

# **New Concept for CTO guidewire manipulation Importance of Penetration Plane View (PPV)**

**Kenya Nasu, MD, FACC,  
Toyohashi Heart Center**

**Osamu Katoh, MD**

**Shunpei Yoshitake, Tomoki Ichikawa, Masahiro Kashiwai,  
Masako Manabe, and Satoshi Nakazawa  
ASAHI INTECC CO., LTD.**

**In this presentation, all new medical devices and software are unapproved all over the world. All theories are based on mathematical standpoint.**



# Necessity and importance guidewire navigation in CTO

- In CTO PCI, guidewire crossing to the distal true lumen is the most important part.
- However, guidewire advances in 3D blinded space to the distal target under 2D angiographic guidance.

**➔Therefore, CTO guidewiring is difficult.**

- If we have guidewire navigation...

**➔CTO segment can be visualized.**

**➔Guidewiring eventually simplifies and gets easier.**

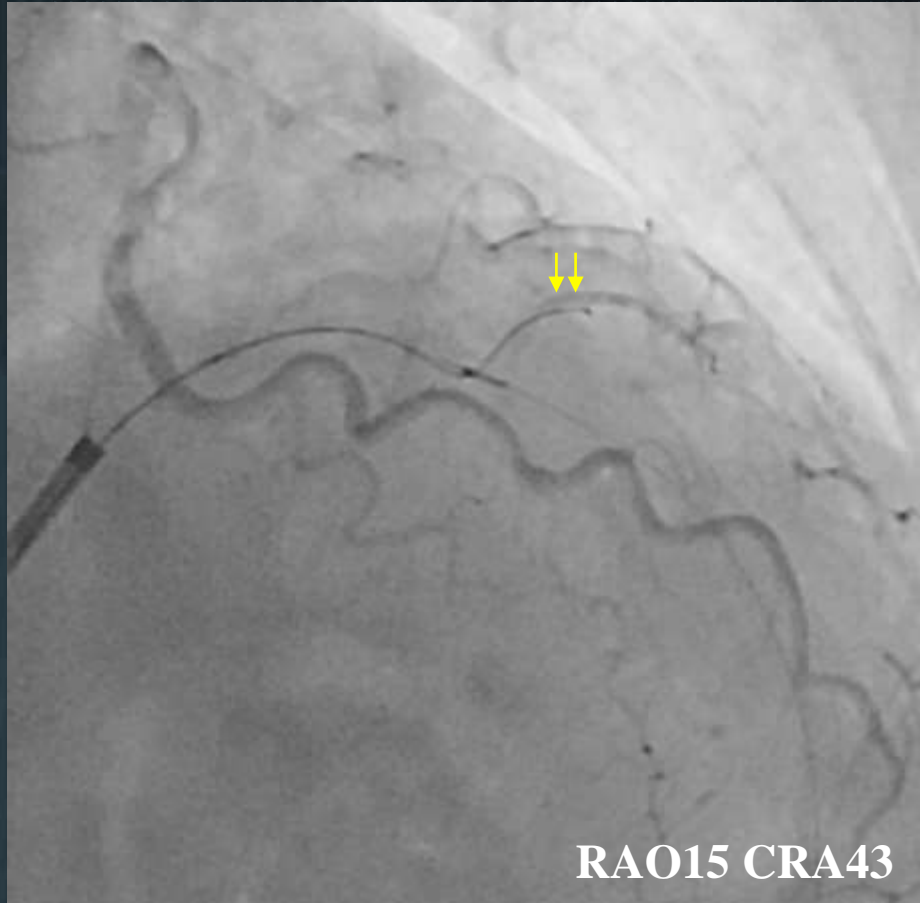
**➔Standardization of CTO guidewiring**

**(No need to rely on personal experience!)**

**How can we figure out the morphology of CTO segment?**

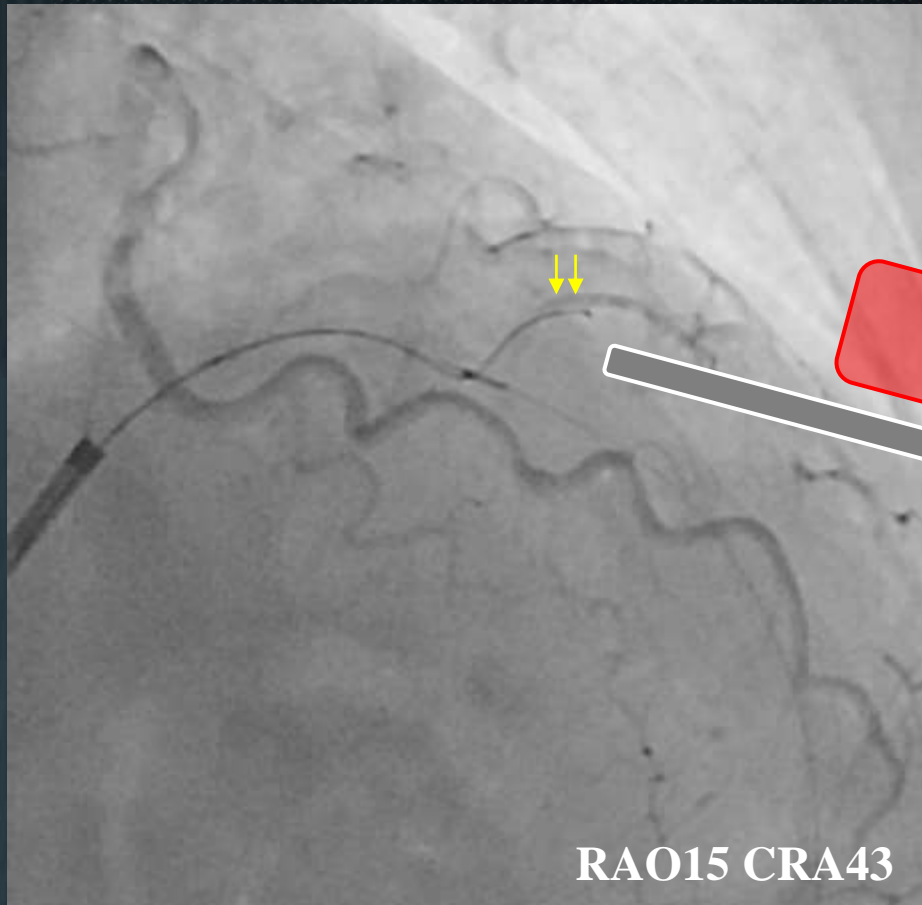


# Is bilateral angiography effective?



- Even in bilateral angiography, appropriate wire direction to get distal true lumen is often unidentified in daily practice.

# Is bilateral angiography effective?



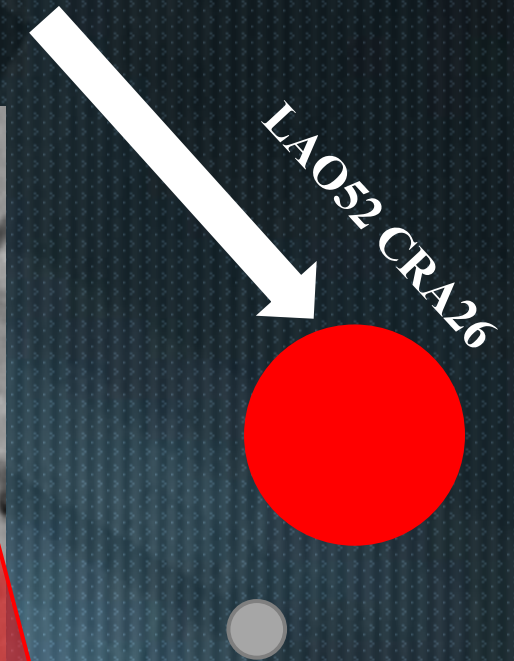
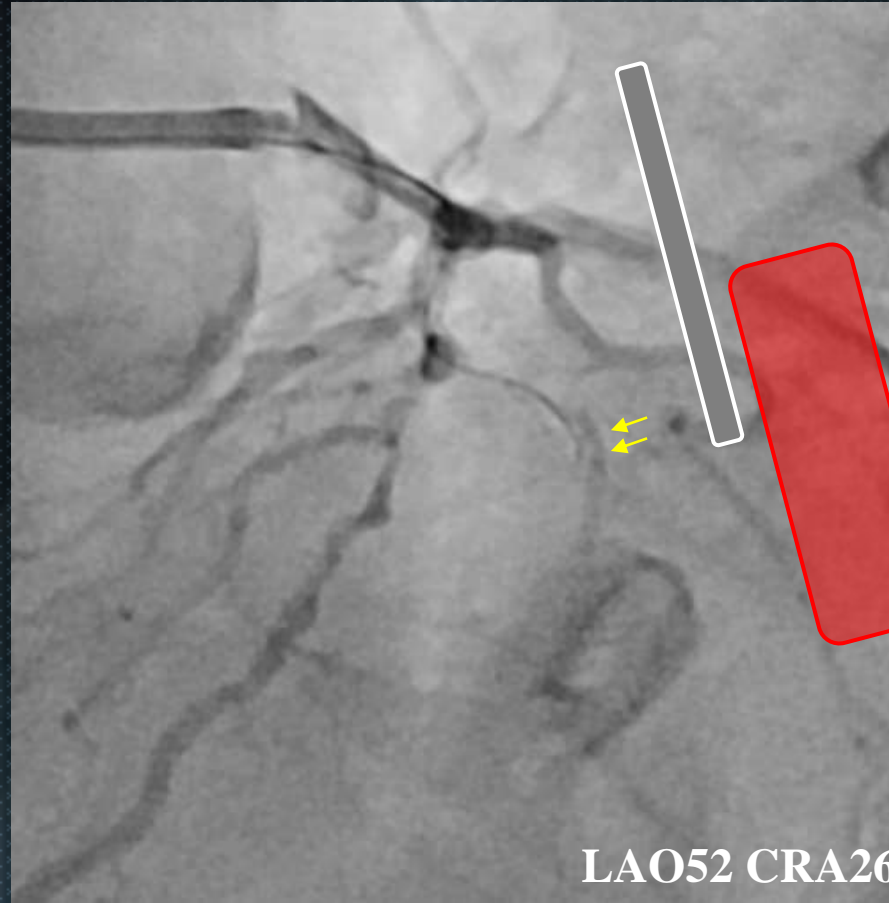
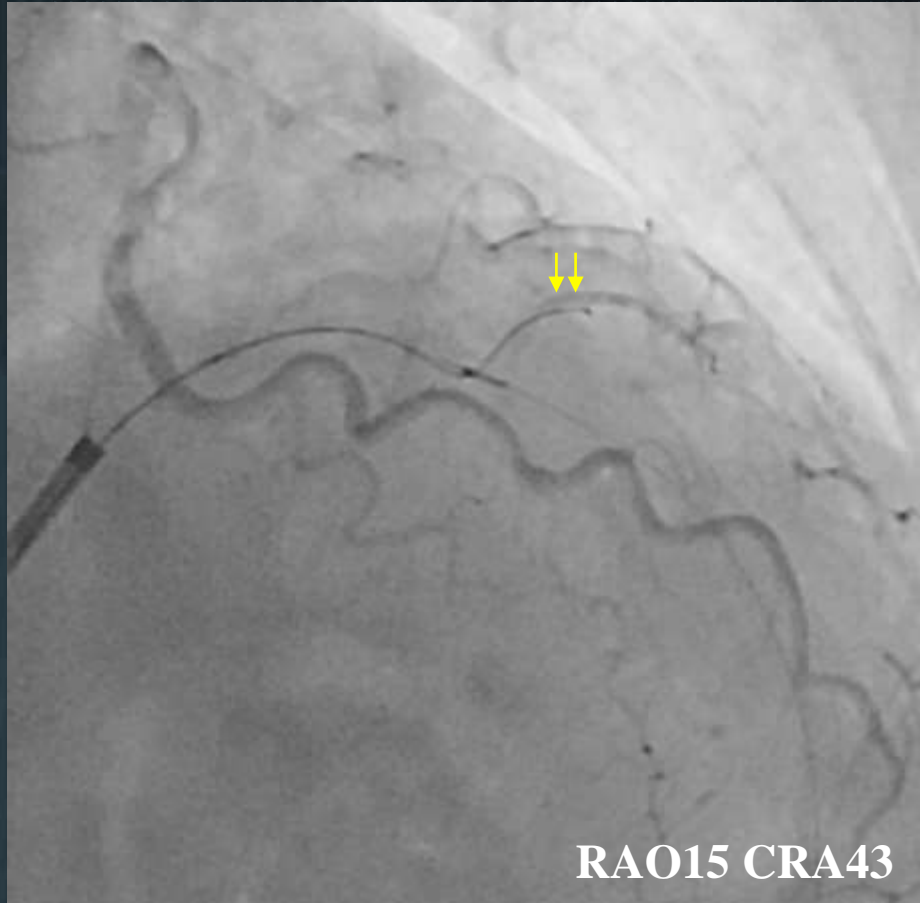
RAO15 CRA43

A diagram showing a white arrow pointing from the text 'RAO15 CRA43' to a red circle. A smaller grey circle is positioned below the red circle.

➤ Calculated perpendicular projection of RAO15/CRA43 is **RAO29/CAU18**

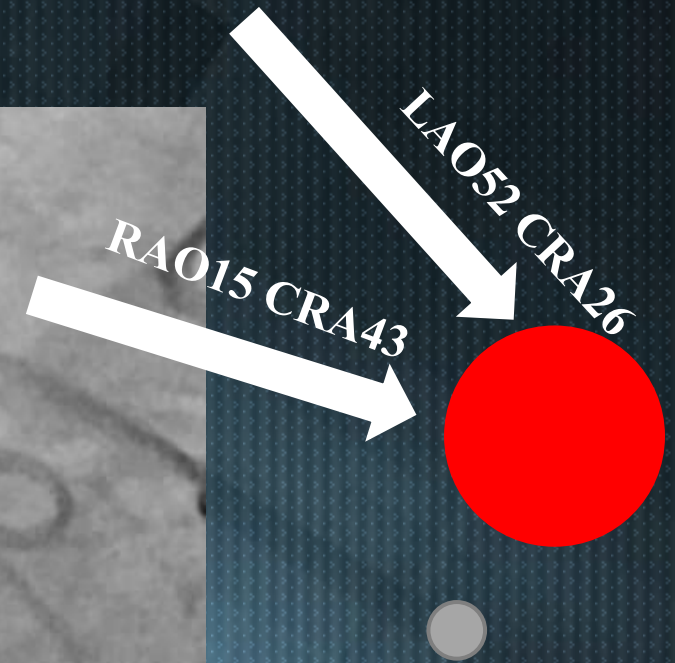
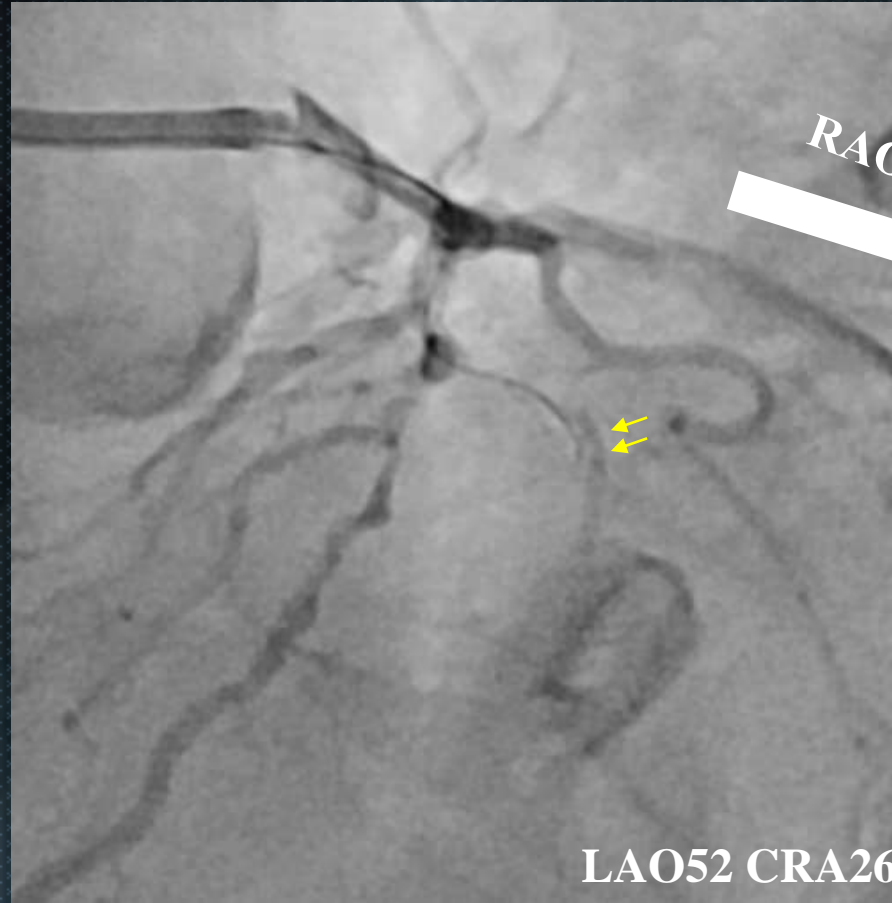
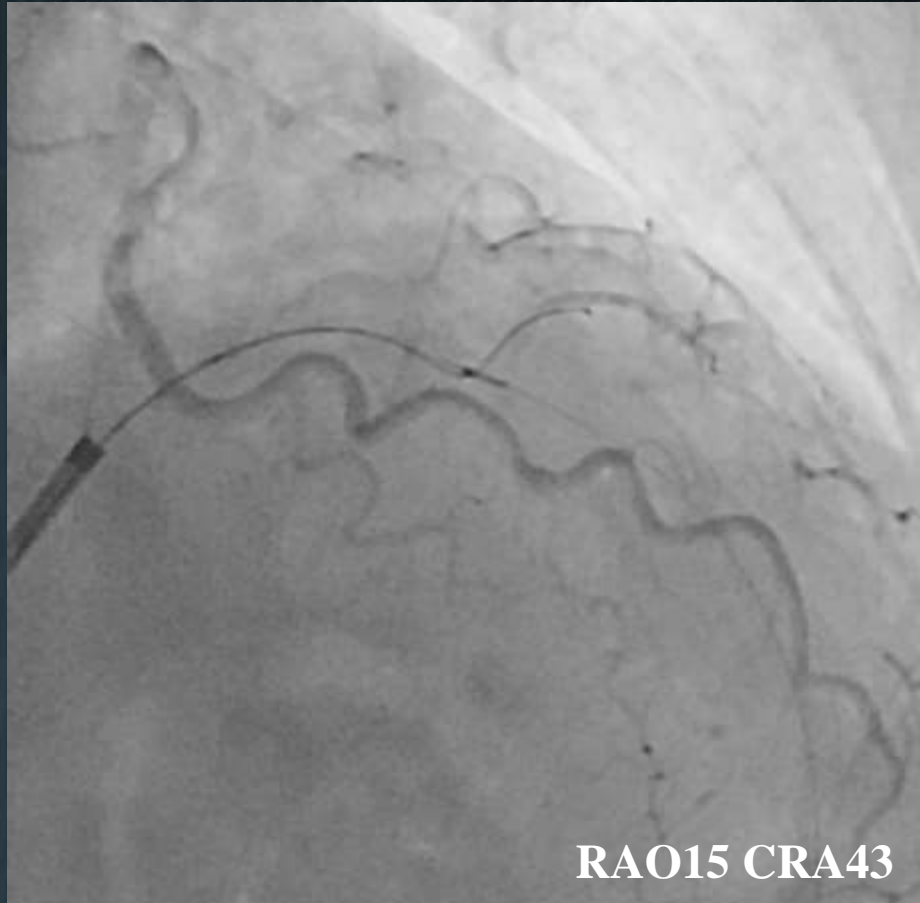


# Is bilateral angiography effective?



➤ Calculated perpendicular projection of LAO52/CRA26 is **RAO43/CAU43**

# Is bilateral angiography effective?



- In this case, both bilateral angiography viewed from similar direction of distal true lumen.



**If perpendicular views are detected...**



**Conversion from 3D image to 2D image for making GW control simple**

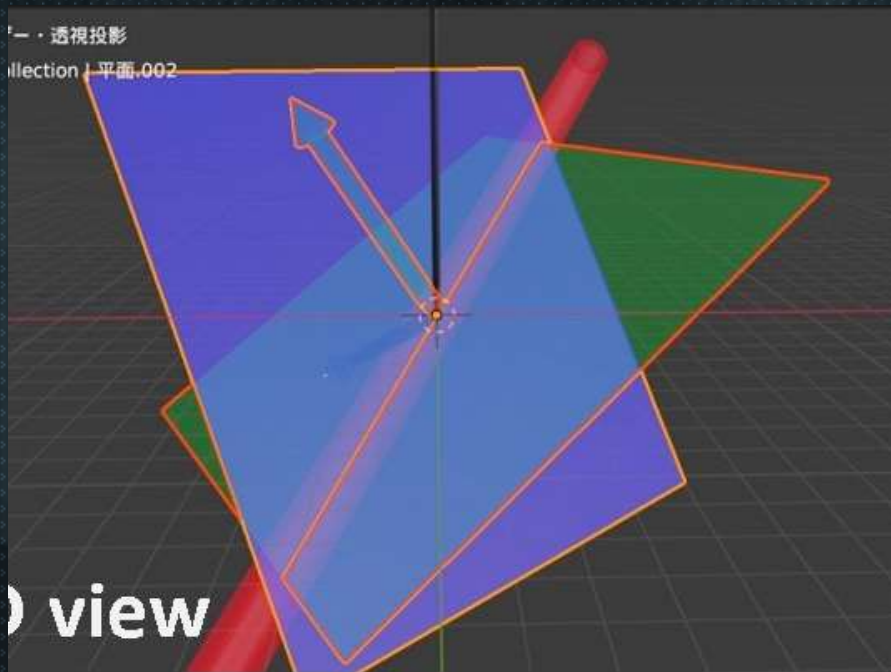


## **Next step:**

- 1. Detection of vessel vector (CTO segment or distal true lumen)**
- 2. Searching of perpendicular projections.**

# Vector of vessel detection by vector projection

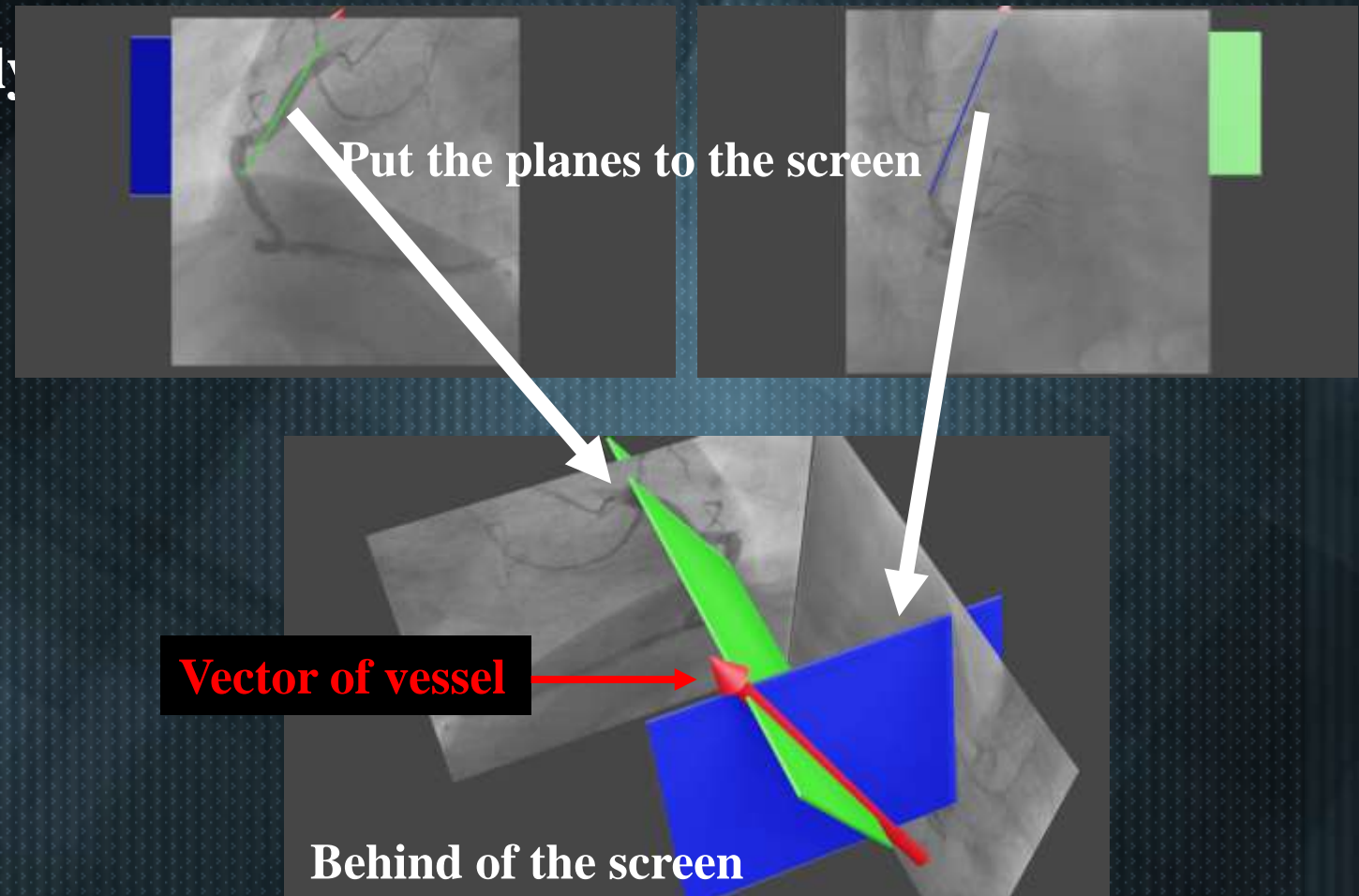
- Coronary angiography is a projection image of real coronary artery (3D).
- Conversely, 3D vessel vector (only short straight part) can be detected from random two angiographic images.





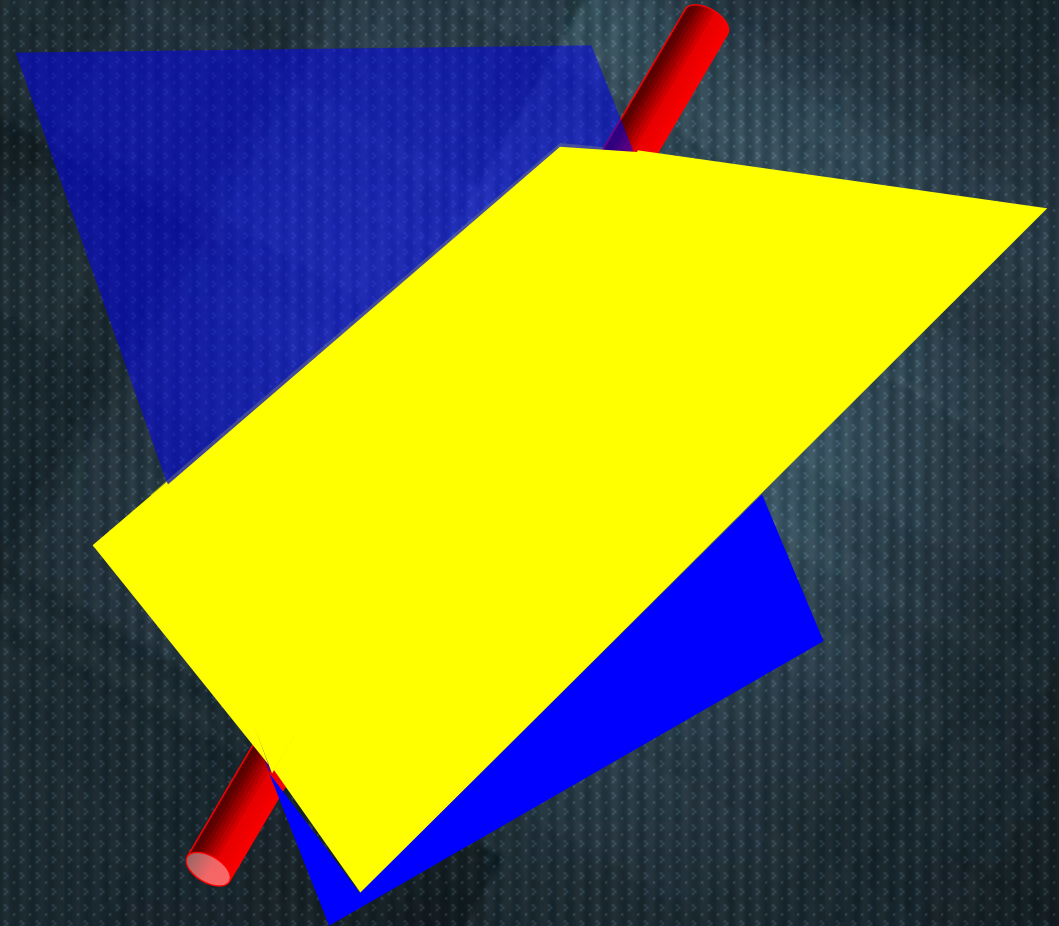
# Vector of vessel detection by vector projection

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- Vessel vector is a line of intersection of two planes.



# Vector of vessel detection by vector projection

- **Coronary angiography is a projection image of real coronary artery (3D).**
- **Conversely, 3D vessel vector (only short straight part) can be reconstructed from random two angiographic images.**
- **Vessel vector is a line of intersection of two planes.**





# Vector of vessel detection by vector projection

1. Input angle information of two random angiographic projections
2. Input angles between vertical and vessel axes



Calculation of feasible two perpendicular projections

RAO 40 CRA 0 Δ: 時計方向 25

LAO 50 CRA 0 6p2: 時計方向 20

計算

PPV及びNVV図表示

LAO 88 CRA 59

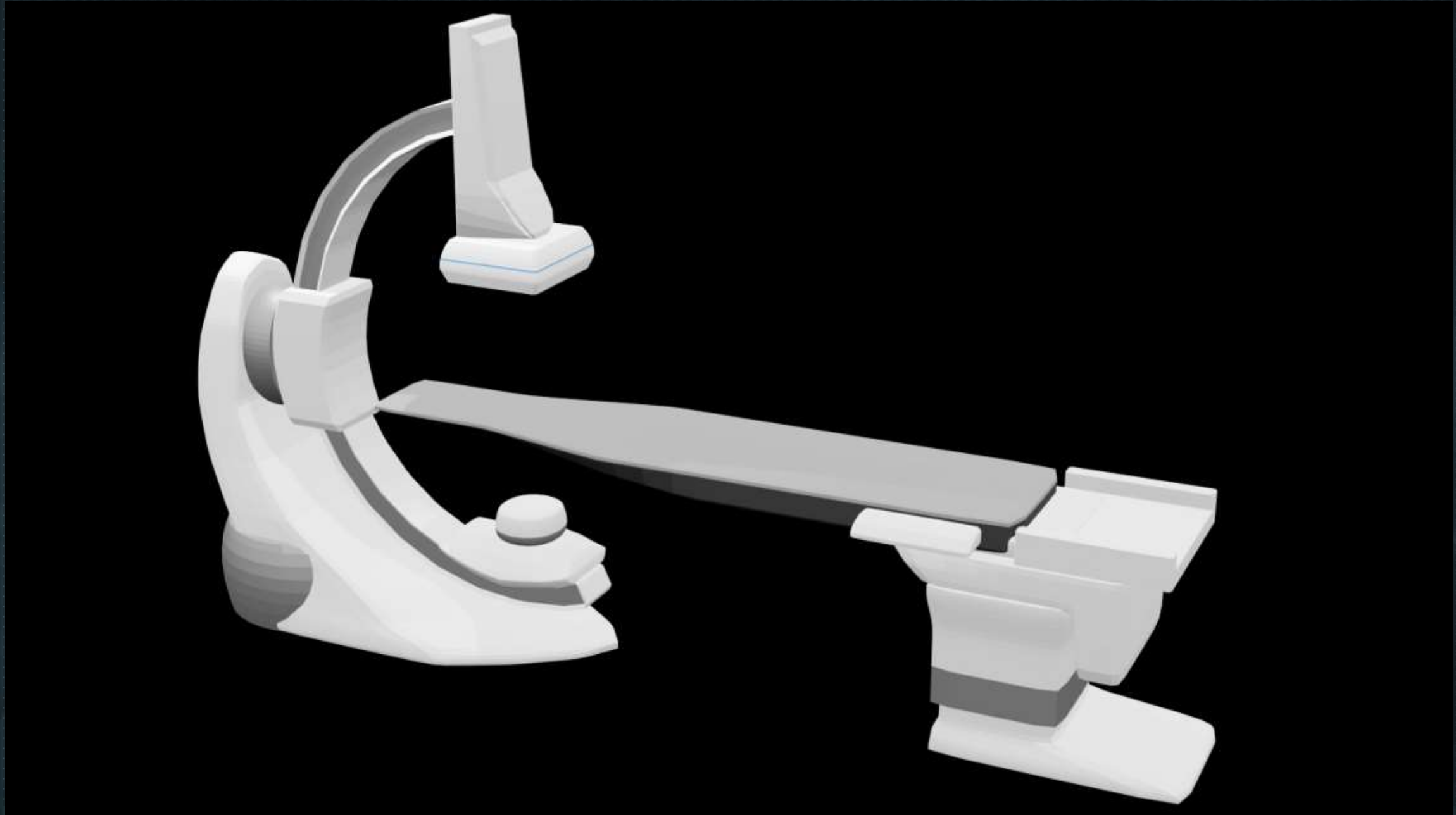
Z-axis

PPV RAO 32 CRA 16

NV1 LAO 50 CAU 25

NV2 \*\*\*

Set



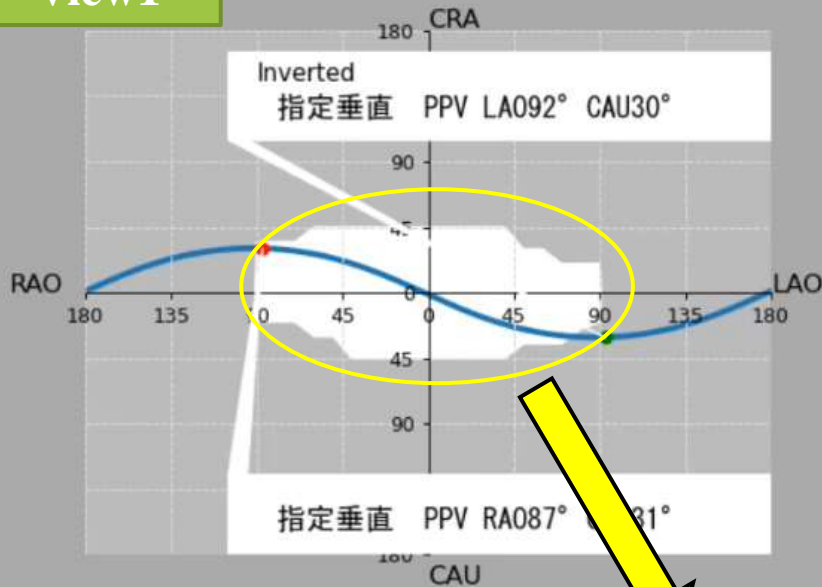


# Vector of vessel detection by vector projection

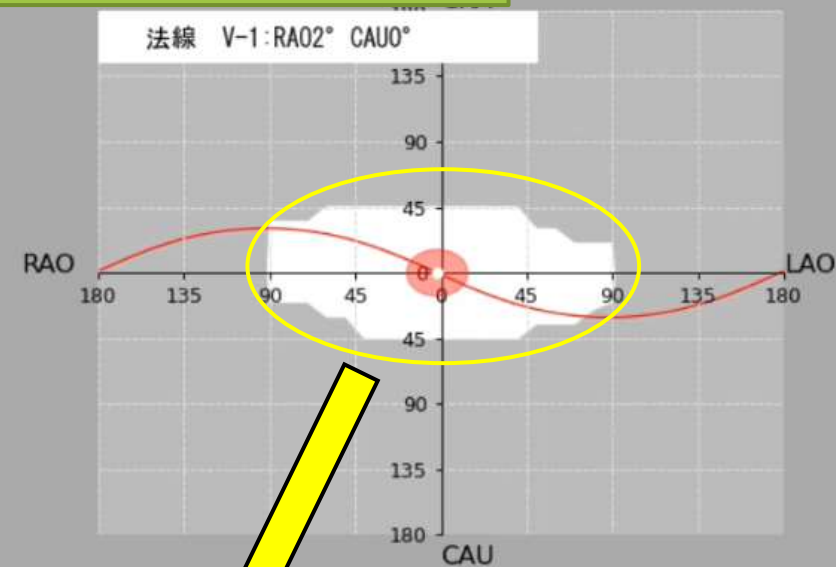
➤ Detection of perpendicular views on the orbit map

Ve: RAO 92 CAU 59

View1



View2 (Normal vector)

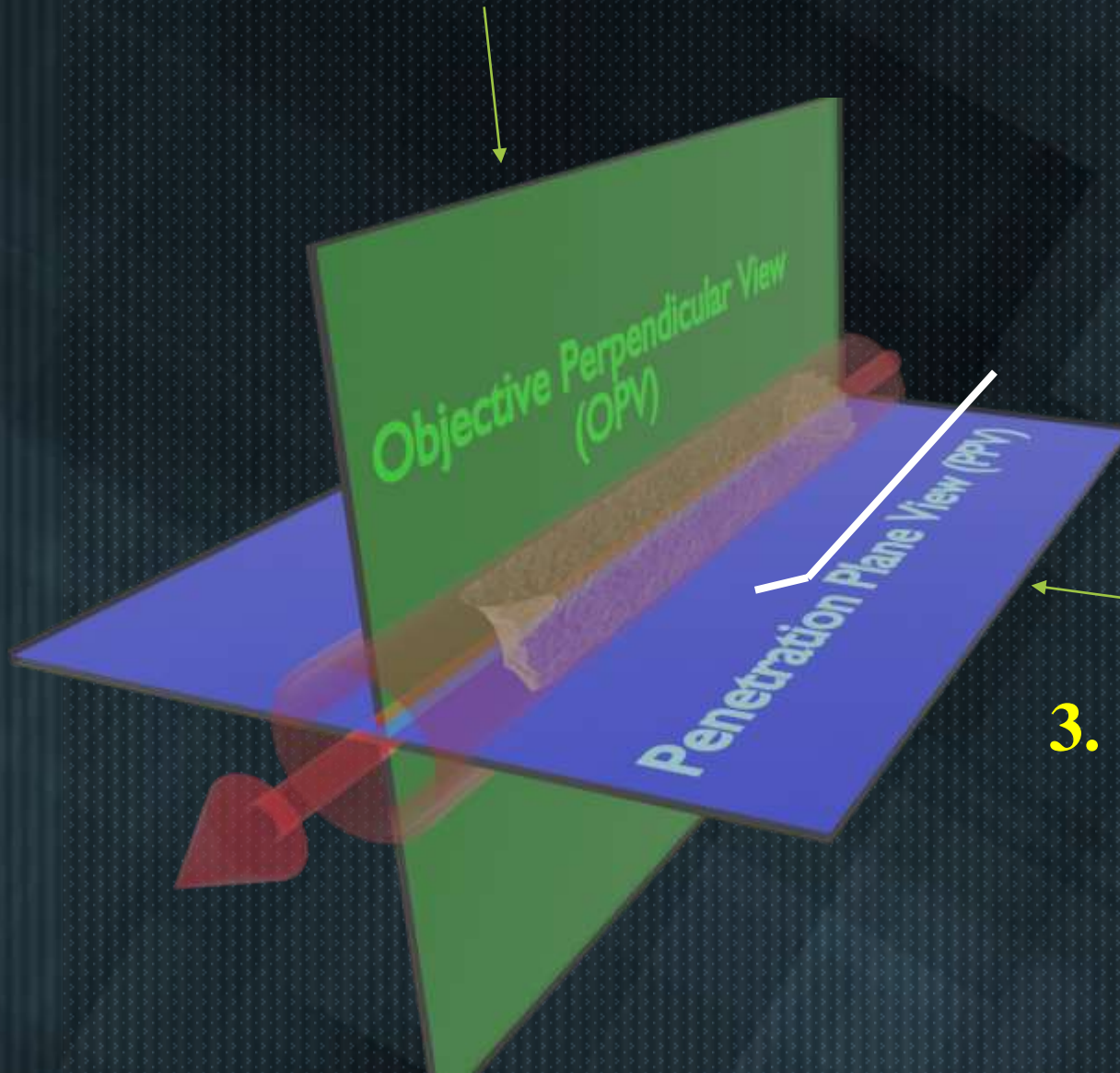


Movable range of C-arm

**Tips and tricks of guidewire manipulation  
in perpendicular views**



# Definition of terminology



## 1. Penetration Plane

The plane for manipulation of GW

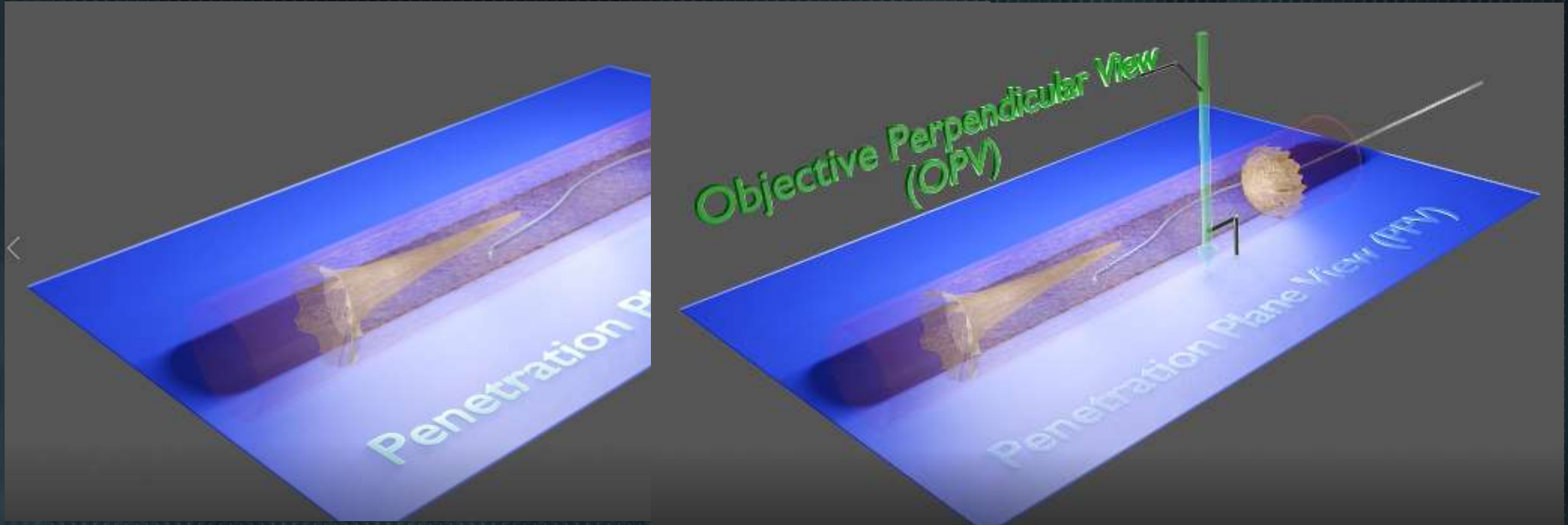
## 2. Penetration Plane View (PPV)

Keeping GW tip straight from this view

## 3. Objective Perpendicular View (OPV)

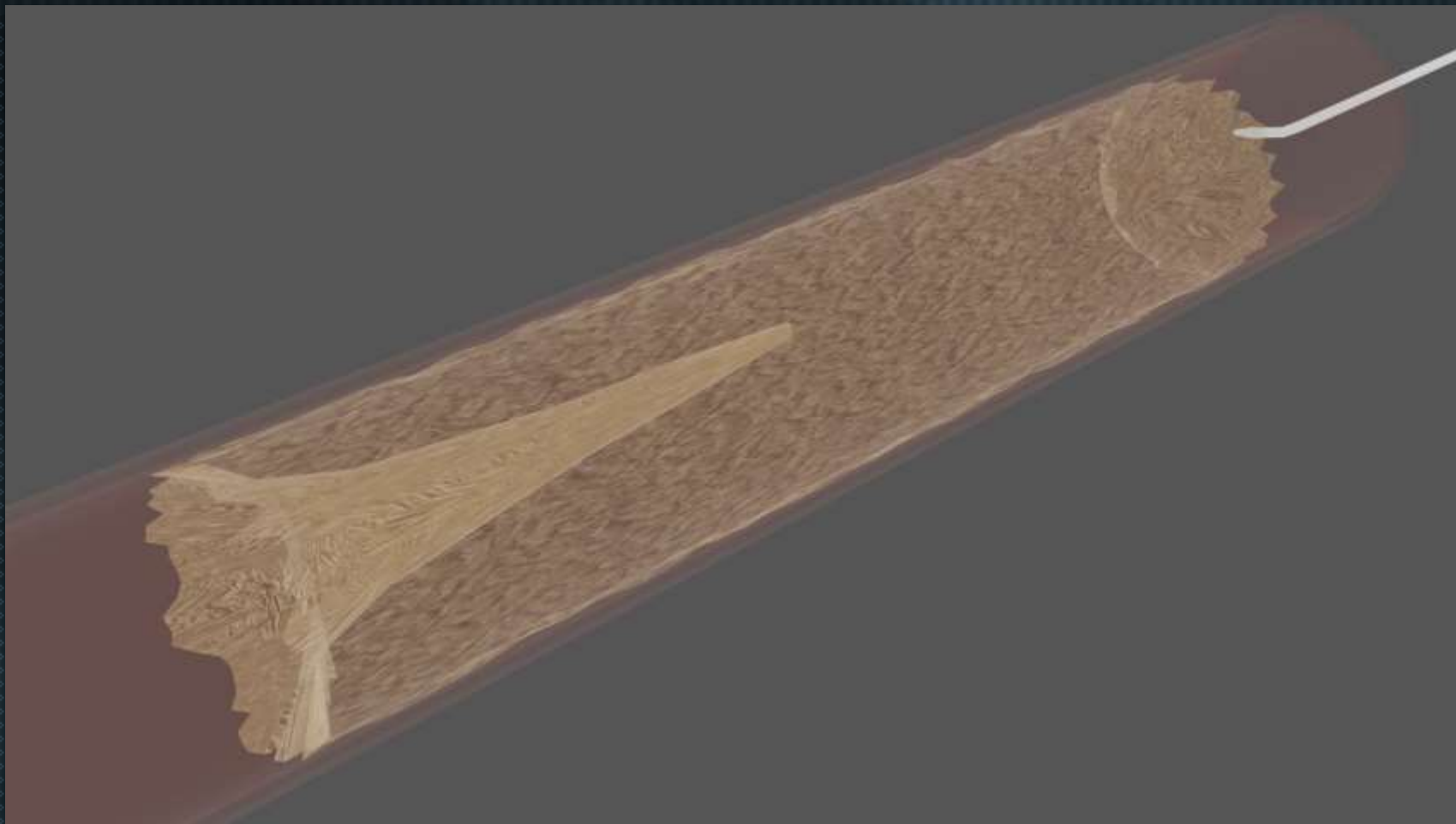
Checking and changing GW tip direction

# What is the penetration plane?



- If you can insert a “thin plane” to the CTO segment, all you have to do is manipulate wire on this plane.
  - ➔ GW control is simplified.
  - ➔ GW can be controlled from perpendicular projection (OPV).





**1. Keeping straight line on the penetration plane view (PPV) when guidewire is advanced.**

**2. Check the direction of guidewire on objective plane view (OPV).**

# **Basic requirements and procedures for setting penetration plane**

- 1. Select straight segment to calculate vector of vessel**
- 2. Select short segment (<10mm) to detect straight part of the vessel.**
- 3. Vector of vessel detection by vector projection method**
- 4. Setting projection for Penetration Plane View (PPV) and Objective Perpendicular View (OPV)**
- 5. Manipulation of guidewire keeping on the penetration view**



# Basic requirements and procedures for setting penetration plane

1. Select straight segment to calculate vector of vessel

2. Select short segment (<10mm) to calculate direction of the vessel

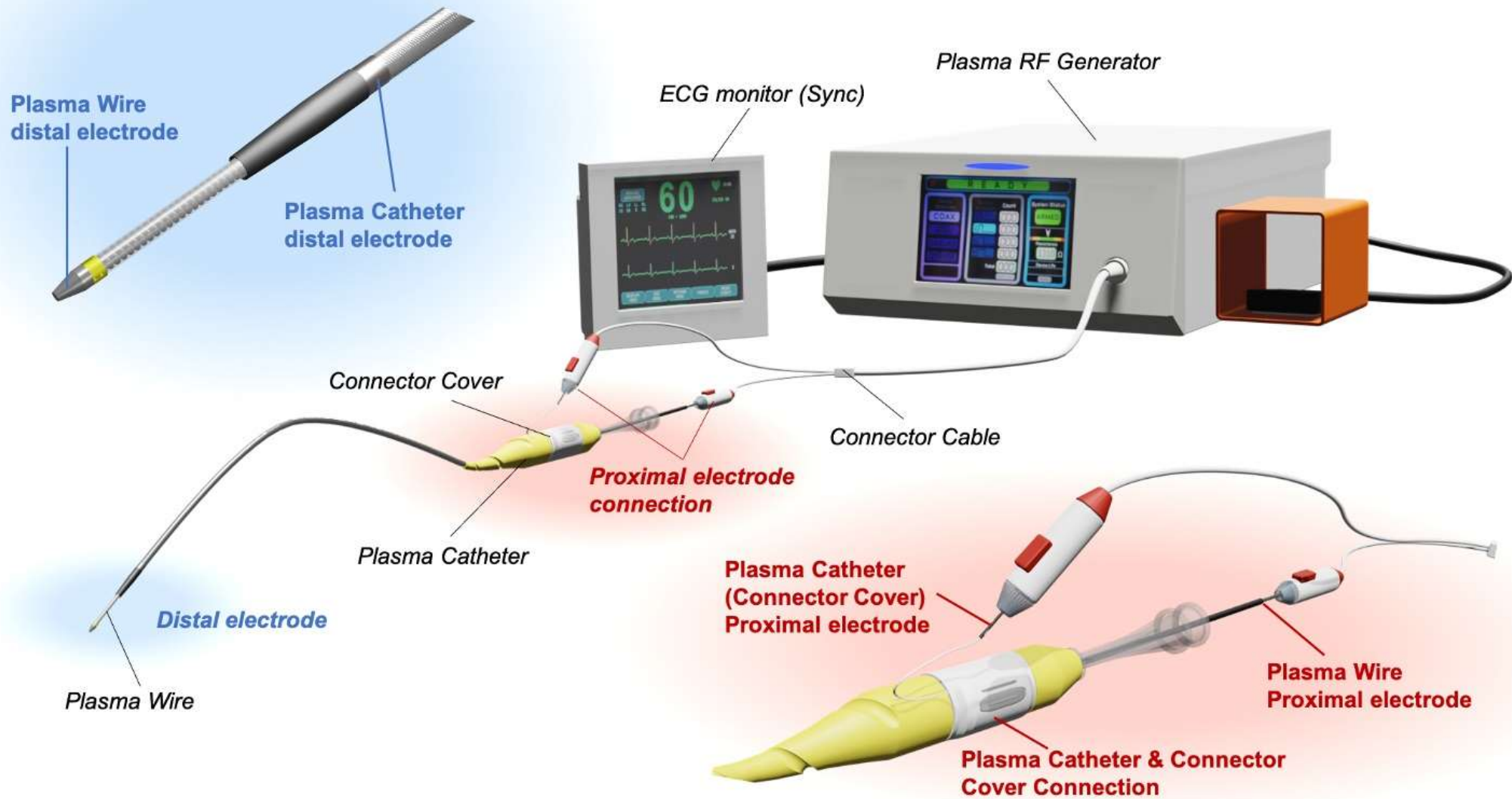
## A current serious limitation of this theory

- Mechanical guidewires are unable to be changed their direction and course intentionally.
  - ➔ Even if we can understand the right way to proceed using by this navigation system, mechanical GW can't advance in hard lesion such as calcified CTO.

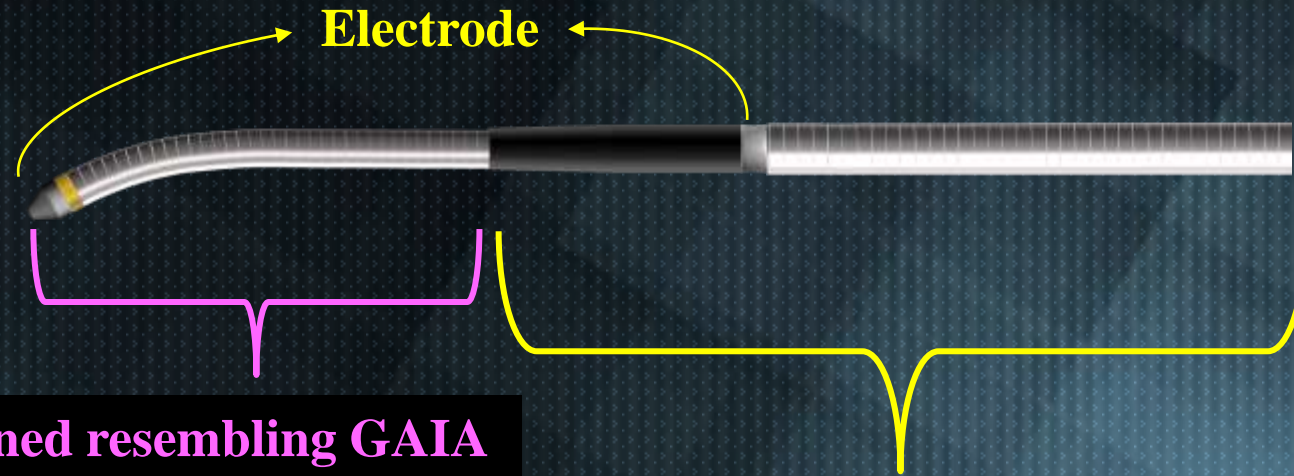
**We need the game changer!  
The time has come!**



# Plasma mediated ablation (PMA) system

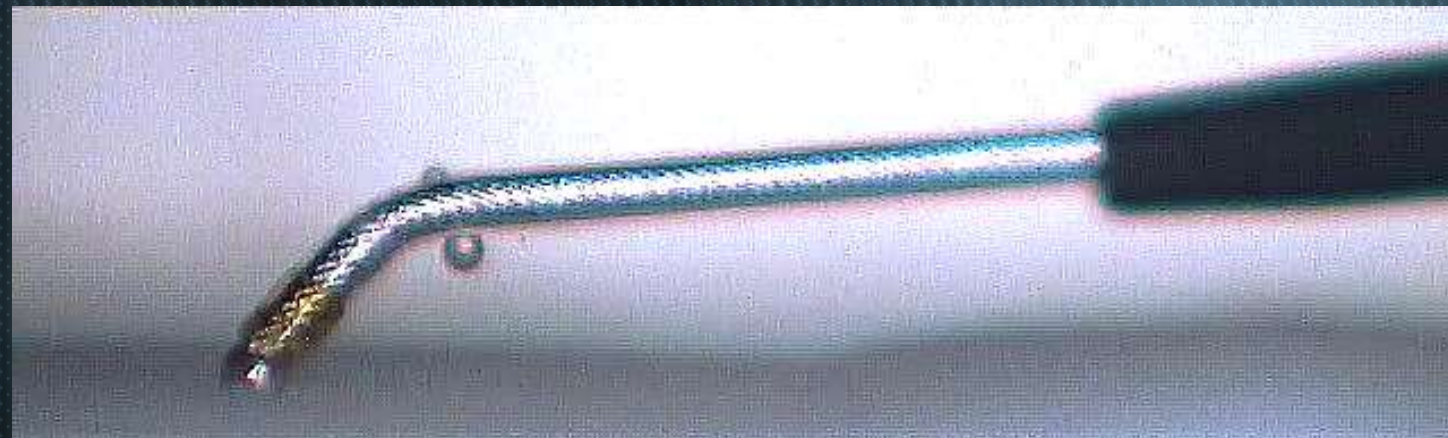


# Plasma mediated ablation system



**Plasma wire (designed resembling GAIA  
Tip load 3.5g/5g.)**

**Plasma catheter (designed resembling Corsair pro)**





# Summary

- **We need real useful GW navigation system in clinical setting.**
- **In straight and short segment, PPV and OPV can be selected by calculation of vessel vector.**
- **This strategy can simplify the concept of guidewiring in CTO lesion**
- **However, the conventional mechanical GWs can not advance in hard lesion such as calcified CTOs.**