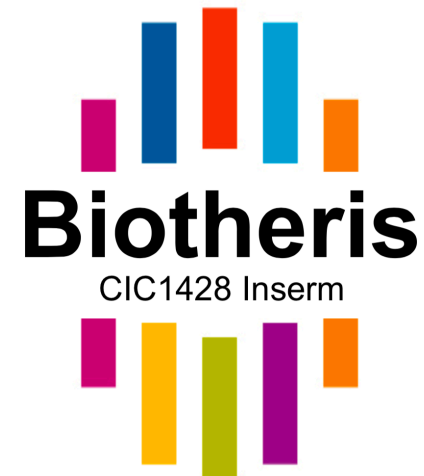


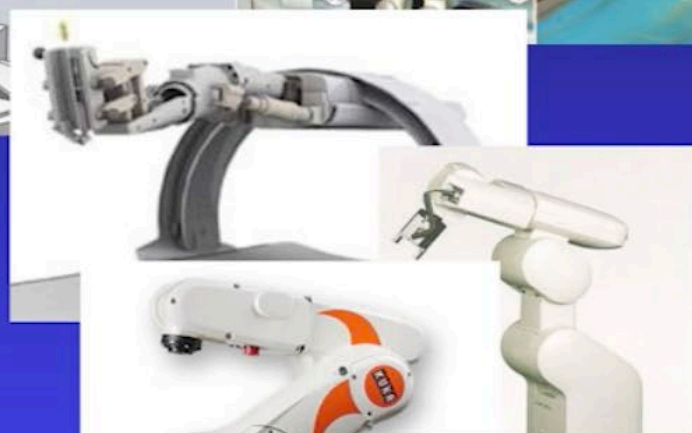
# Robot or Not Robot ?



1985



2015



Puma 650  
Acubot  
Innomotion  
Mitsubishi  
Kuka  
B-ROB I  
Robio  
Maxxio  
Isys-1

**liberty**<sup>®</sup>  
microbot medical



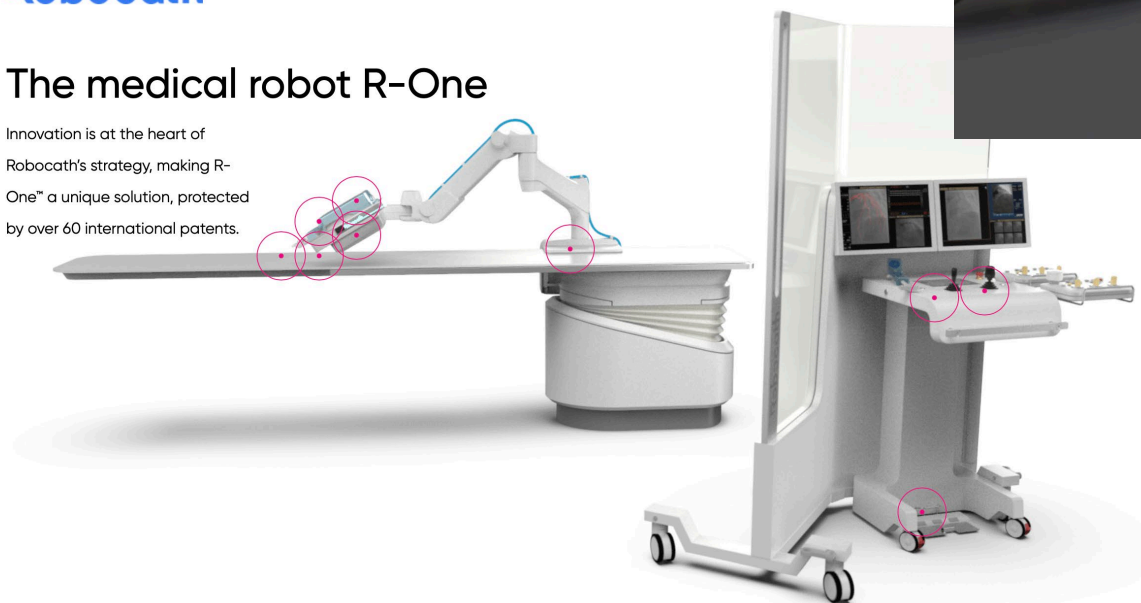
Liberty Product Hotspot

LIBERTY® is the first ever fully disposable surgical robot designed to streamline endovascular procedures.

**Robocath**

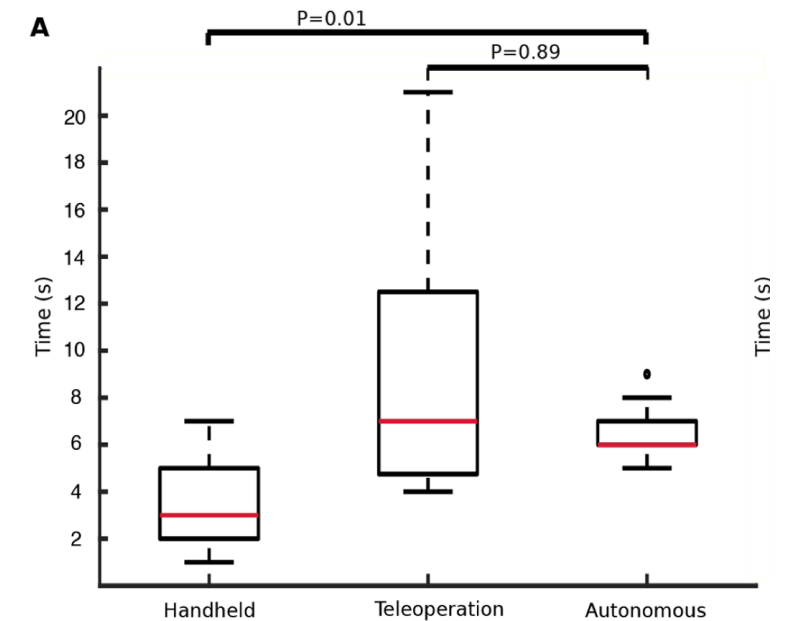
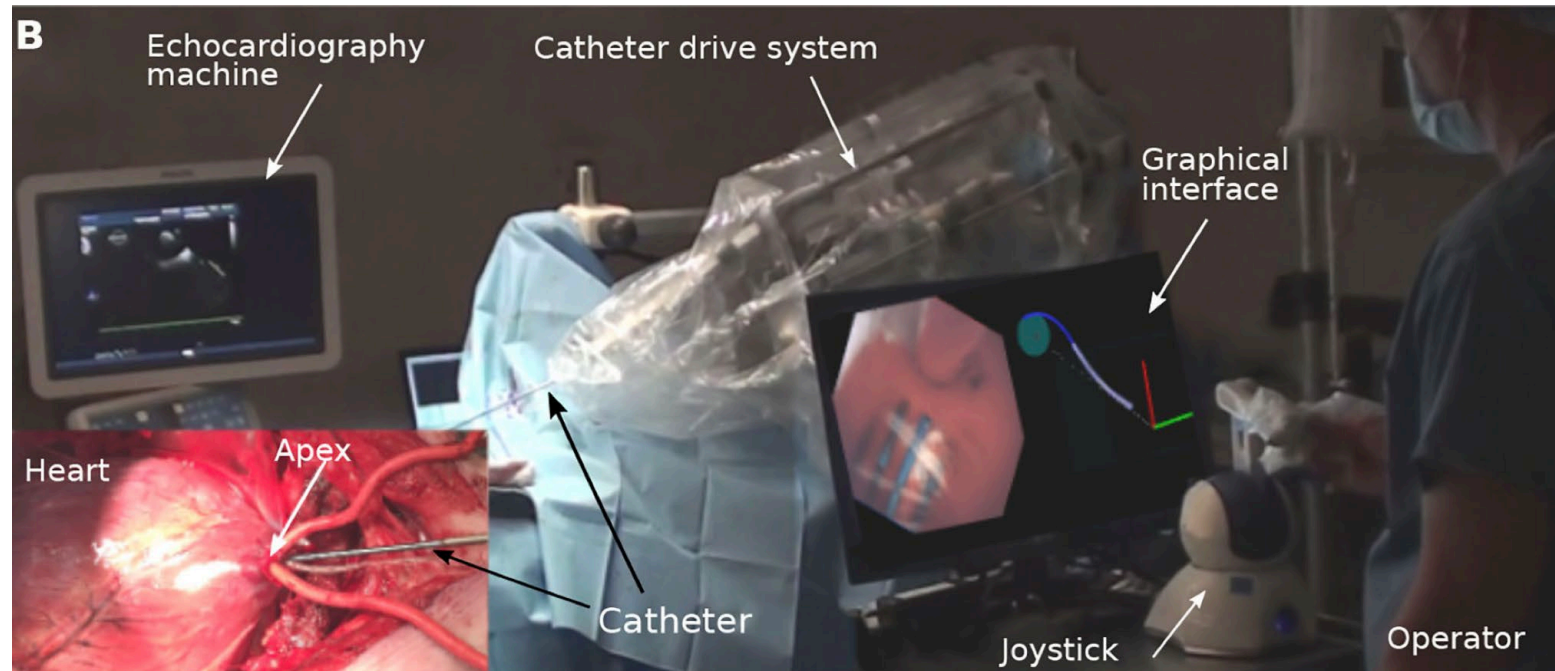
## The medical robot R-One

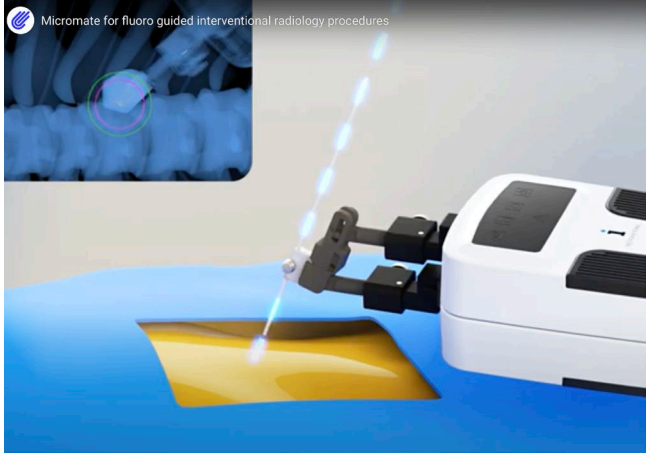
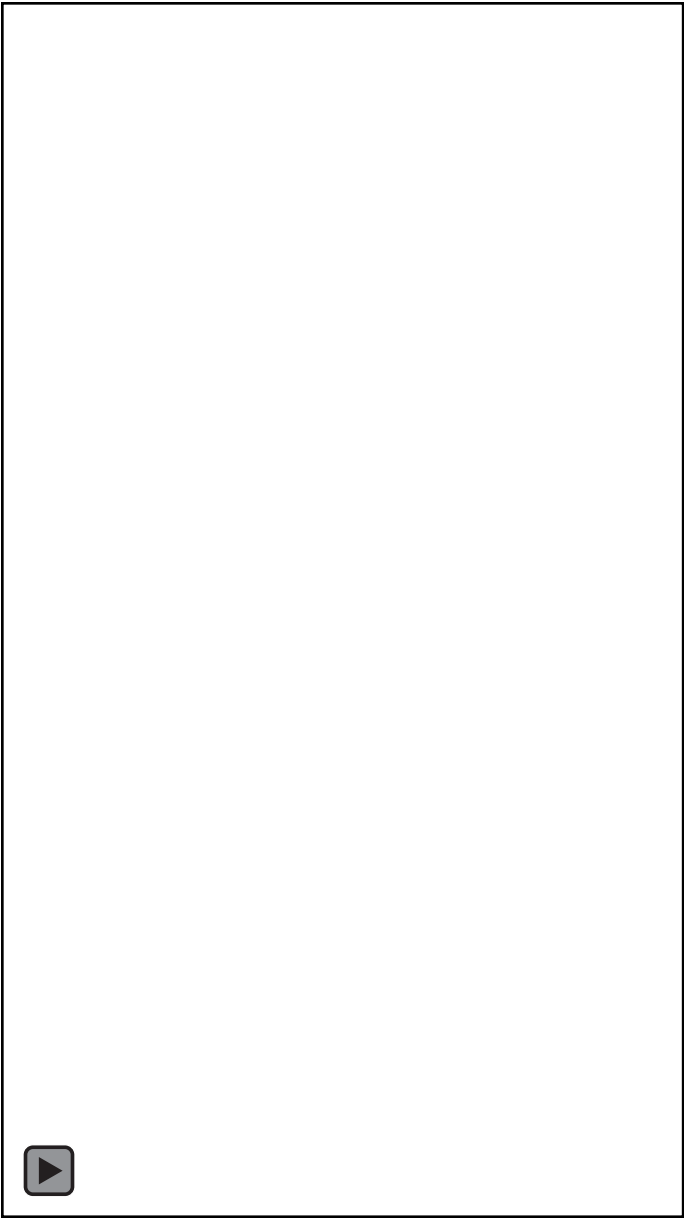
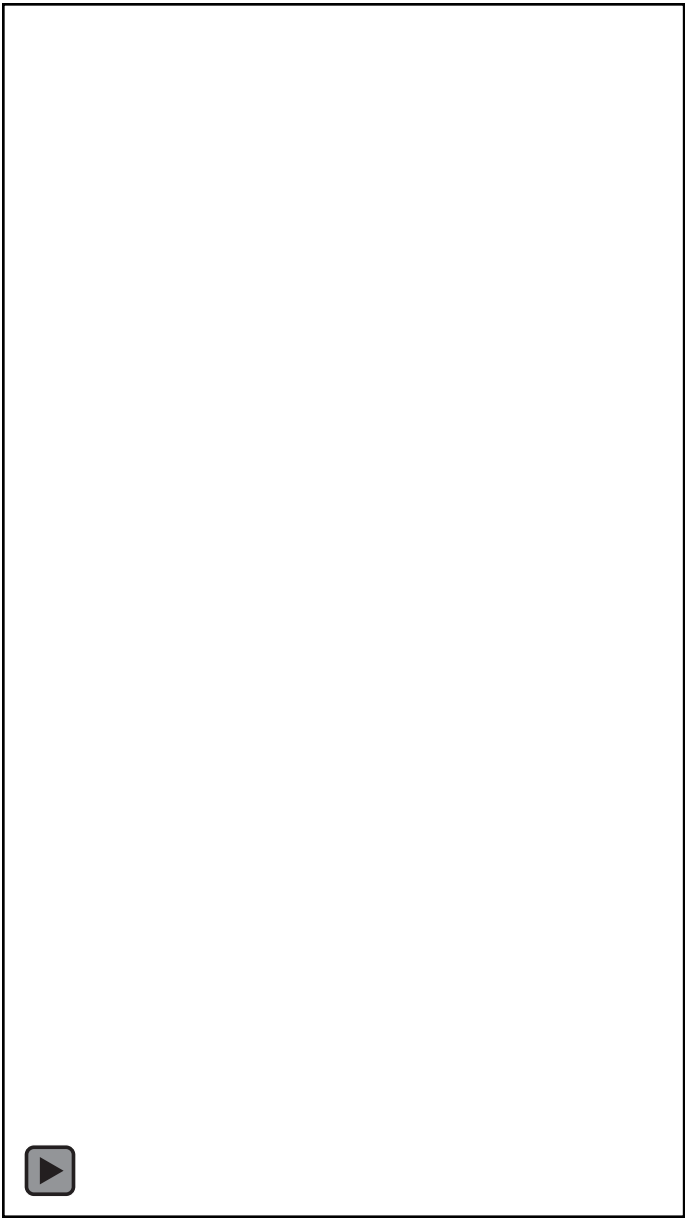
Innovation is at the heart of Robocath's strategy, making R-One™ a unique solution, protected by over 60 international patents.



## Autonomous Robotic Intracardiac Catheter Navigation Using Haptic Vision

G. Fagogenis<sup>1</sup>, M. Mencattelli<sup>1</sup>, Z. Machaidze<sup>1</sup>, B. Rosa<sup>2</sup>, K. Price<sup>1</sup>, F. Wu<sup>3</sup>, V. Weixler<sup>1</sup>, M. Saeed<sup>1</sup>, J. E. Mayer<sup>1</sup>, P. E. Dupont<sup>1</sup>





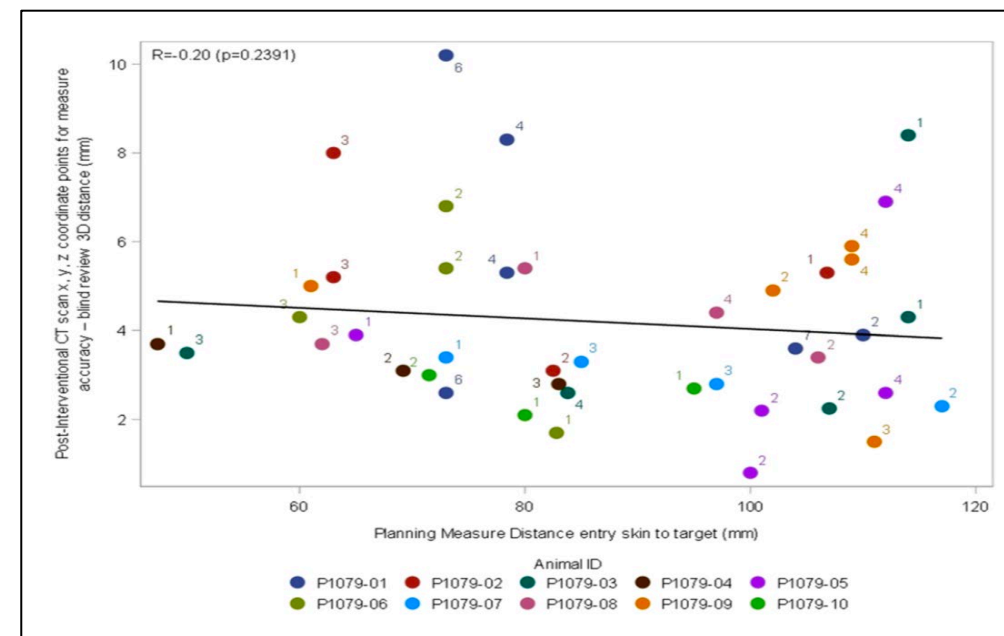
- Accuracy
- Low operator input and variability
- Short learning curve
- Validation : planned vs done
- Replay: Education, AI of robots on failure
- Radiation safety
- Foot print
- Time sparing
- cheap



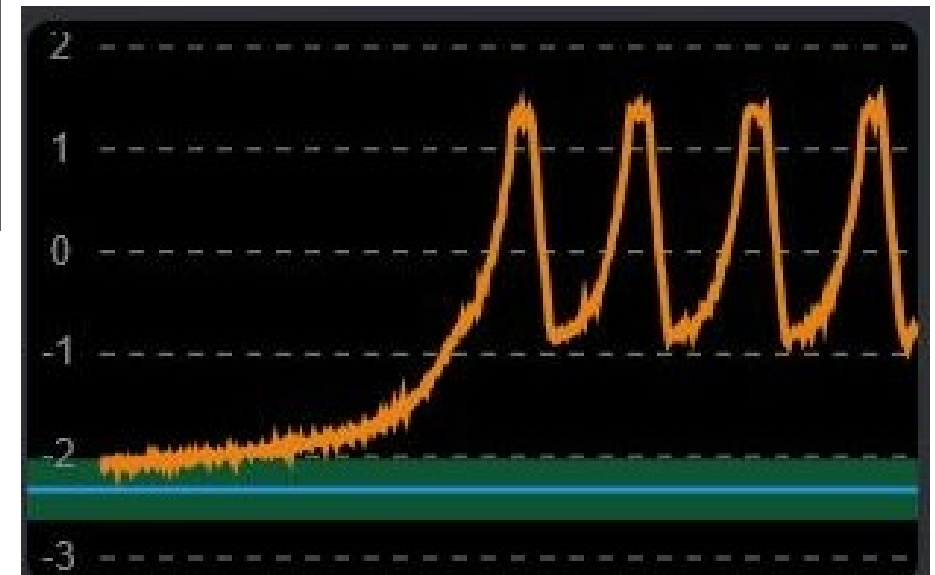
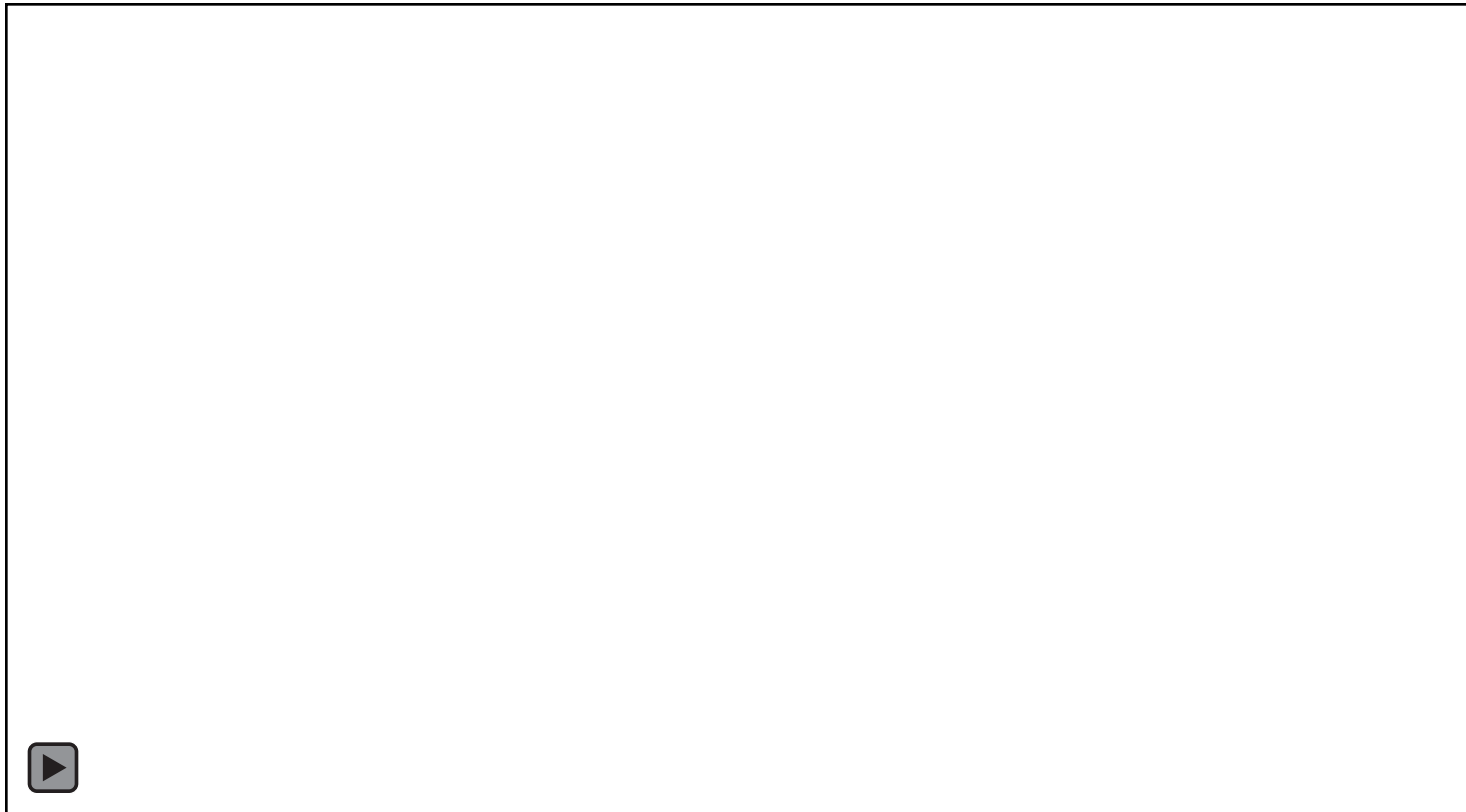
# Feasibility, safety and accuracy of a CT-guided robotic assistance for percutaneous needle placement in a swine liver model

Boris Guiu<sup>1</sup>, Thierry De Baère<sup>2</sup>, Guillaume Noel<sup>3</sup> & Maxime Ronot<sup>4</sup>

- 43 insertions, med traject. length = 83 mm (72–105 mm)
  - **Accuracy blinded evaluation :  $3.5 \pm 1.3$  mm.**
    - $83/3.5=0,042$  / tang  $2,5^\circ$
  - **Novice vs Experts :  $3.7 \pm 1.3$  versus  $3.4 \pm 1.2$  mm,  $P = 0.44$**
  - Neither angulation nor length trajectory impacted accuracy
  - **one (n = 36) or two (n = 7) attempts (100% feasibility).**



(Guiu B. nature.com/scientificreports 2021 : 11:5218 )

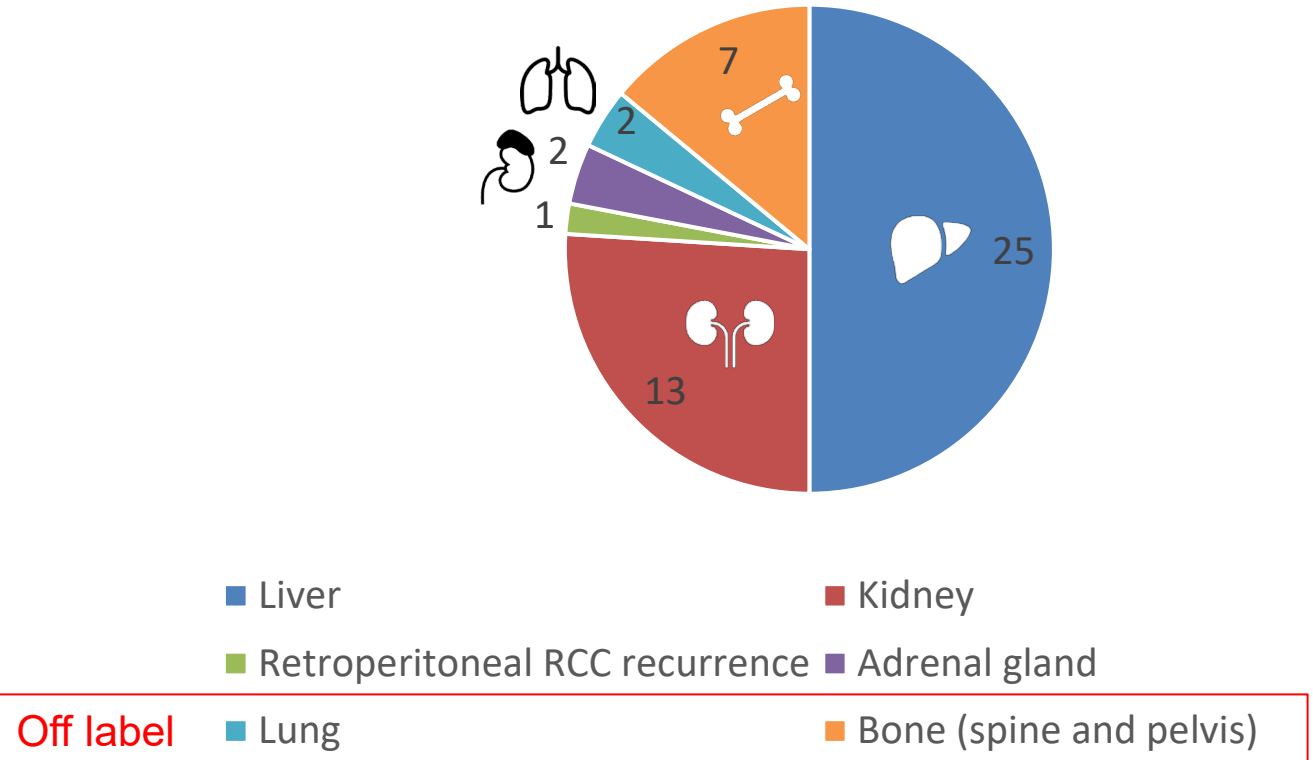


Screenshot of the respiratory monitoring function.

# Type of procedure

- 50 patients (January-July 2022)
- Sex : 15 F / 35 M
- Age :  $66 \pm 10$  years old (mean  $\pm$  SD)
- BMI :  $25.8 \pm 4.2$  kg/m<sup>2</sup> (mean  $\pm$  SD)
- Targeted Lesions
  - Size :  **$22.9 \pm 9.2$**  mm (mean  $\pm$  SD)
  - In Abdomen: 41 patients
  - Off-label: 9 patients

Cases by organs

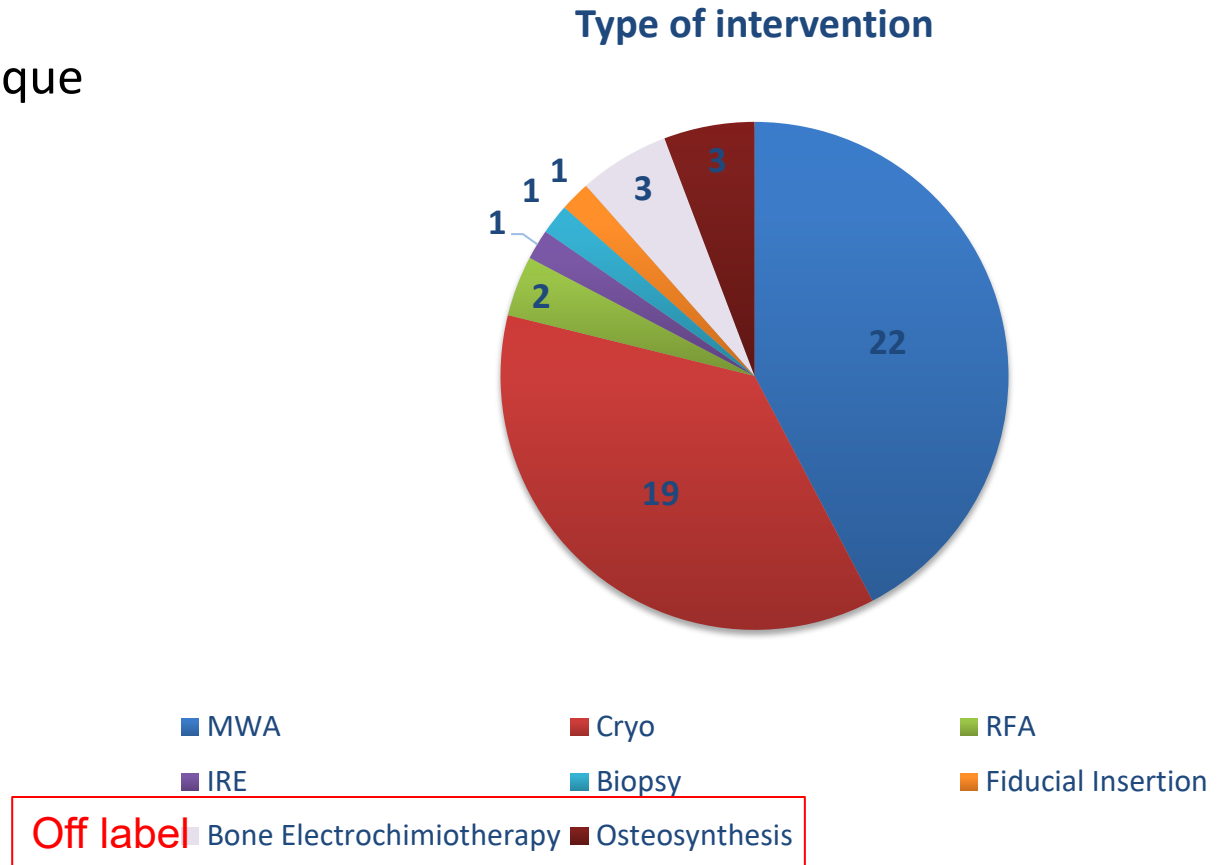


# Type of procedure

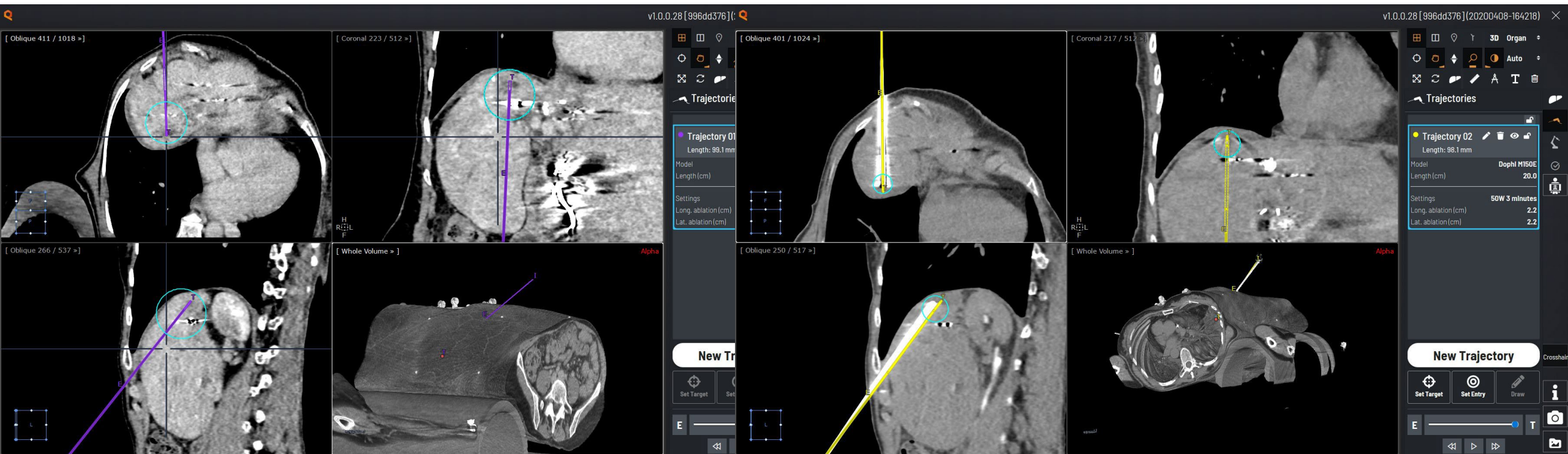
- Compatible with all ablation technique
  - MWA
  - Cryo
  - RFA
  - IRE
- Biopsy
- Fiducial insertion

But also...

- Osteosynthesis, cementoplasty
- Electrochemiotherapy

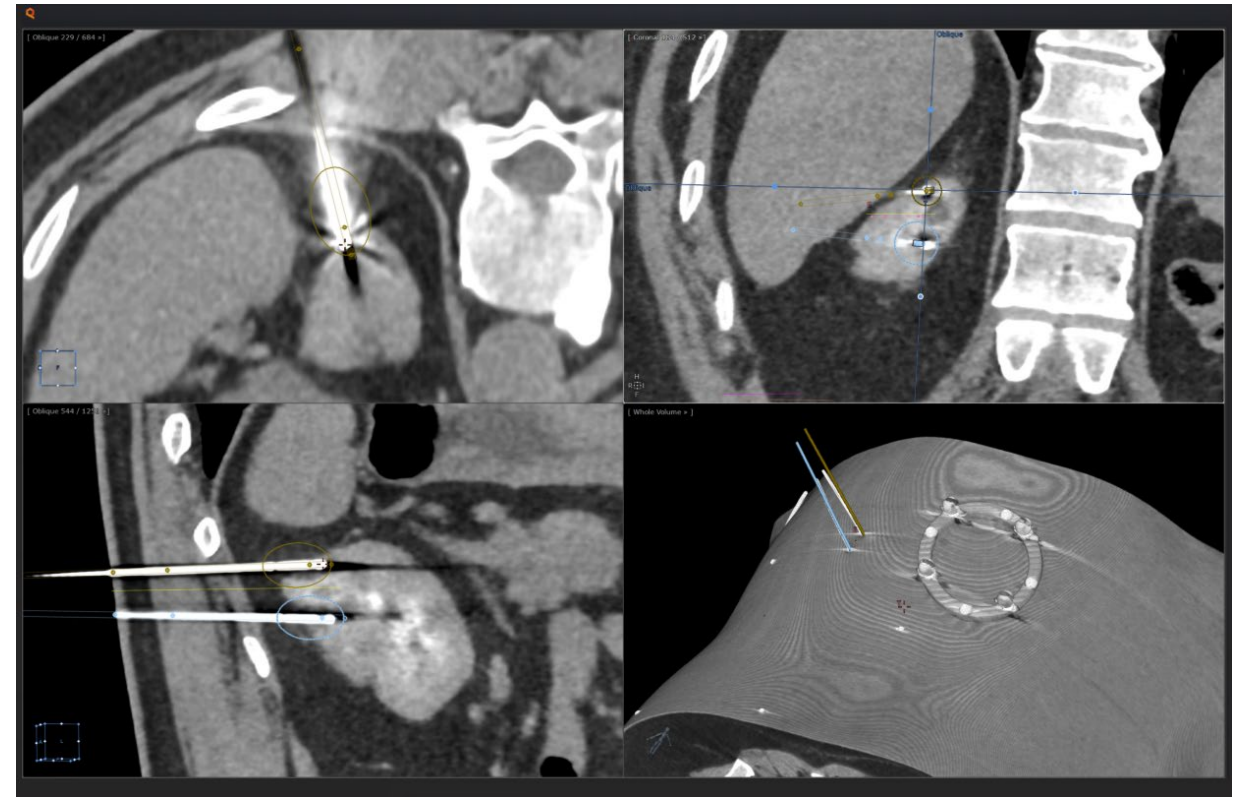
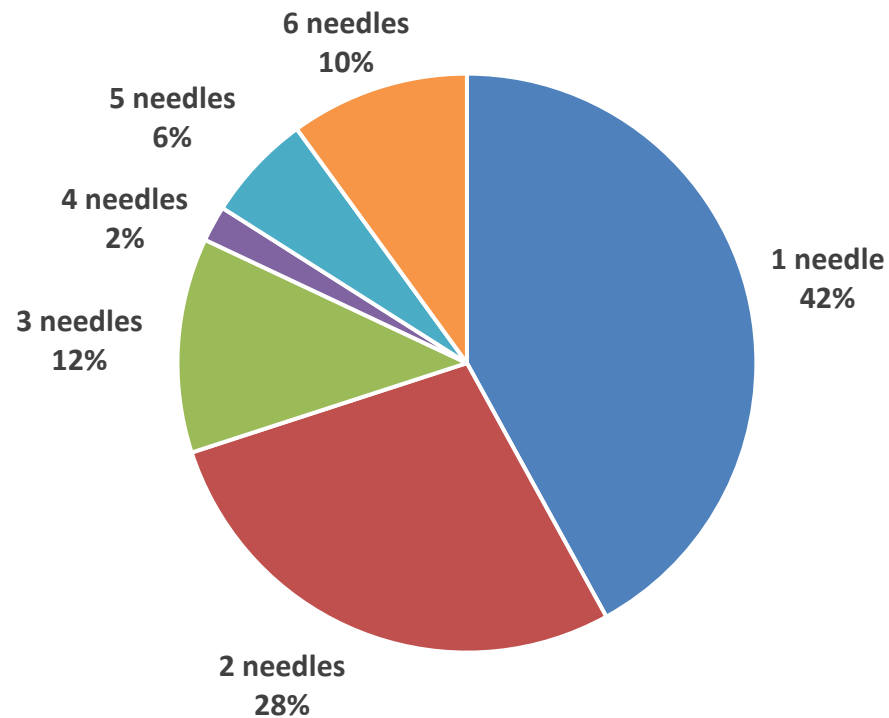


# complex trajectories



# multi-needle

- Number of planned needle trajectories
  - 58% of patients had multiple -needle insertion



# multi-needle

- Time needed for needle insertion

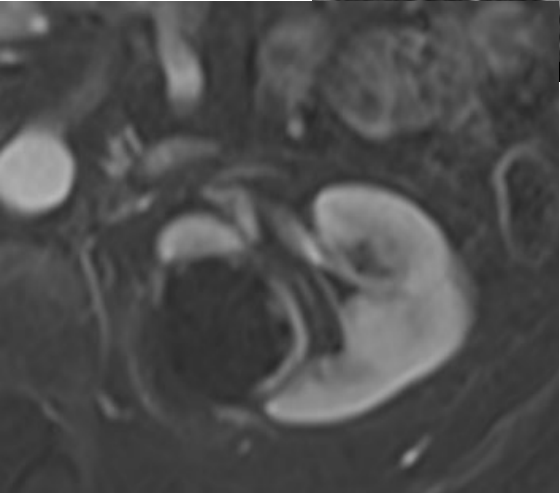
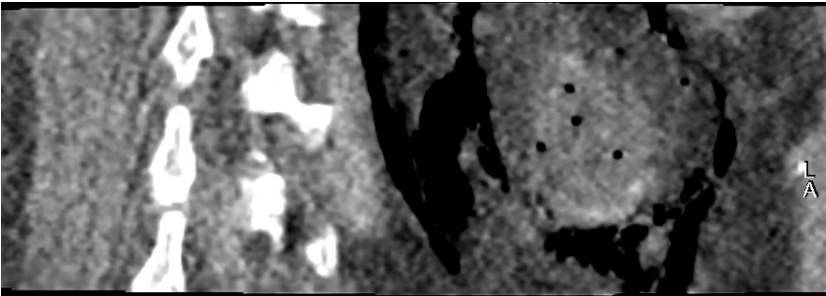
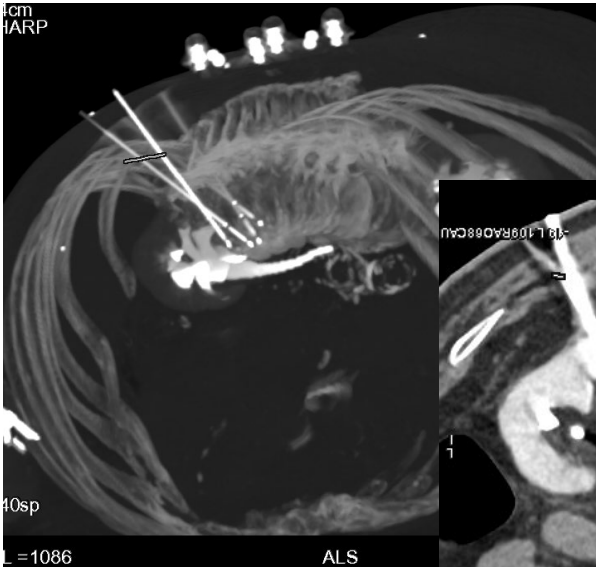
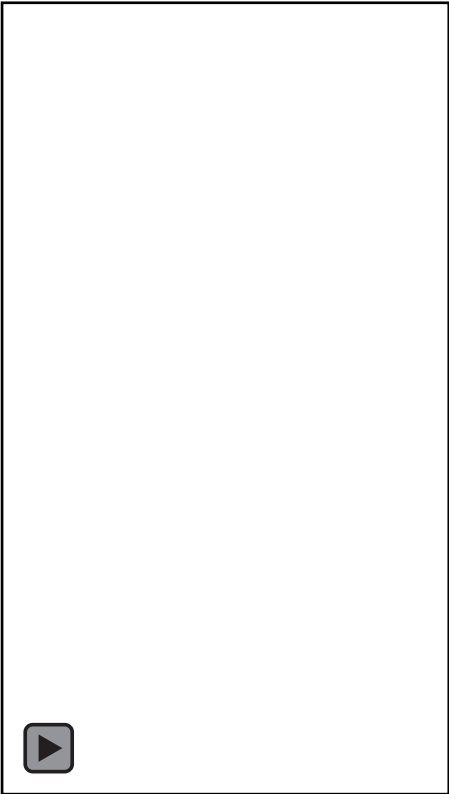
*(data from the 20 first patients of the post-market study)*

- 26 needles inserted in less than 1 minute

Insertion time	0-1 min	1-2 min	>2 min
Number of needles	26	7	1
In %	76%	21%	3%

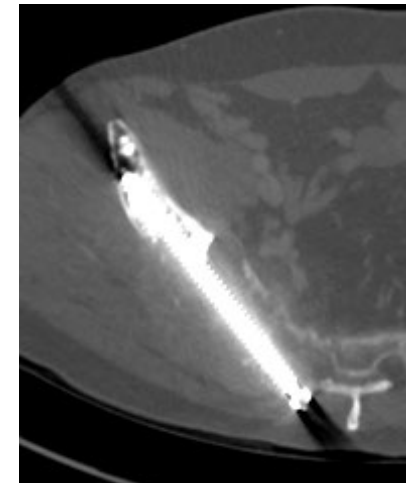
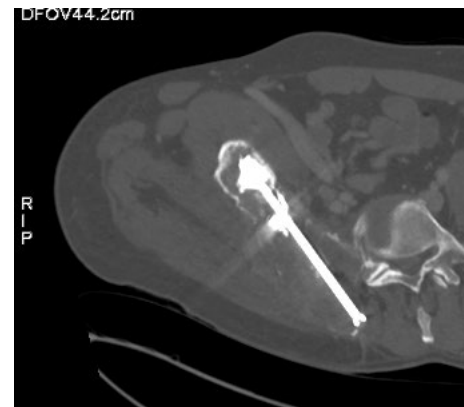
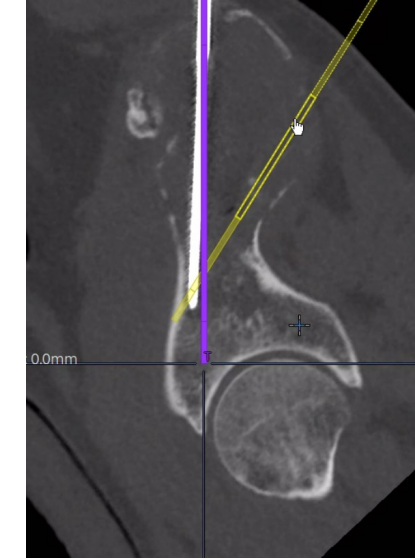
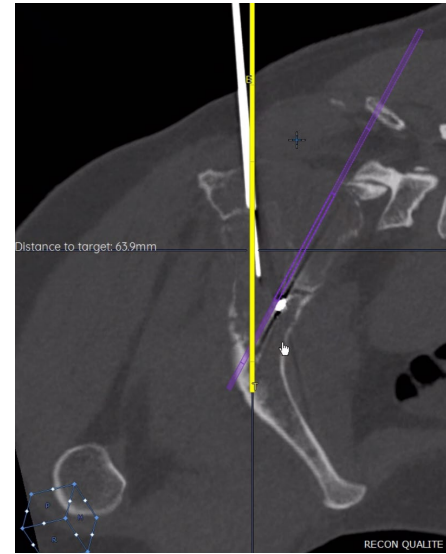
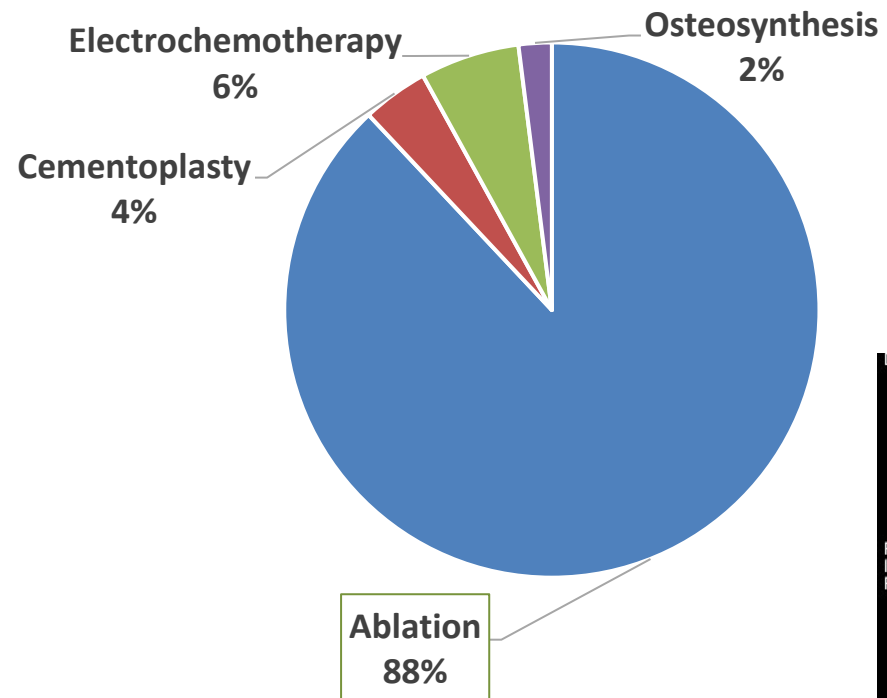
- Mean time per needle insertion

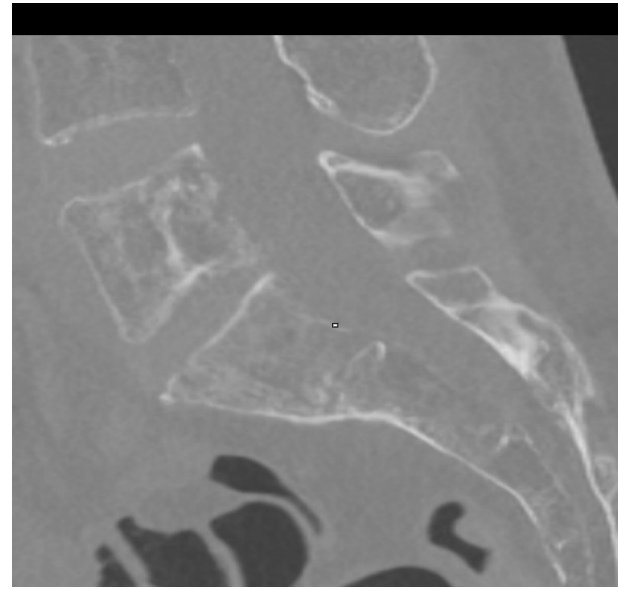
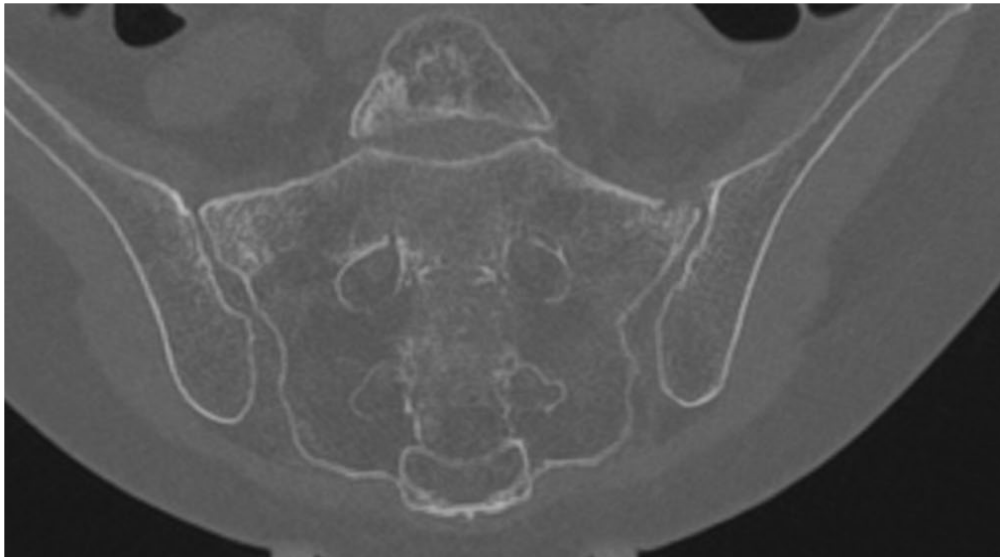
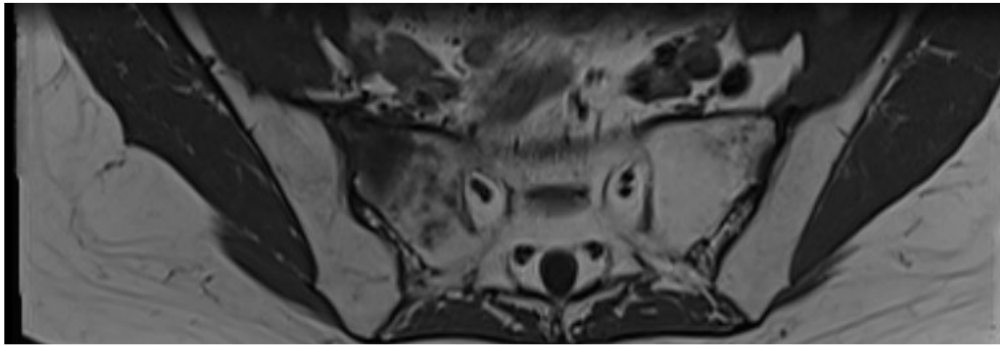
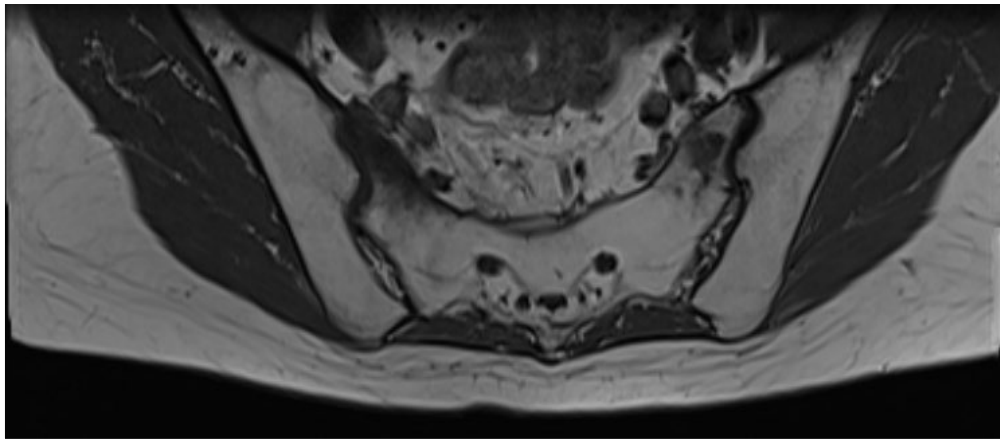
Organ	Liver	Kidney
Mean insertion time per needle (in seconds)	50,77	38,56

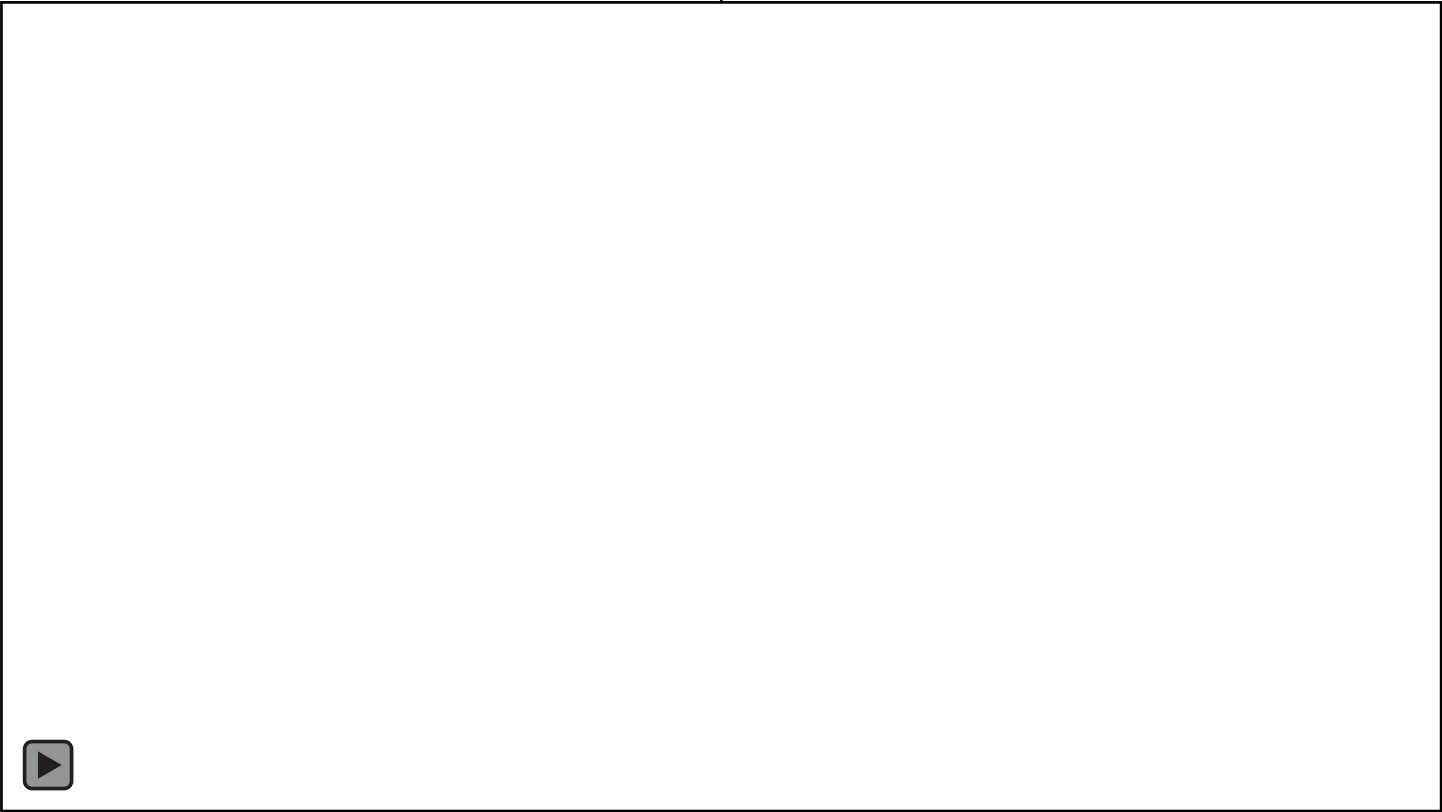
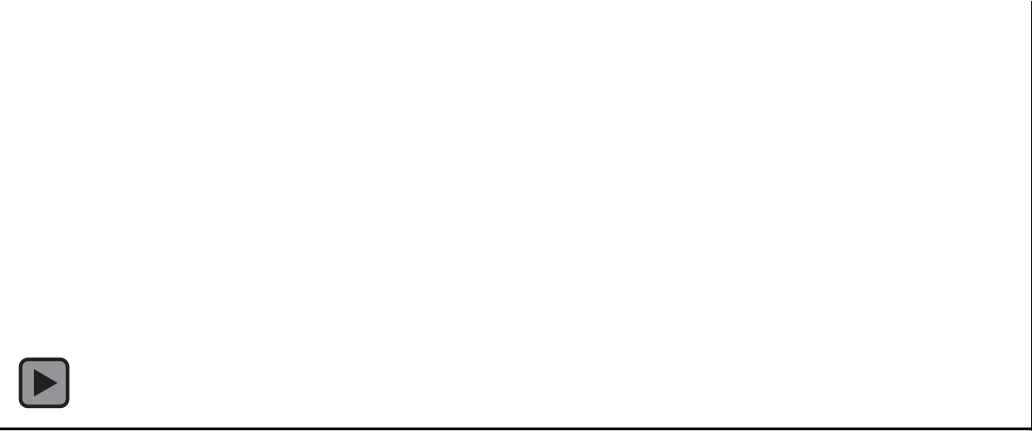


# Results - Focus Bone/Lung (off label)

- Intervention type













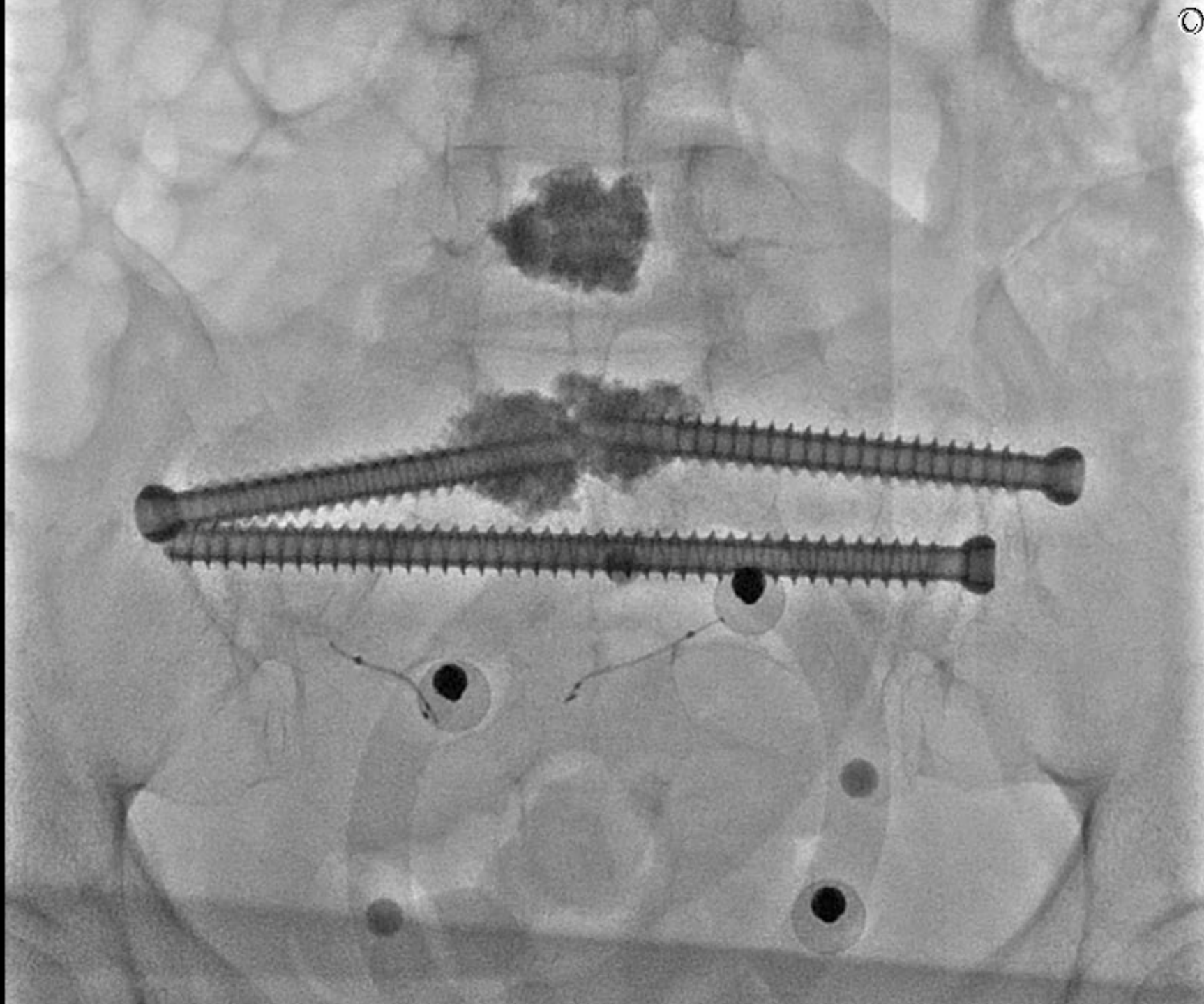




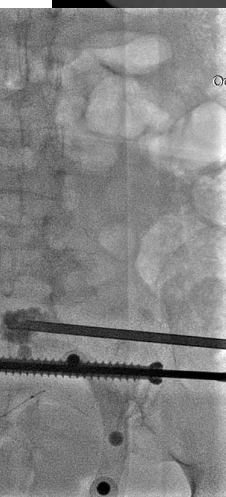




Oct 11 2022  
11:46:46



Oct 11 2022  
11:32:37



# Results – Safety & Performance

## Safety: 2 adverse events

- Both classified as moderate (grade 2) according to CIRSE and SIR Guidelines
  - *Choice of longer needle than the one planned leading to lung penetration and pleural effusion not requiring drainage (during liver dome lesion ablation)*
  - *Pneumothorax requiring drainage (during lung lesion ablation)*
- No severe complication

## Performance :

- Estimation of accuracy by physician=  **$2.45 \pm 3.5\text{mm}$**  (mean  $\pm$  SD)  
*(data from the 20 first patients of the post-market study)*
- After a median of adjustment of **0,5/lesion**  
*(data from the 20 first patients of the post-market study)*
- All post ablation contrast enhanced CT shows  
**complete ablation (for all 44 ablation patient)**  
**adequate screws positioning** in 2 osteosynthesis patient.

# Discussion – Pros and Cons

- Needle trajectory in any plane, ... not anymore stuck in the axial plane
  - Breath monitoring
  - Easy comparison in between planned and performed
  - Multiple needle ability with  $1+1+1+1 = 1,5$
  - Short learning curve
  - Low operator impact
  - Attracting technology
- Set-up time (Single needle vs multiple needles)
  - Need for some manual adjustment in 50% of cases
  - Foot print
  - From skin to target
  - Cost

# Conclusion

## Promising early clinical results

- After a first in man study previously reported in liver only
- First postmark series enlarge the field with liver, kidney, lung tumors and bone reconstruction
- Extended experience in 50 patients suggest that Epione® robotic system needle insertion is safe, highly feasible, requiring few needles adjustments, and provided efficient thermal ablation.



Cardiovasc Intervent Radiol  
<https://doi.org/10.1007/s00270-022-03267-z>



CLINICAL INVESTIGATION

NON-VASCULAR INTERVENTIONS

## Evaluation of a New CT-Guided Robotic System for Percutaneous Needle Insertion for Thermal Ablation of Liver Tumors: A Prospective Pilot Study

Thierry de Baère<sup>1</sup> · Charles Roux<sup>1</sup> · Frédéric Deschamps<sup>1</sup> · Lambros Tselikas<sup>1</sup> · Boris Guiu<sup>2</sup>