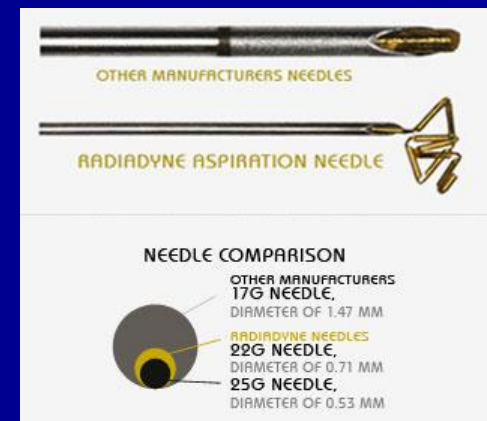


- Introduction
- Phantom Test
- Clinical Experience
- Conclusion

# Introduction

- Gold Anchor™ Marker (RadiDyne LLC. Houston, TX) is either a 10 mm or 20 mm long gold wire (0.28 mm in diameter) with notches every 2 mm
- Preloaded Needle
  - 22 GA: 0.7 mm, 20 cm
  - 25 GA: 0.5 mm, 12 cm



# Introduction

## ■ Advantage

- Less risk of pneumothorax (2%), internal bleeding or infection
- Less migration possibility
  - Lung
  - Breast
- Less CT artifact



# Final Shape Depends on Insertion Technique

- Advance Stylet:  
Ball shape



- Withdraw needle:  
linear shape



- Advance & Withdraw:  
Tadpole shape



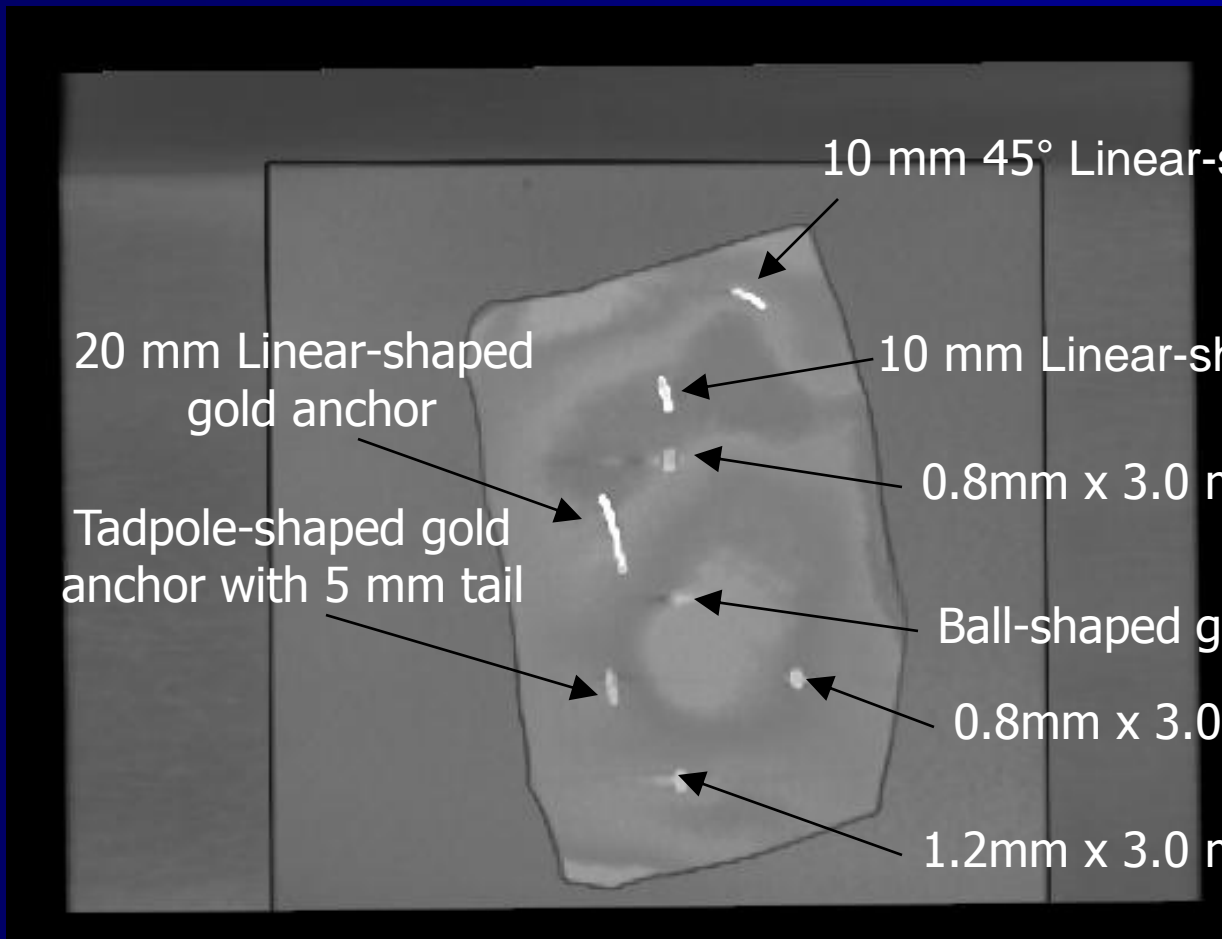
Can Cyberknife track it ?

- Introduction
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# Phantom Study

- 1 cm SuperFlab bolus on top of 10 cm solid water
- Multiple Gold Anchor markers were injected into a Superflab with different shapes, lengths, and directions
  - #1, #2: 10 mm Linear ( Longitude and 45 °)
  - #3: 20 mm Linear
  - #4: **Ball shape**
  - #5: **Tadpole Shape**
- Three regular gold fiducial markers were also injected into the superflab as reference to verify the tracking accuracy
- Phantom scanned by GE Lightspeed CT scanner with 1.25 mm per slice

# Fiducial distribution in Phantom



10 mm 45° Linear-shaped gold anchor

20 mm Linear-shaped gold anchor

10 mm Linear-shaped gold anchor

Tadpole-shaped gold anchor with 5 mm tail

0.8mm x 3.0 mm regular fiducial

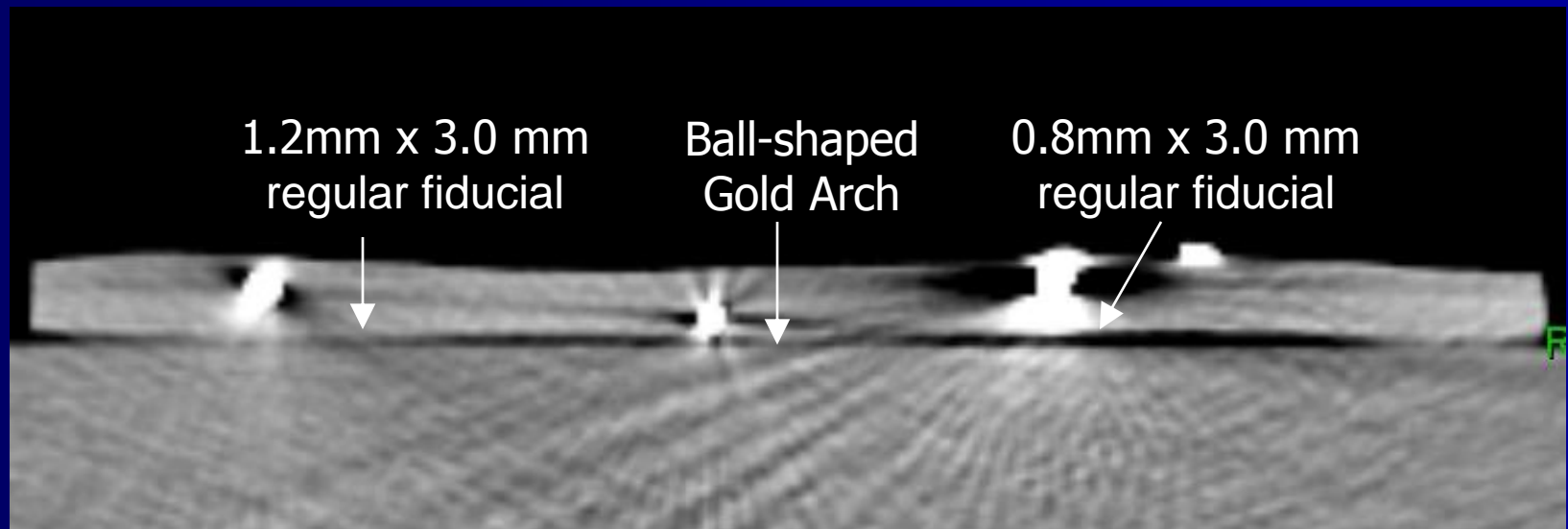
Ball-shaped gold anchor

0.8mm x 3.0 mm regular fiducial

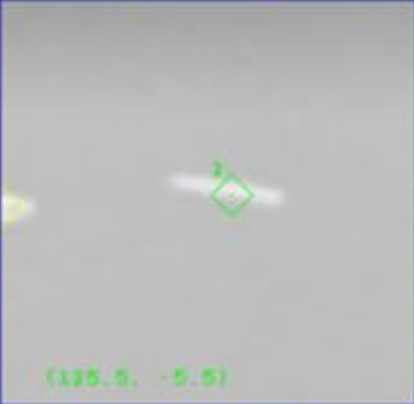

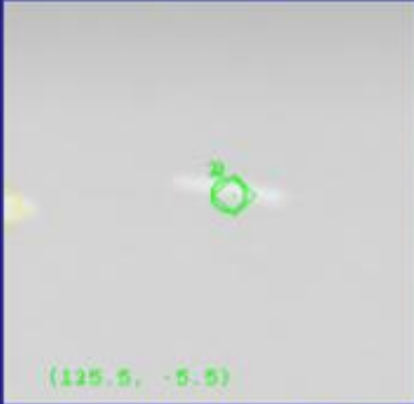
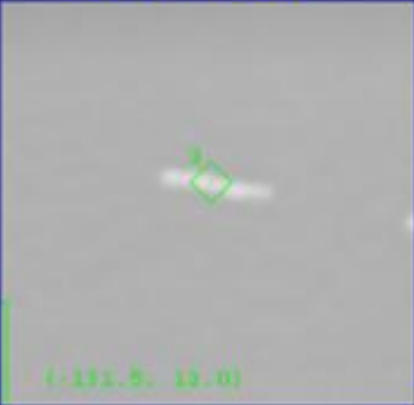

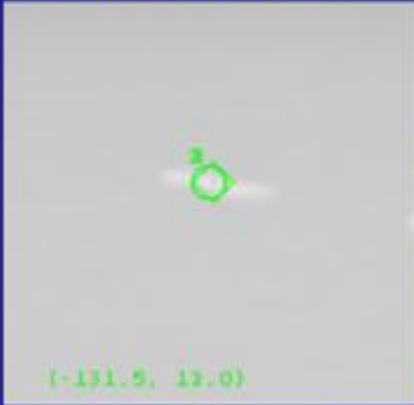
1.2mm x 3.0 mm regular fiducial

# Result

## ■ Less CT Artifact ?



# 10 mm Linear-shaped Gold Anchor Fiducial

Synthetic Image A	Camera Image A	Overlay of Images A	Couch Corrections
			RGT: 0.6 mm
			SUP: 0.6 mm
			POS: 0.1 mm
			Correlation Error
			Tracking Mode
			Fiducial
			Imaging Parameters
			Treatment Monitoring

# 10 mm 45° Linear-shaped Gold Anchor Fiducial

Synthetic Image A	Camera Image A	Overlay of Images A	Couch Corrections
<p>(202.2, 51.2)</p>	<p>(202.2, 51.2)</p>	<p>(202.2, 51.2)</p>	<b>Couch Corrections</b> RGT: 1.0 mm SUP: 0.6 mm POS: 0.8 mm
Synthetic Image B	Camera Image B	Overlay of Images B	Correlation Error
<p>(-208.5, -29.5)</p>	<p>(-208.5, -29.5)</p>	<p>(-208.5, -29.5)</p>	<b>Tracking Mode</b> Fiducial Imaging Parameters Treatment Monitoring

# 20 mm Linear-shaped Gold Anchor Fiducial

The screenshot displays a medical imaging software interface for tracking a 20 mm linear-shaped gold anchor fiducial. The interface is organized into a 2x3 grid of image panels and a control panel on the right.

**Image Panels:**

- Synthetic Image A:** Shows a synthetic view of the fiducial with a green diamond marker. Coordinates: (0.0, -16.5).
- Camera Image A:** Shows the real-time camera view of the fiducial with a green circle marker. Coordinates: (0.0, -16.5).
- Overlay of Images A:** Shows the synthetic and camera images overlaid, with the green diamond and circle markers. Coordinates: (0.0, -16.5).
- Synthetic Image B:** Shows a synthetic view of the fiducial with a green diamond marker. Coordinates: (-20.0, 41.5). A red box highlights the marker.
- Camera Image B:** Shows the real-time camera view of the fiducial with a green circle marker. Coordinates: (-20.0, 41.5). A red box highlights the marker.
- Overlay of Images B:** Shows the synthetic and camera images overlaid, with the green diamond and circle markers. Coordinates: (-20.0, 41.5).

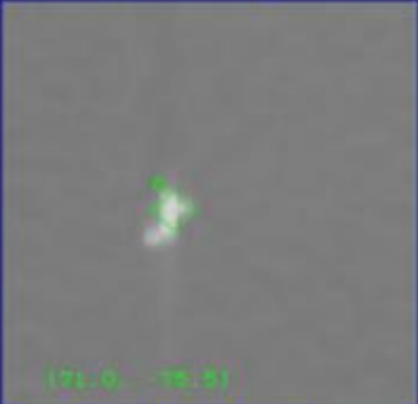

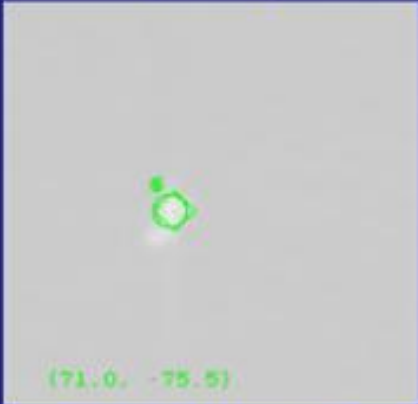
**Control Panel (Right):**

- Couch Corrections:**
  - LFT: 1.4 mm
  - INF: 5.5 mm (highlighted with a red box)
  - POS: 0.4 mm
- Tracking Mode:** Fiducial
- Buttons:** Imaging Parameters, Treatment Monitoring



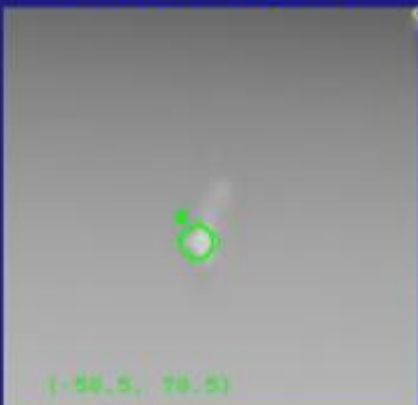
# Ball-shaped Gold Anchor Fiducial

Synthetic Image A	Camera Image A	Overlay of Images A	Couch Corrections
<p>(7.5, -37.0)</p>	<p>(7.5, -37.0)</p>	<p>(7.5, -37.0)</p>	LFT: 0.1 mm SUP: 0.0 mm POS: 0.1 mm
Synthetic Image B	Camera Image B	Overlay of Images B	Correlation Error
<p>(-10.0, 24.5)</p>	<p>(-10.0, 24.5)</p>	<p>(-10.0, 24.5)</p>	Tracking Mode Fiducial Imaging Parameters Treatment Monitoring

# Tadpole-shaped Gold Anchor Fiducial

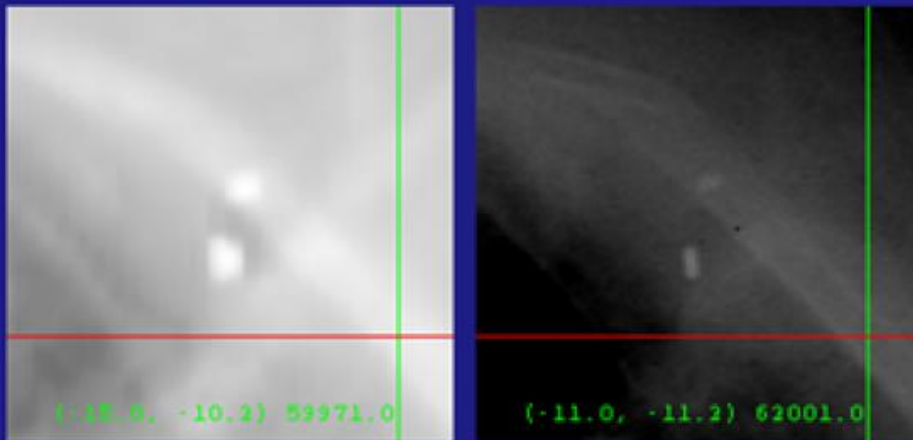
Synthetic Image A	Camera Image A	Overlay of Images A	Couch Corrections
			RGT: 0.2 mm
			SUP: 0.1 mm
			POS: 0.0 mm
			Correlation Error
			Tracking Mode
			Fiducial
			Imaging Parameters
			Treatment Monitoring

Synthetic Image B	Camera Image B	Overlay of Images B
		

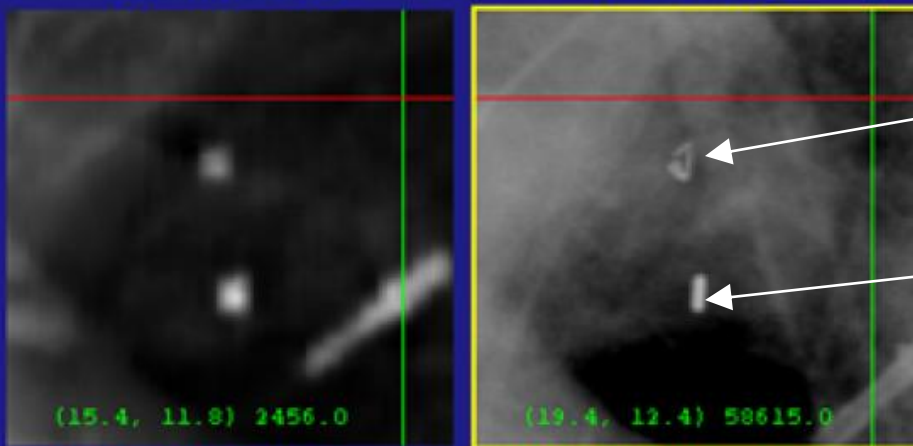
- Introduction
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# Lung



Synthetic Image B

Camera Image B

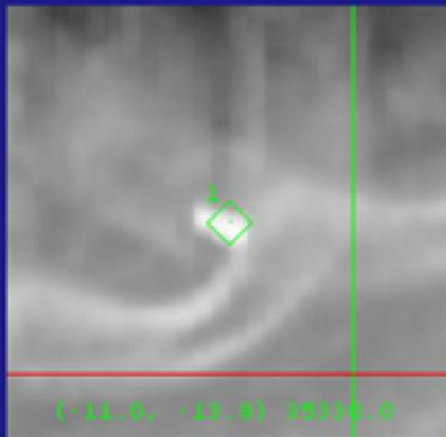


Ball-shaped Gold Anchor fiducial

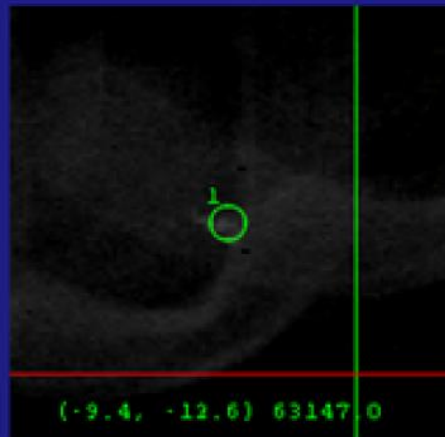
Regular fiducial

# Lung

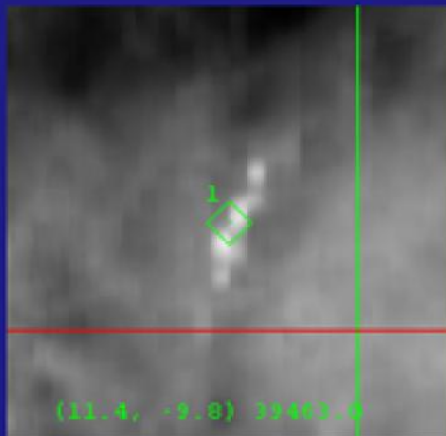
Synthetic Image A



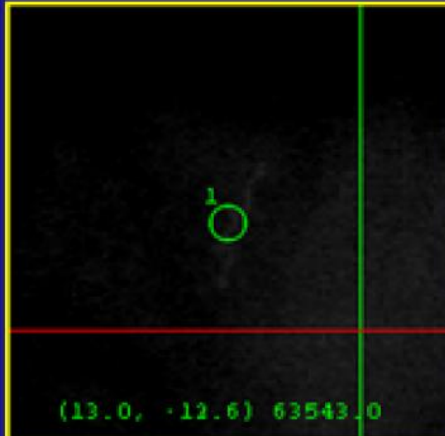
Camera Image A



Synthetic Image B

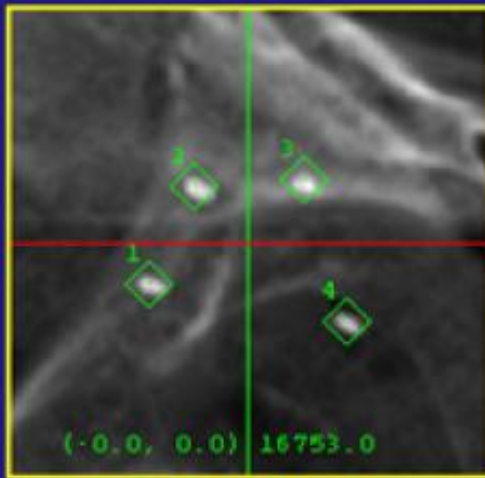


Camera Image B



# Prostate

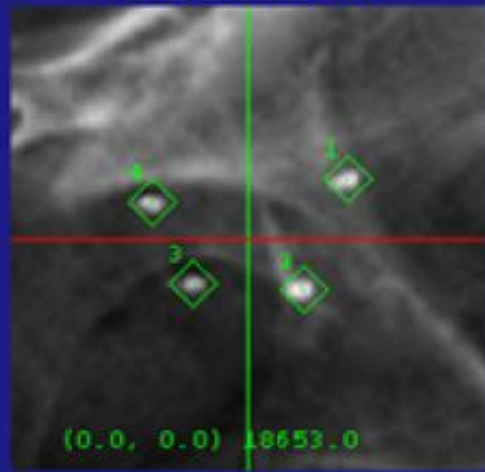
Ball-shaped Gold Anchor



Synthetic Image B



Camera Image B

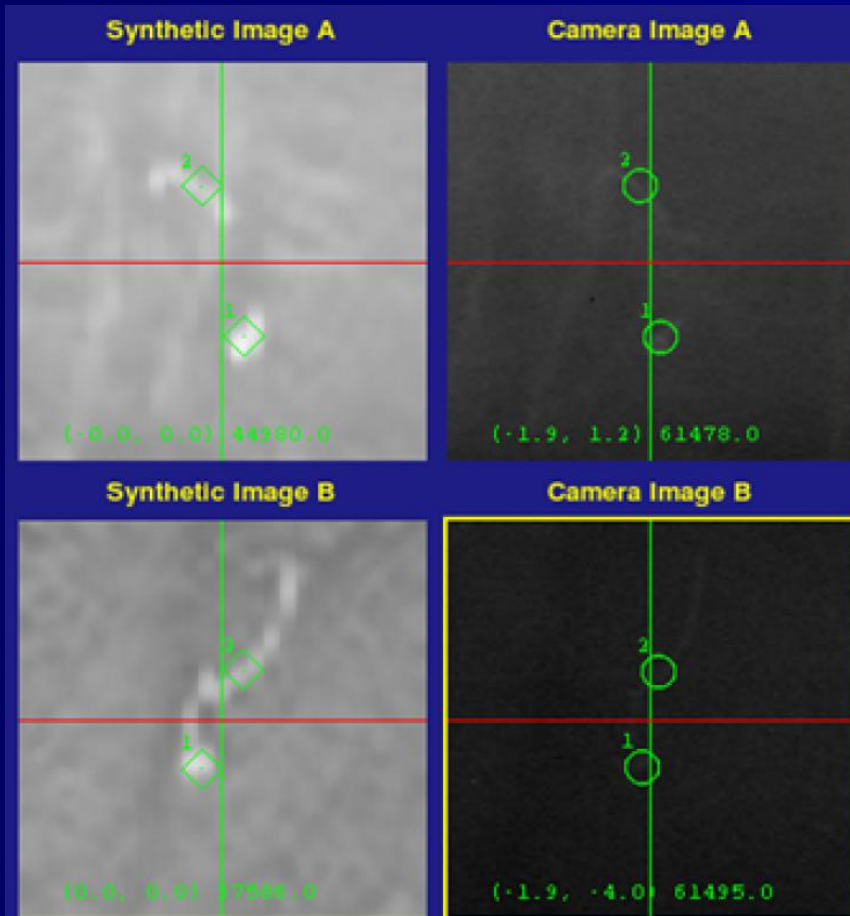


Synthetic Image B

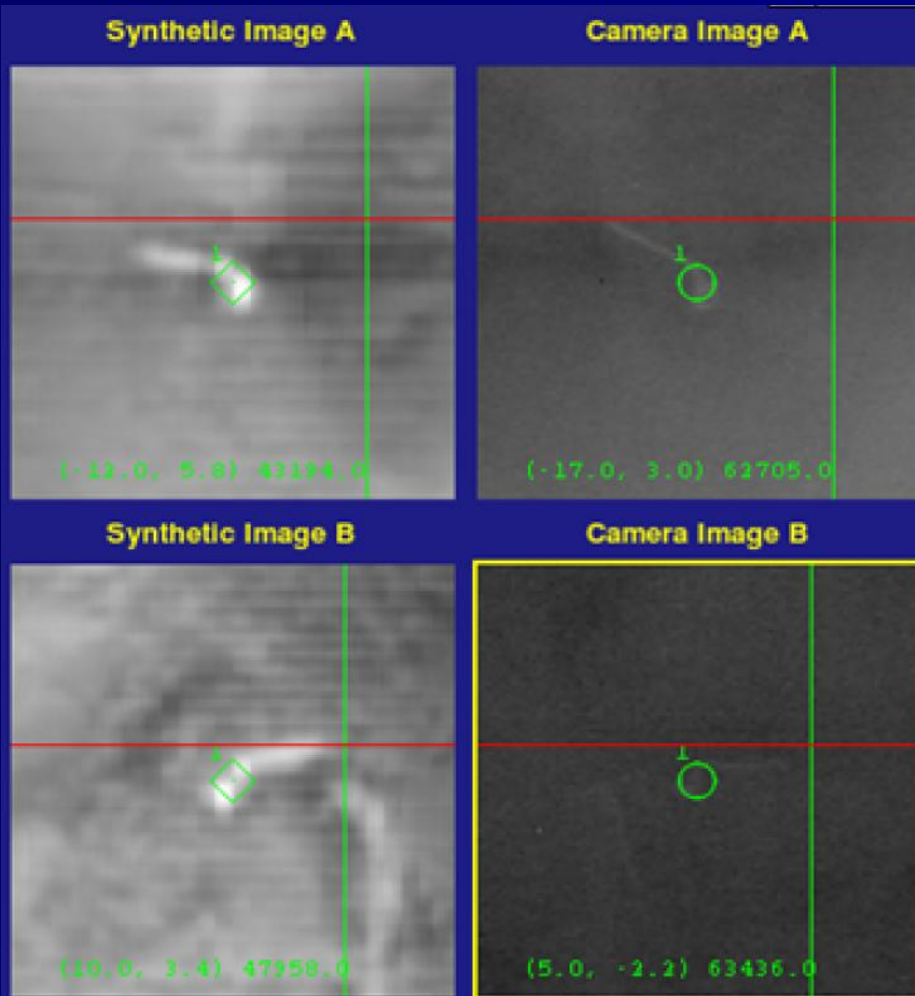


Camera Image B

# Adrenal Gland



# Pancreas



# Conclusion:

- It is feasible to use gold anchor marker for Cyberknife
- Ball shape or Tadpole gold anchor markers are recommended
- Visual confirmation of lock-on is important due to the irregular shape of gold anchor markers
- More study is needed to evaluation clinical effect

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