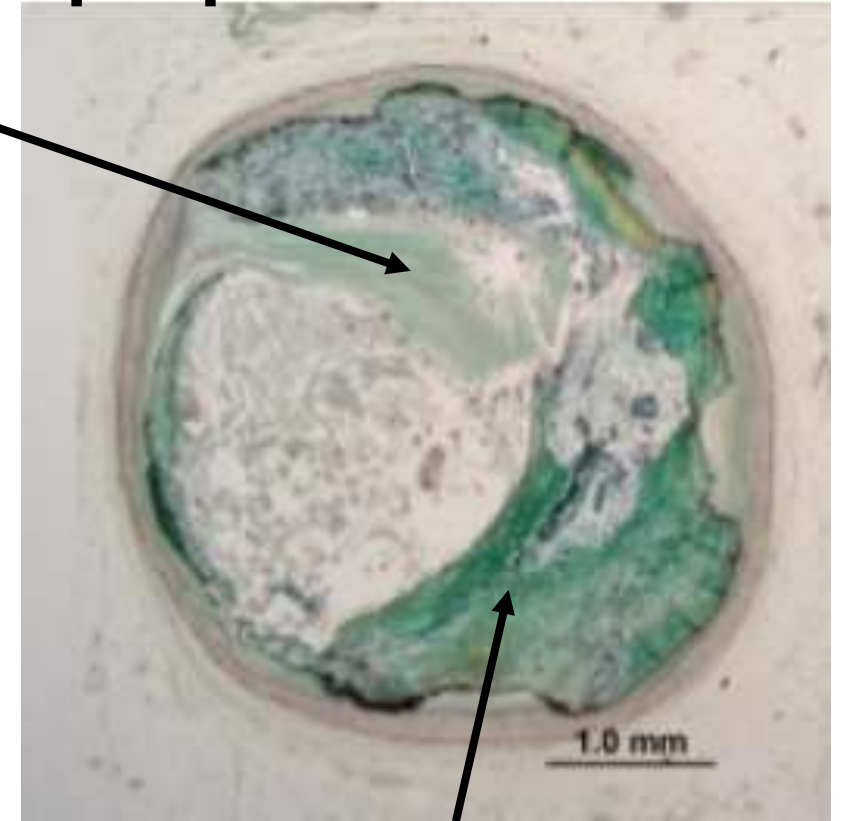
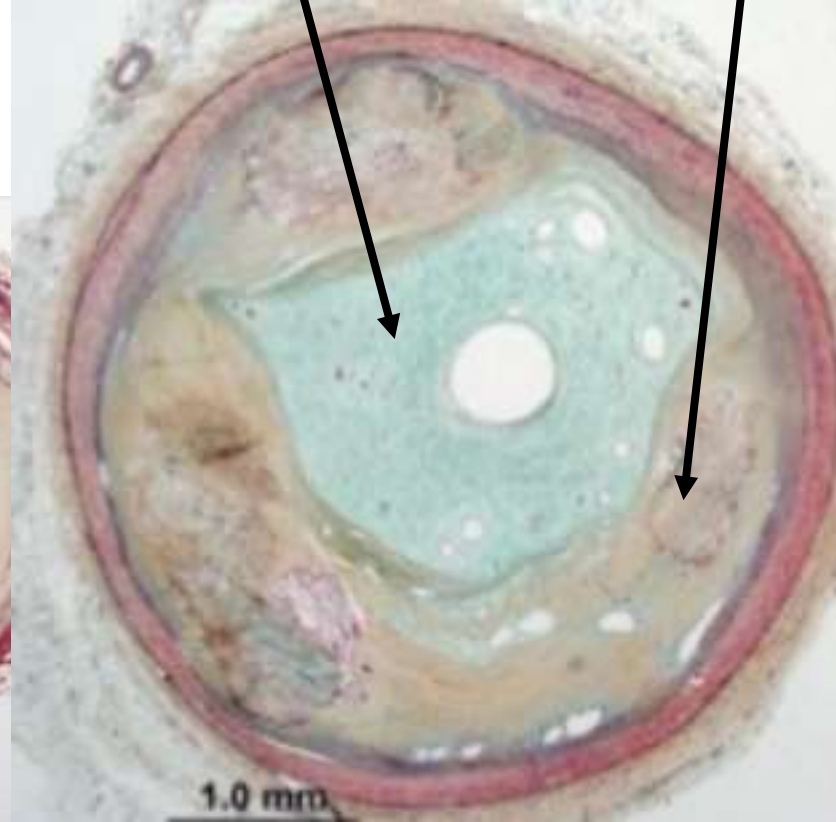
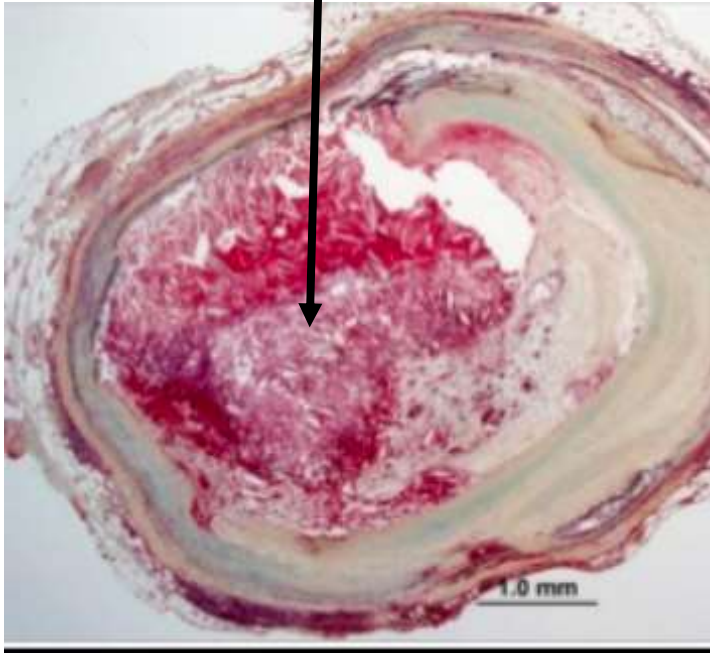


# Calcified and Fibrous

Proteoglycan  
Soft ?

Fibrous plaque  
Hard?

Soft ?

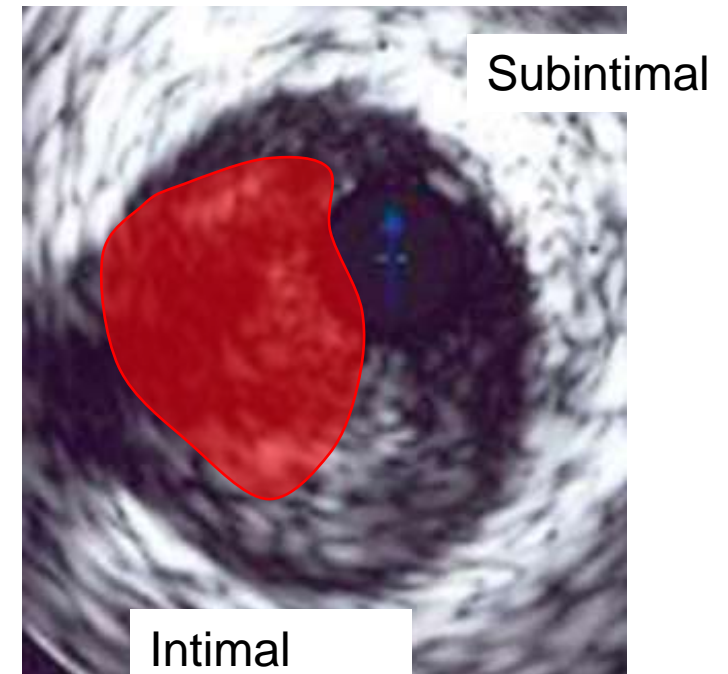
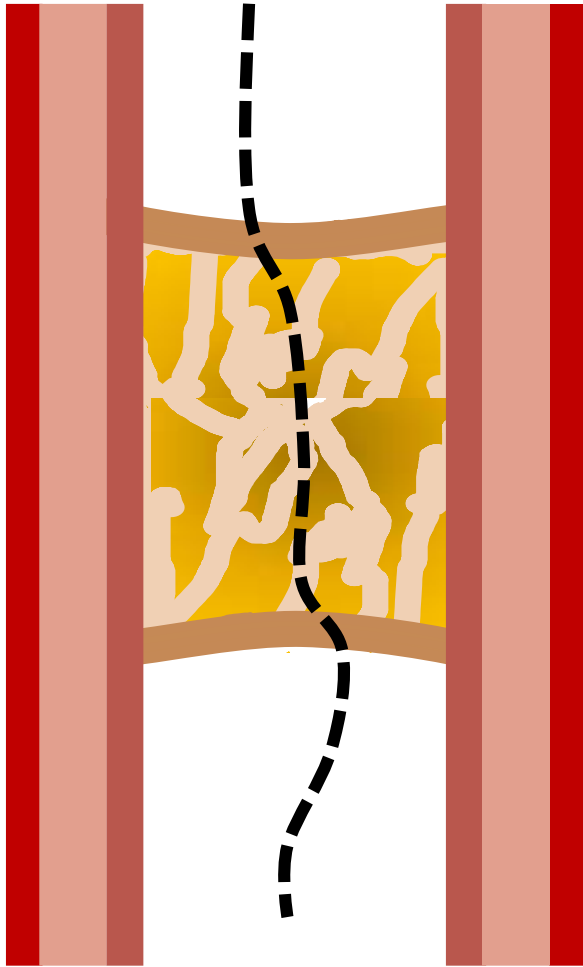


Calcified plaque  
Hard?

**Organizing Thrombus**

# Intimal Tracking

- Calcified plaque
- Organizing thrombosis ***Keep intimal tracking.***
- Fibrous plaque
- Microchannel
- Proximal cap (Thick, Hard, Convex ☐)
- Distal cap (Thin, Concave ☐)



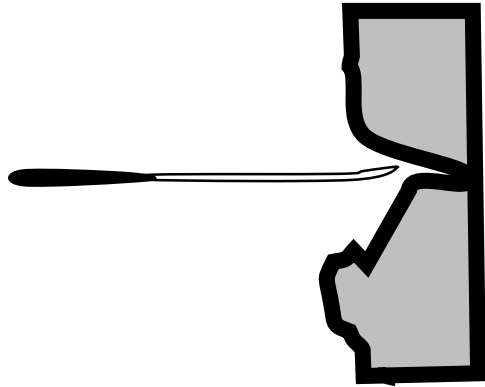
# Characteristics of Wires

1. Tip Load
- 2. Penetration Force**
3. Tip Flexibility
4. Shaft Support
- 5. Torque Response**
6. Torque Force
- 7. Tip lubricity**
  - i. Hydrophilic on Polymer jacket
  - ii. Hydrophilic ( Hi / Low)
  - iii. Silicone



# Characteristics of Wires

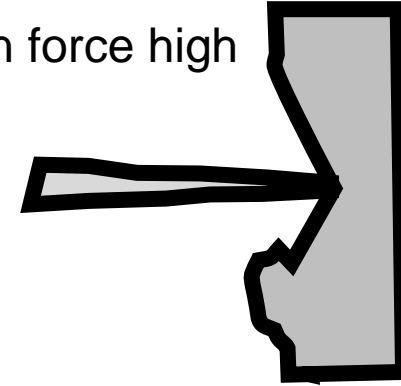
Tapered wire



⇒ XT-R, XT-A

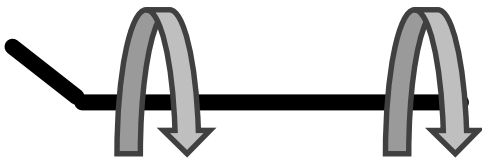
Tip Flexibility low

Penetration force high

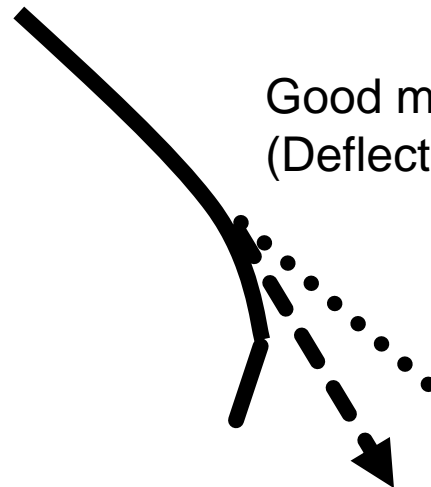
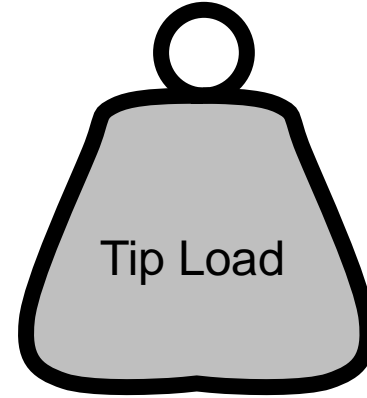


⇒ Conquest PRO

Torque Response

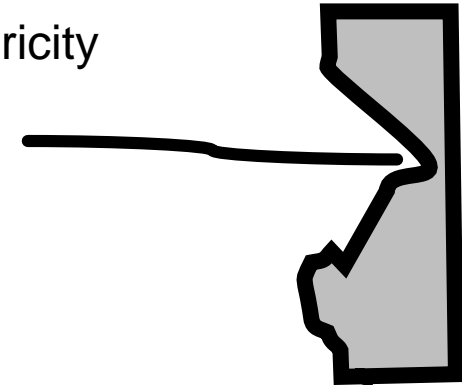


⇒ GAIA Next 1, 2, 3

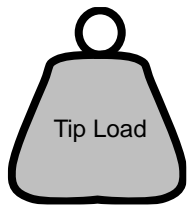


Good manipulation  
(Deflection)

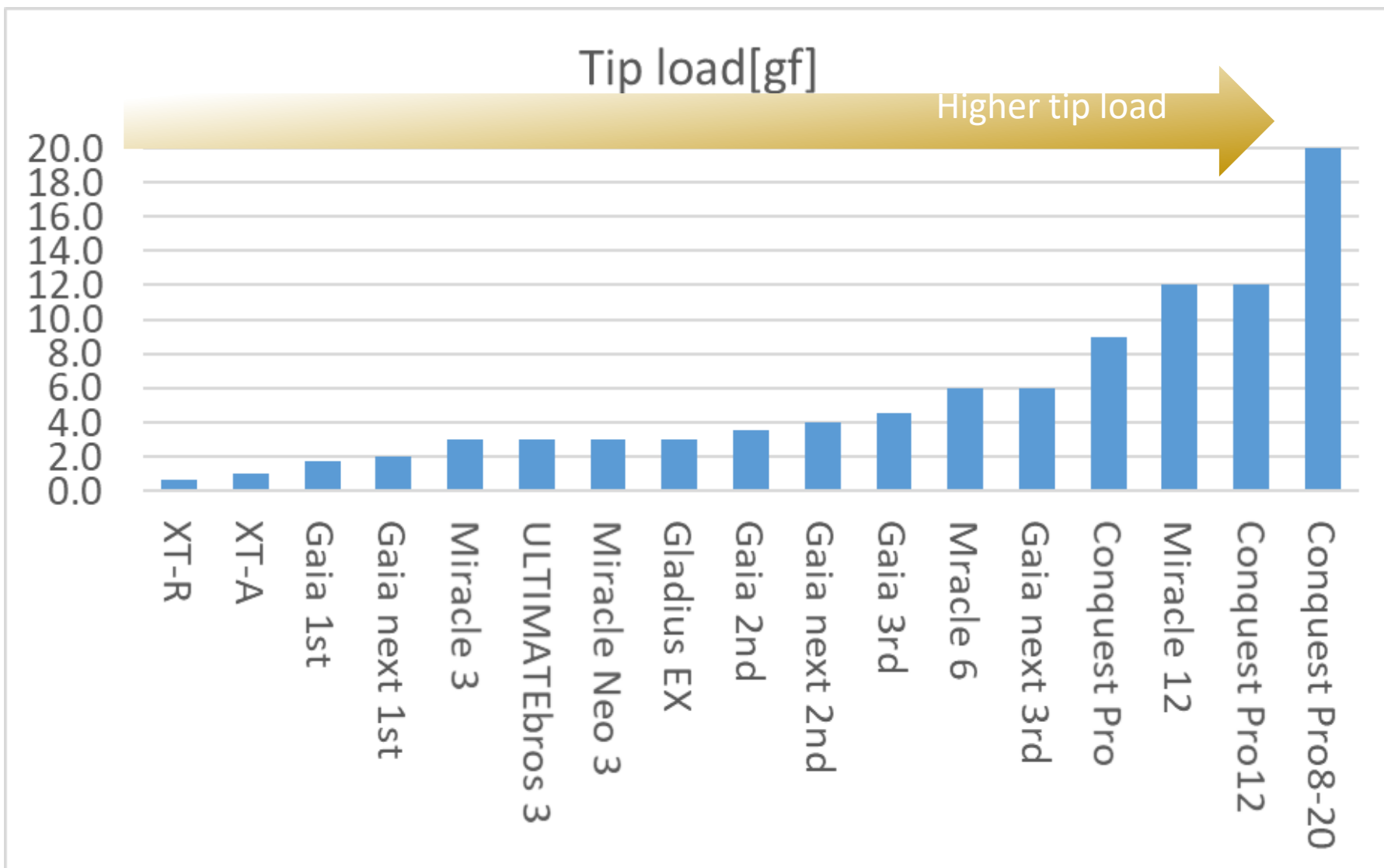
Lubricity



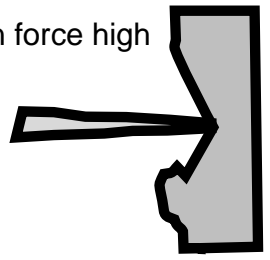
⇒ Fielder FC, SION black



# Tip Load

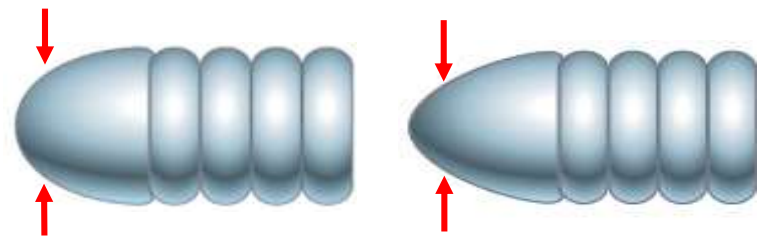


Penetration force high

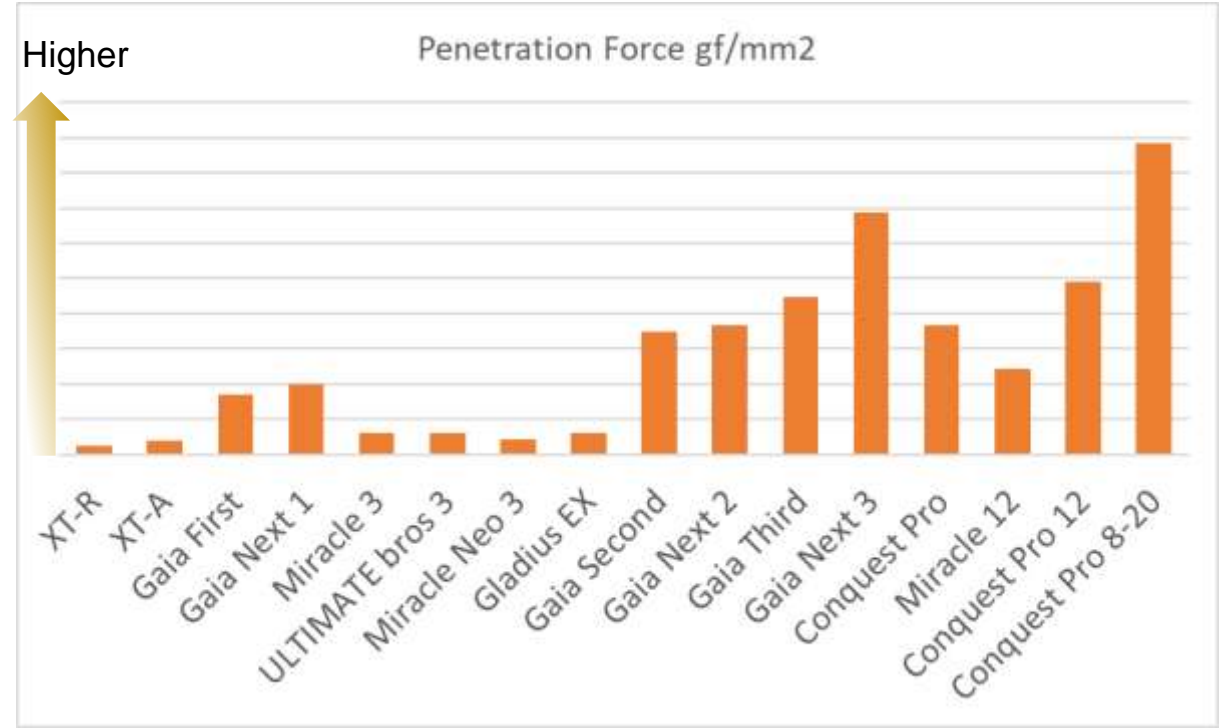


# Penetration Force

$$\text{Penetration Force} = \frac{\text{Tip load}}{\text{Tip dimension}}$$



Outer diameter of the distal end

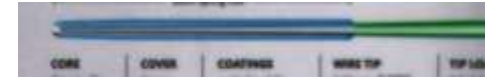
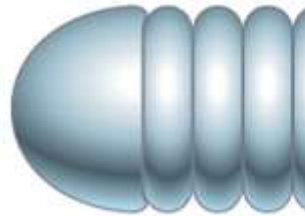


# Tip End Design / Cross Section Area

The ball tip has been sharpened to provide the necessary penetration

## ➤ Plain ball tip

--- *Conventional guide wire*



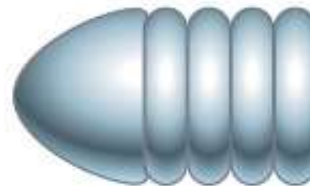
Conquest PRO



Miracle series, UB3

## ➤ Micro-cone tip

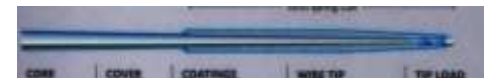
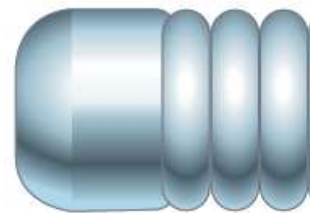
--- *Gaia, Gaia Next*



GAIA NEXT 1, 2

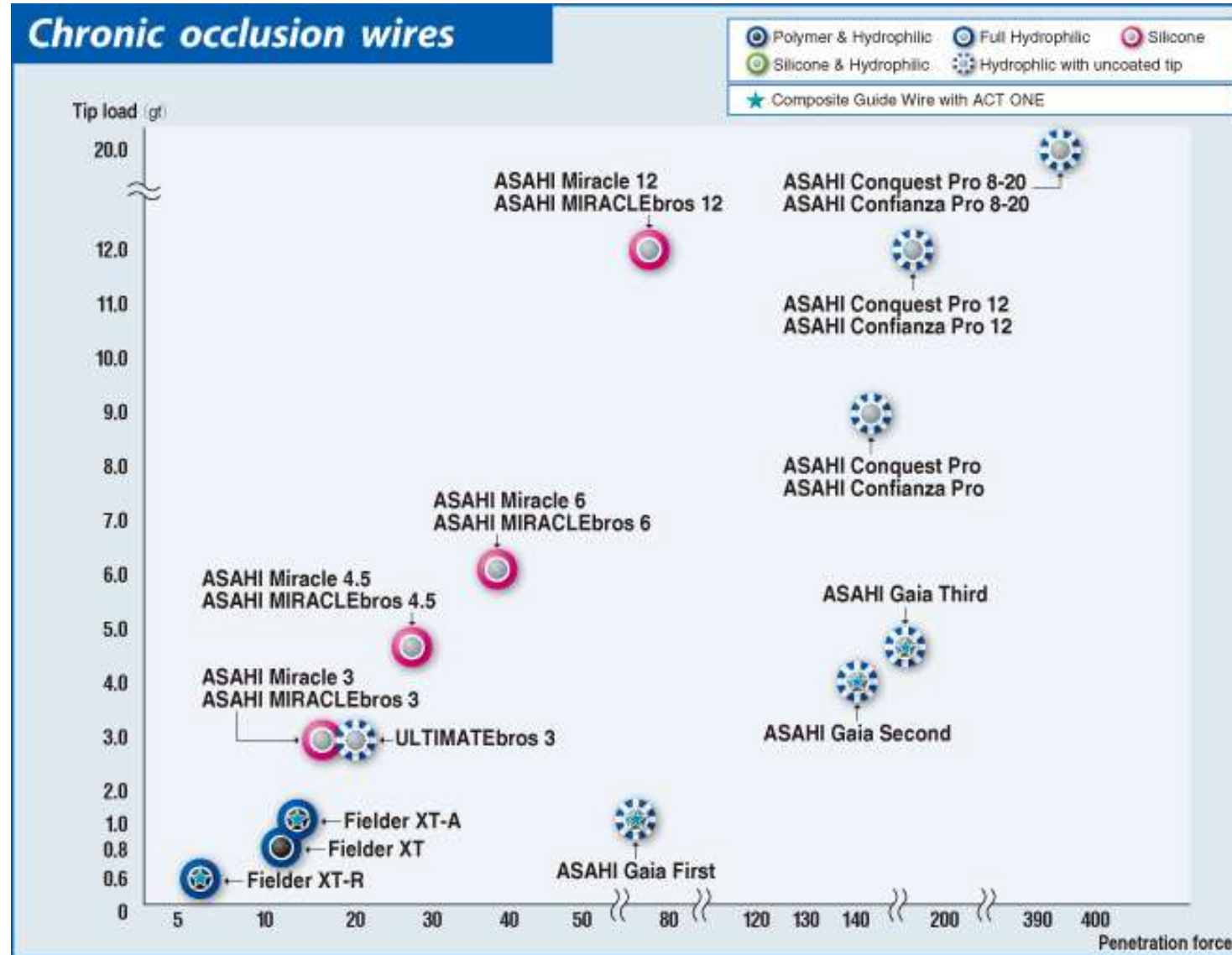
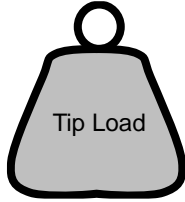
## ➤ Blunt tip

--- *Miracle Neo 3*

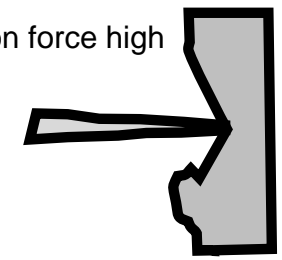


GAIA NEXT 3

# Characteristics of Wires



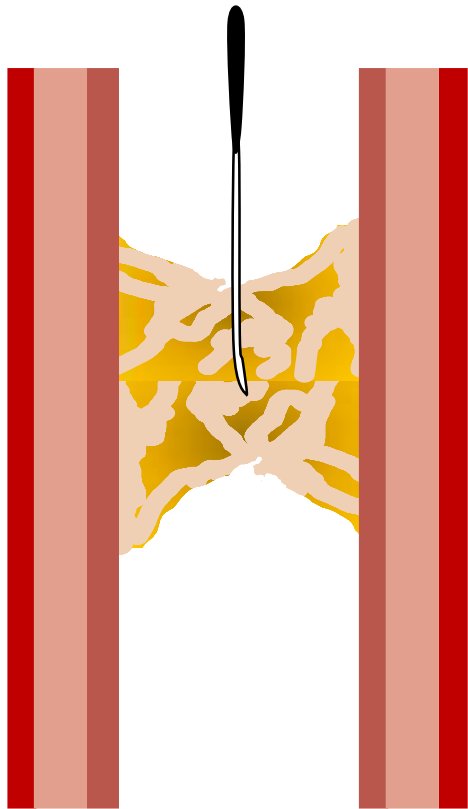
Penetration force high



# STEP1. Advance into the CTO Body

## *Identify lesion types.*

Proximal cap?  
Micro channel



Distal cap?  
Micro channel

Tapered cap

### 1. Micro channel tracking

→ very low tip load, polymer jacket wire



### 2. Loose tissue tracking

→ low tip load, polymer jacket wire

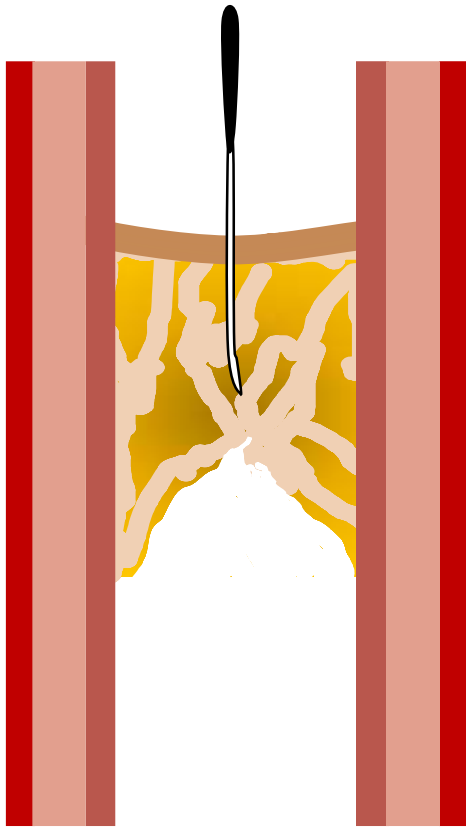


XT-A

- Advance along the imagined pass line by angiogram.
- Intentional and careful wire manipulation.

# STEP1. Advanced into Body of CTO

Proximal cap  
Penetration



Distal cap?  
Micro channel

## 3. Proximal fibrous or calcified cap

Abrupt proximal cap

→ high tip load, tapered, high penetration force

Drilling



Miracle series, UB3

Controlled Penetration



GAIA NEXT 3

Visible CTO Negotiation



GAIA NEXT 1, 2

Calcified Penetration



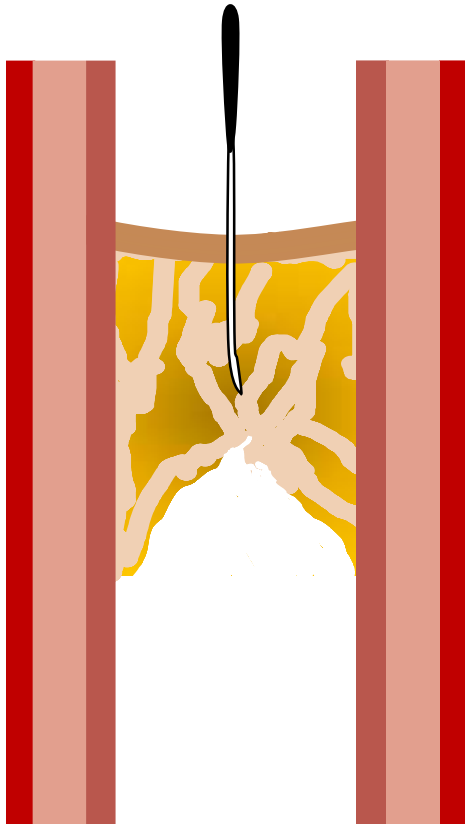
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# STEP2. Tracking Body of CTO

**E**scalation ↔ **D**e-escalation

Proximal cap  
Penetration



Penetration of Proximal cap

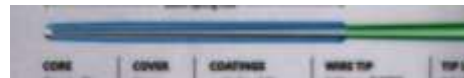
Micro channel tracking

Controlled Penetration



GAIA NEXT 3

Calcified Penetration



Conquest PRO

Low medium tip load  
Polymer wire or medium tip load

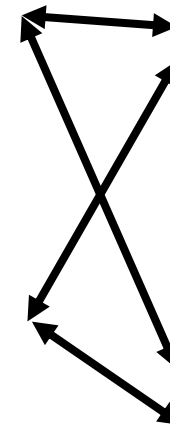


XT-R

Loose tissue tracking  
High torque wire

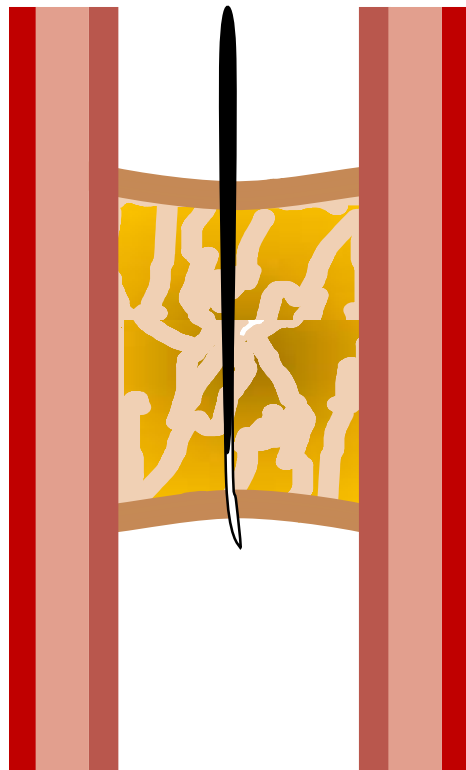


GAIA NEXT 1, 2



# STEP 3

## Penetration of Distal Cap, Advanced to Distal True Lumen



### Re-Escalation

Require

Medium tip load, high torque

Penetration wire

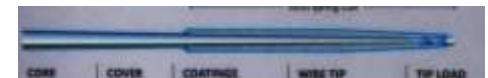
Loose tissue tracking

High torque wire



GAIA NEXT 1, 2

Controlled Penetration



GAIA NEXT 3

Calcified Penetration

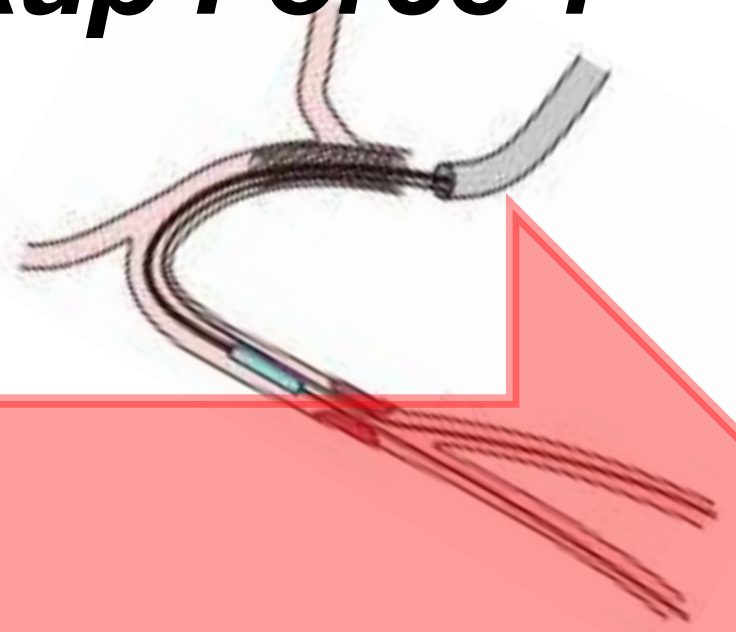


Conquest PRO

# AWE requires Optimal Backup Force.

## *How do you get Backup Force ?*

**Active back up**  
**Passive back up**



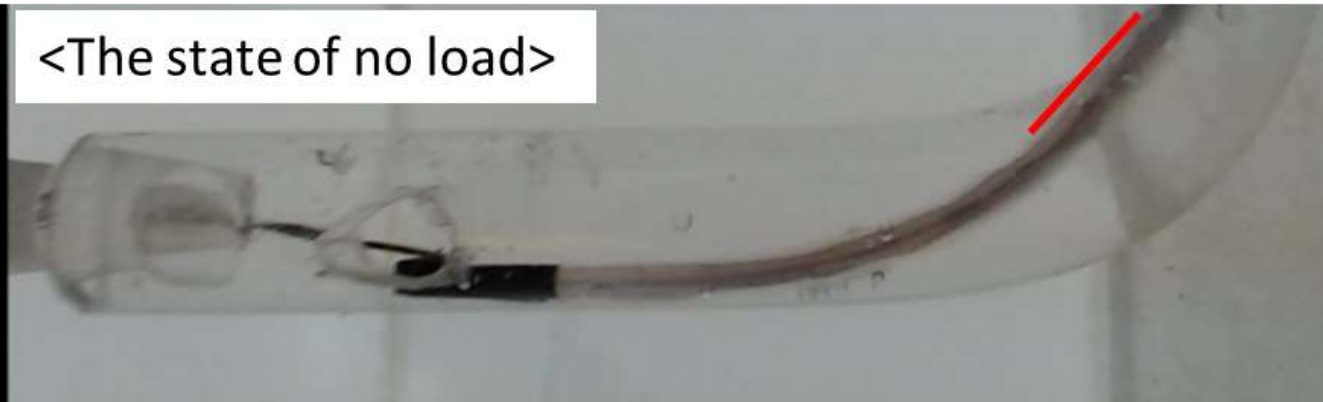
- Larger guiding catheter
- Use Micro catheter, Double lumen catheter
- Anchor balloon
- Guide extension
- Stent jailed wire anchor

**Friction Resistance**

# Definition of MC maximum supportability

- Catheter back up load:  
Load that the catheter is impressed on the greater curvature side by the opposed action when forwarding GW.

<The state of no load>



**No load**

On the bend, catheter touch the lesser curvature side.

<The state of maximum supportability>



**Maximum load**

Shaft shifted to the greater curvature side.

# Parallel guide wire technique

## Comparison of stability

Backup  
with microcatheter for CTO's

CTO Lesion



Backup  
with DLC for CTO's

1<sup>st</sup> Wire



2<sup>nd</sup> Wire

# Supportability test of each GW

Unit:[gf]

## Maximum supportability [gf]

Unit : [gf]	Ultimate Bros3	Gaia First	Gaia Second	Gaia Third	Conquest Pro	Conquest Pro12
Caravel	7.8	6.3	7.3	7.7	10.6	15.0
SASUKE: RX: Gaia First	18.7	≥7.3	18.5	18.9	23.2	27.5
SASUKE: RX: Con12	≥20.7	≥8.8	30.8	≥34.2	31.5	≥50.4

※about ≥

It is mentioned when the catheter did not touch the wall (when the catheter touch the wall, it has maximum supportability ) or the GW reached the maximum load.

→Test results with ≥ means, 【maximum load of GW ≤ catheter's supportability】 and supportability could be larger.

# Supportability of each GW

## The Ratio of Caravel to SASUKE

The maximum catheter's supportability of each GW

	Ultimate Bros3	Gaia First	Gaia Second	Gaia Third	Conquest Pro	Conquest Pro12
Caravel (base line)	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>
SASUKE: RX: Gaia First	<b>2.4</b>	<b>≥1.2</b>	<b>2.5</b>	<b>2.5</b>	<b>2.2</b>	<b>1.8</b>
SASUKE: RX: Con12	<b>≥2.7</b>	<b>≥1.4</b>	<b>4.2</b>	<b>≥4.5</b>	<b>3.0</b>	<b>≥3.4</b>

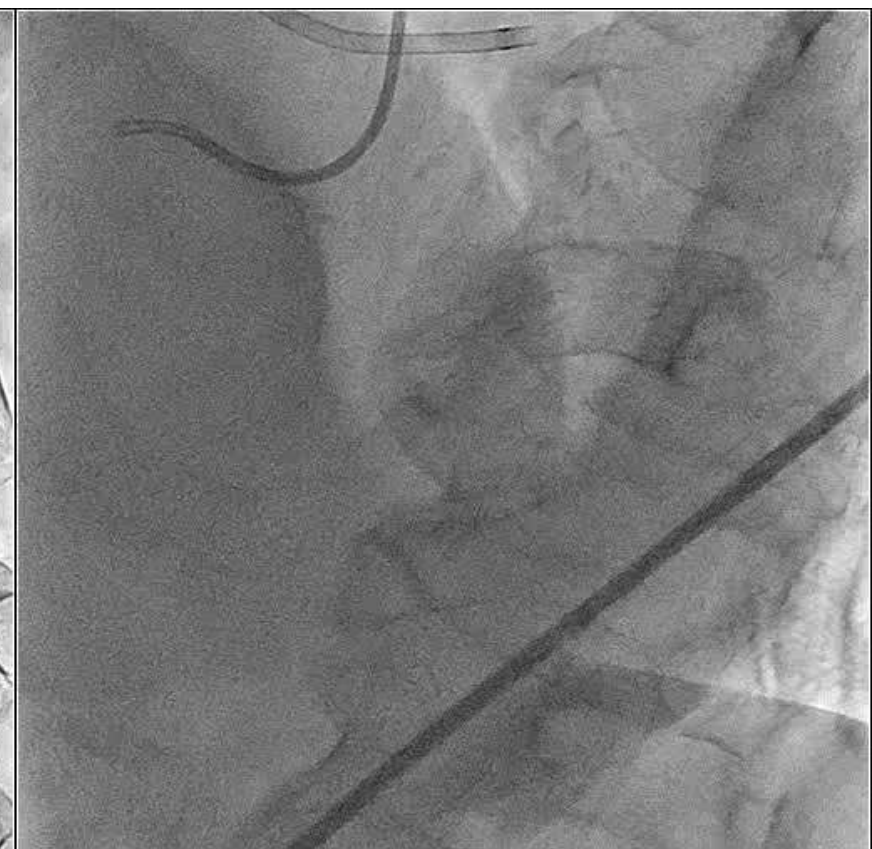
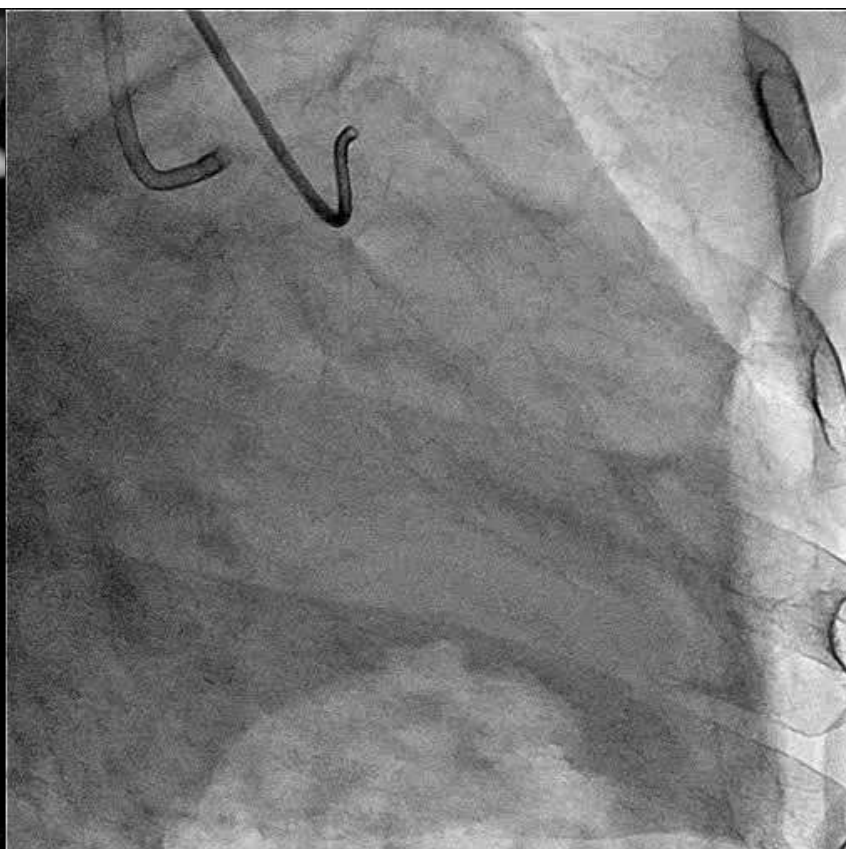
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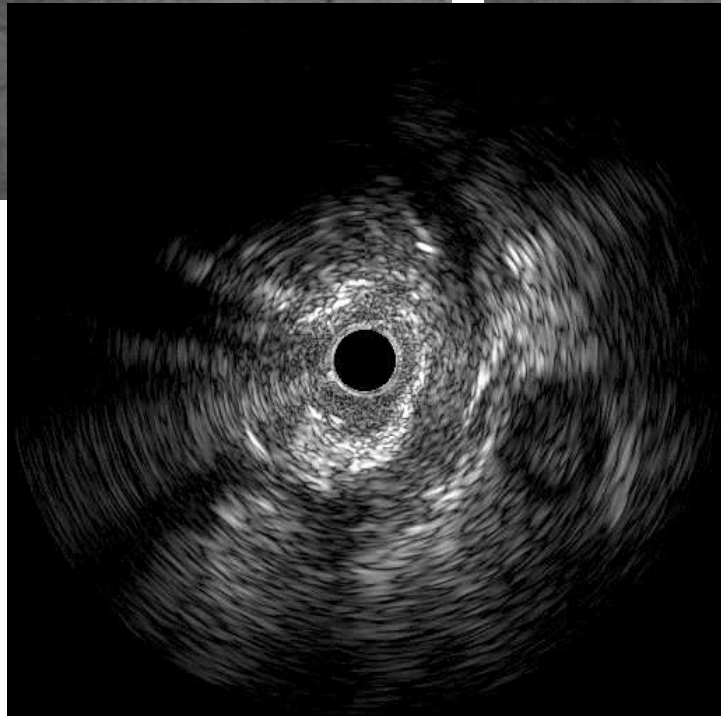
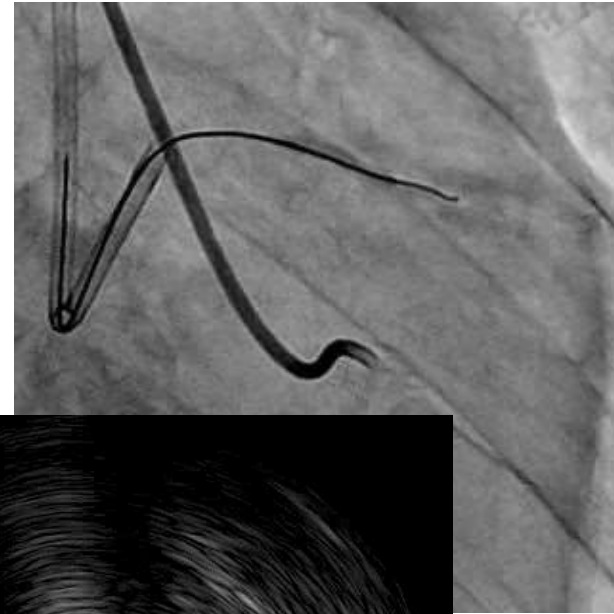
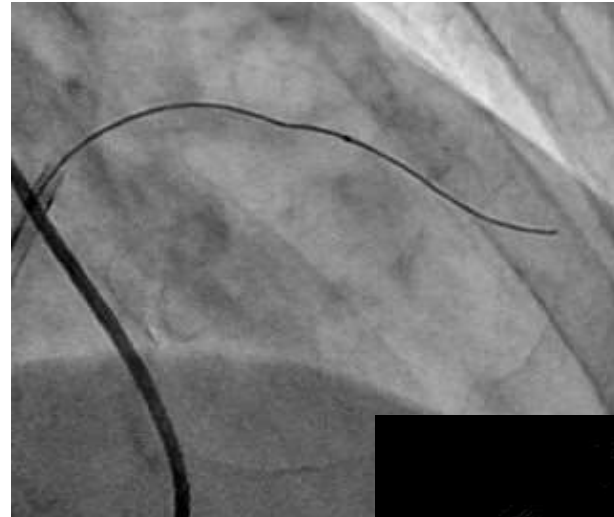
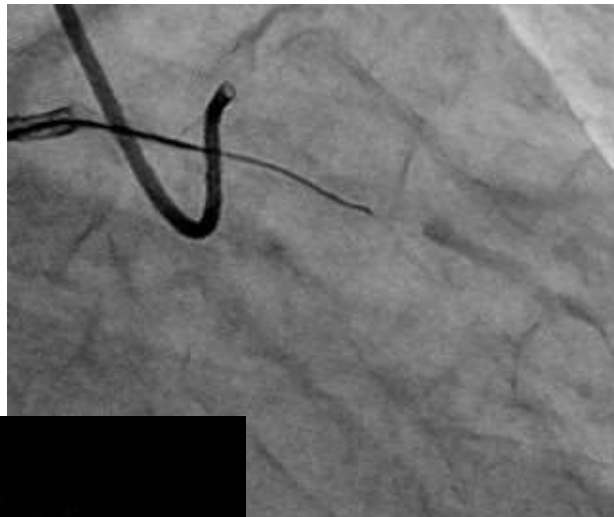
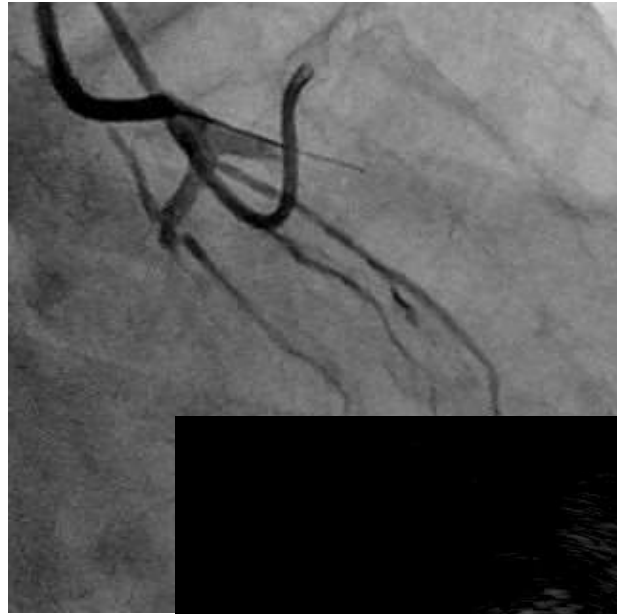
→Test results with ≥ means, 【maximum load of GW ≤ catheter's supportability】 and supportability could be larger.



# LAD CTO



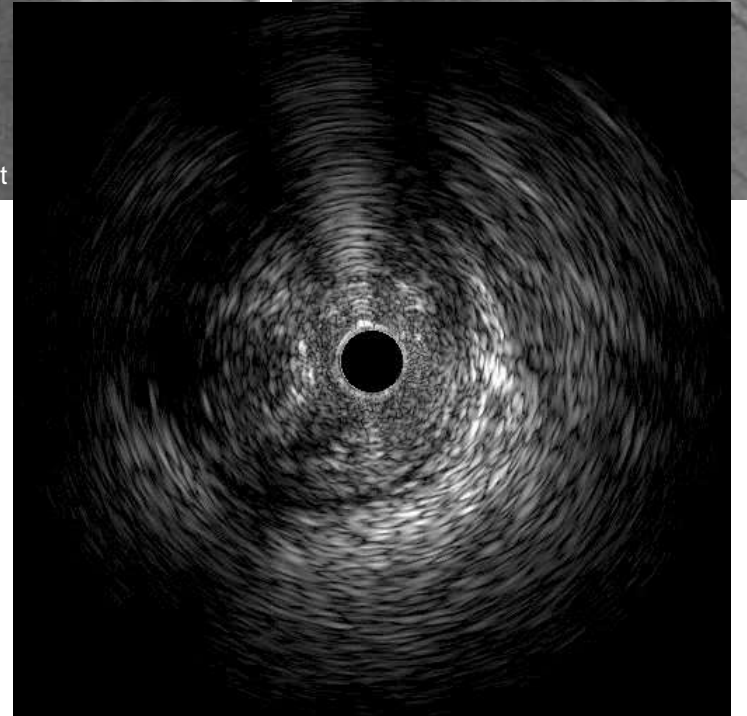
# Antegrade Wire Escalation and De-escalation



GAIA r

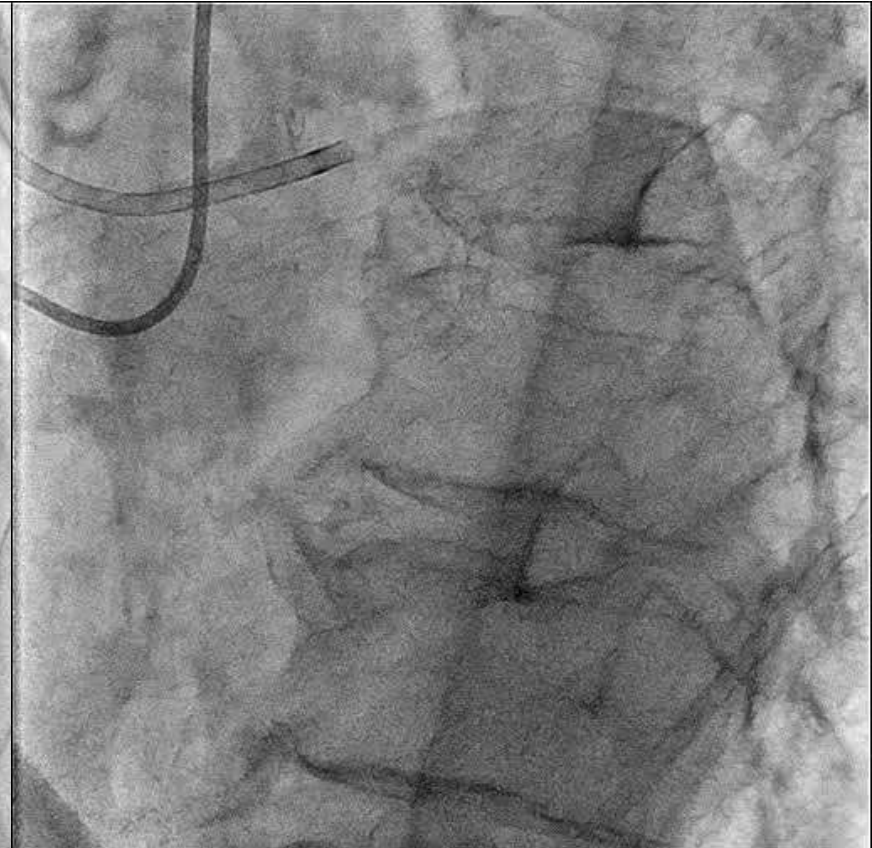
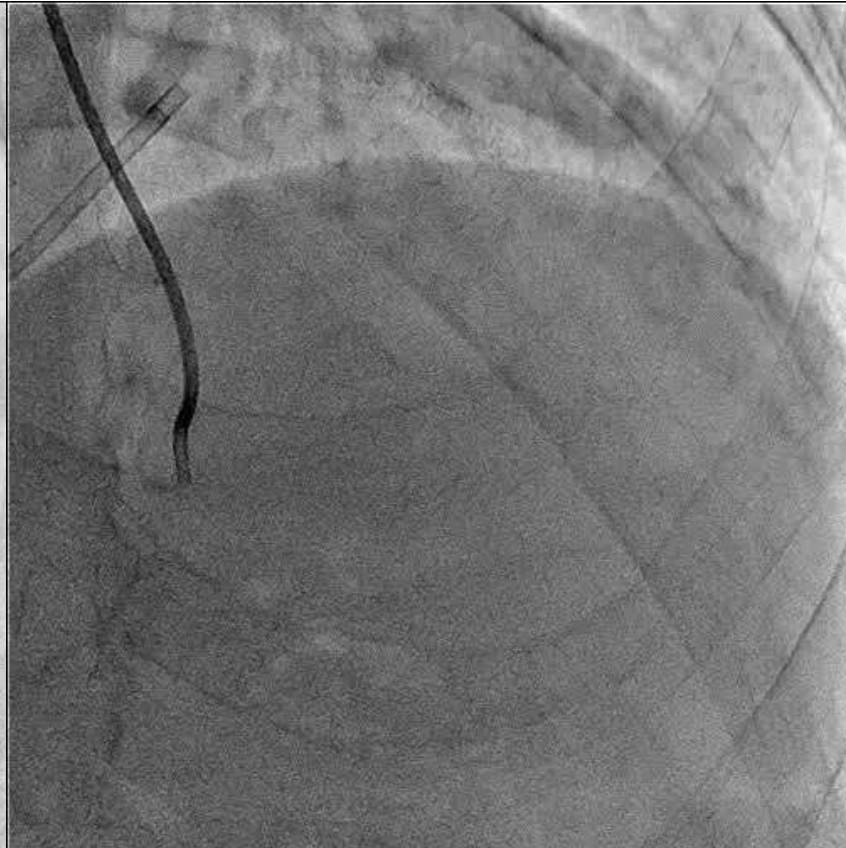
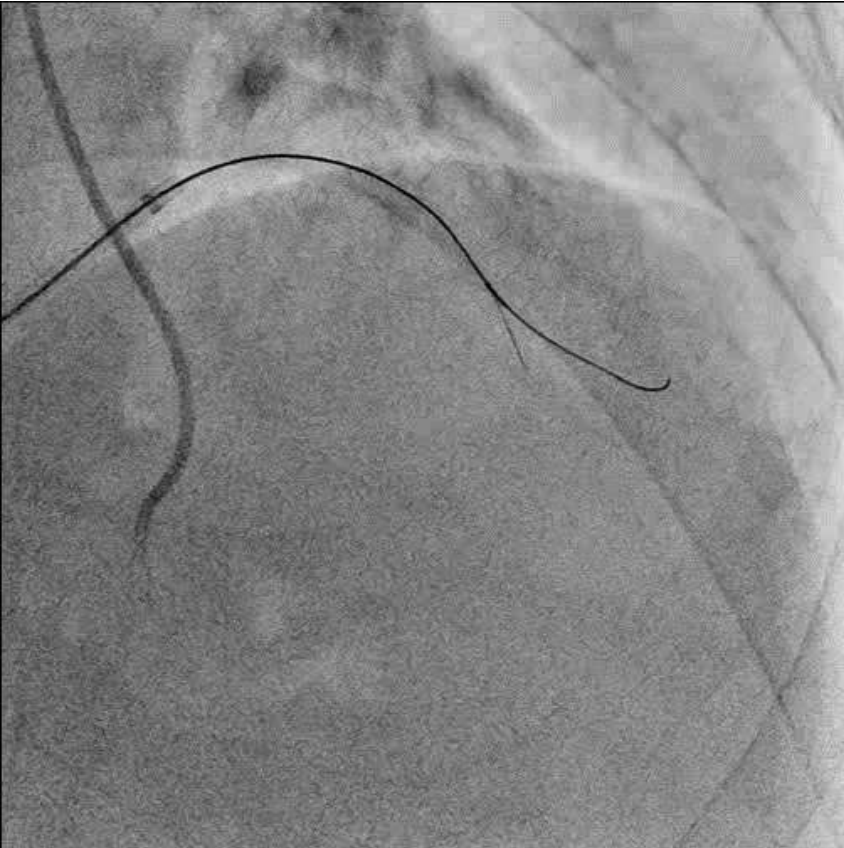


A next





# Antegrade Wire **E**scalation and **D**e-escalation



# Messages

- **AWE is the essential for CTO PCI.**
- Understanding of performance of GW and usage appropriate one for the lesion morphology is important.
- IVUS observation provides useful information not only for the choice of GW, but also help determine to switch to other approach.