PLACE 2026 · ROMA · SALA VENERE

Structural Intervention in 2030

The Mitral Valve

A glimpse into the future of mitral valve treatment

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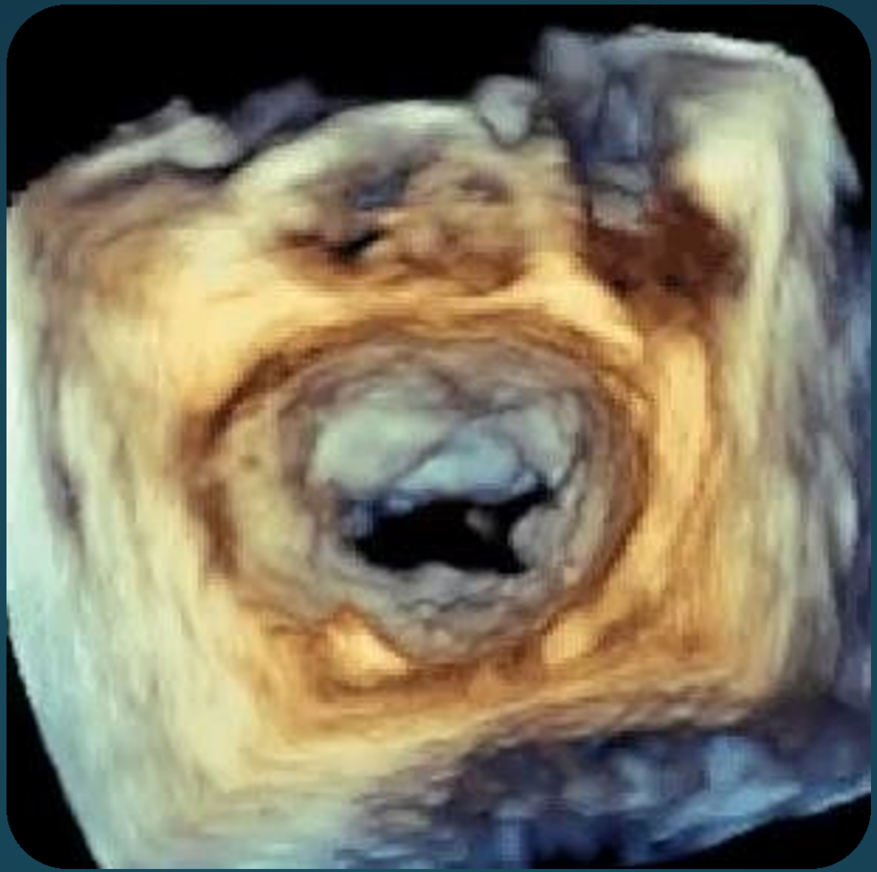


DISCLOSURES

Conflicts of interest

I, Alessandro Sticchi, declare the following relationships with industry.

Abbott Travel support · competition grant
Edwards Lifesciences Advisory board · travel support
CardioValve Travel support
P&F (Products & Features) Travel support
Meril Life Sciences Travel support · educational grant
GE HealthCare Travel support

This lecture is forward-looking and discusses investigational technologies not yet approved for clinical use.

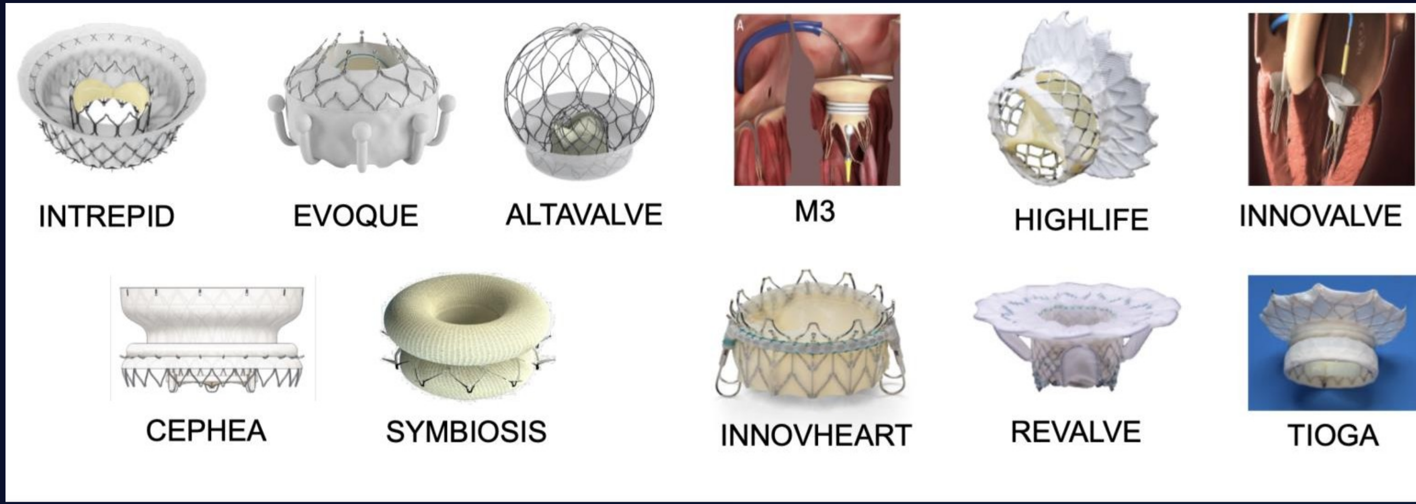
THE STARTING POINT

2026: where we stand

TEER is established :
for both degenerative and functional MR.

TMVR is maturing :
8+ transseptal systems in early-feasibility / pivotal trials.

Real-world reach is narrow :
most candidates never reach an implant.



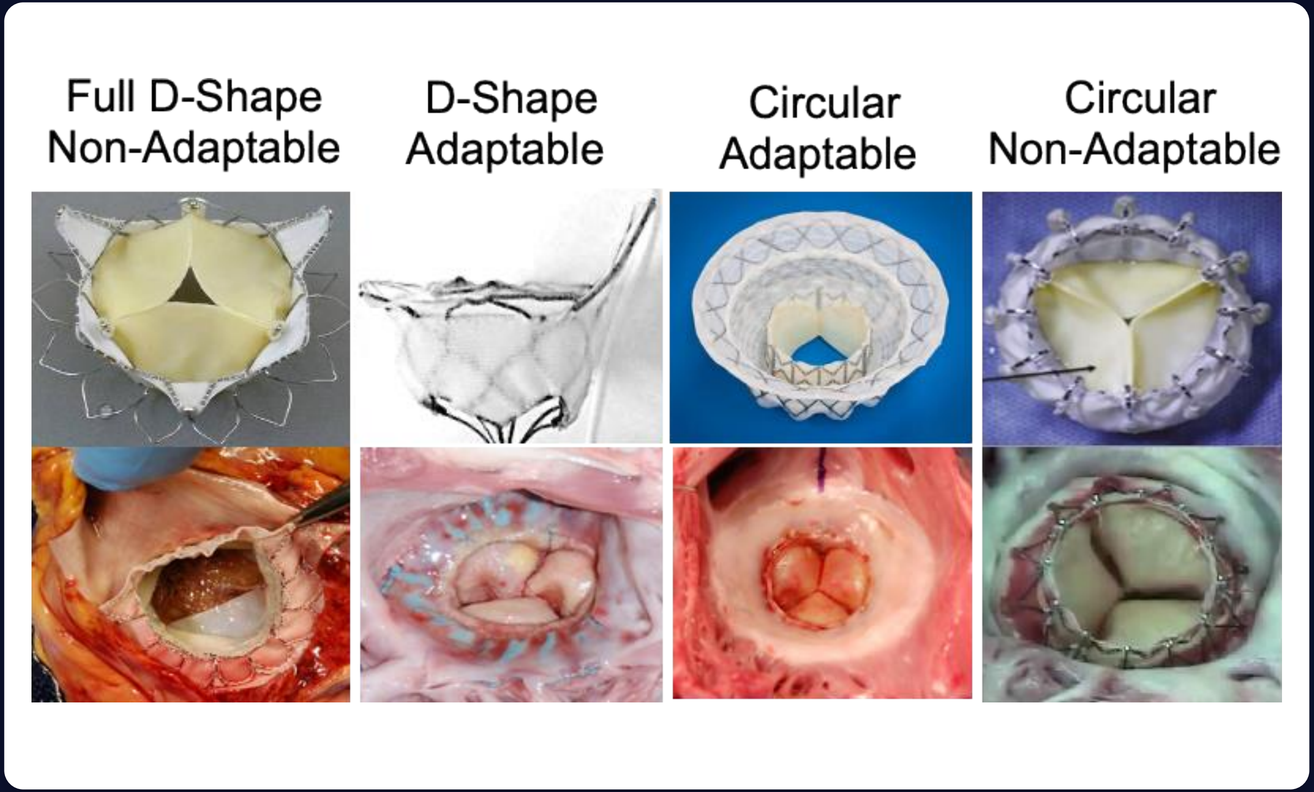
Transcatheter mitral replacement systems in development

70–90% **of potential TMVR candidates are excluded at anatomical screening.**

The bottleneck is anatomy — not enthusiasm. Granada JF, TCT 2024

THE CORE PROBLEM

The Achilles heel: device - anatomy mismatch



Frame adaptability vs. the native mitral annulus

Non-planar & dynamic :
the annulus is D-shaped and moves throughout the cycle.

Rigid circular frames :
fit only a minority of mitral anatomies.

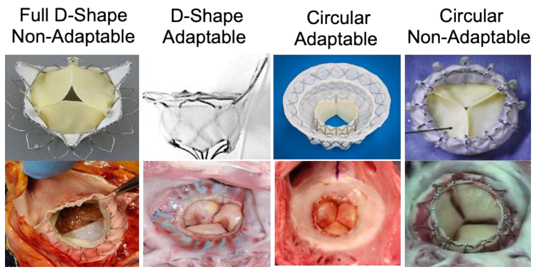
Mismatch has consequences :
oversizing, paravalvular leak, embolization, screen failure.

THREE UNSOLVED PROBLEMS

What we have not yet solved

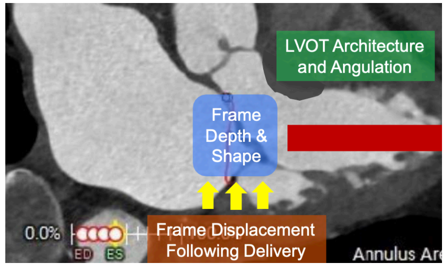
Device–anatomy mismatch

A non-planar, dynamic annulus meets a rigid frame.



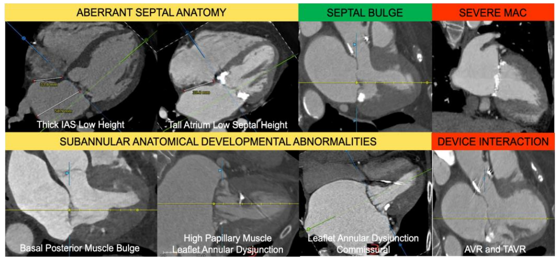
LVOT obstruction

Prosthesis and native leaflet narrow the neo-LVOT.



MAC & complex anatomy

Calcium, prior rings and hostile substrate.



Four forces are converging

Together they turn mitral intervention from anatomy-limited to truly patient-specific.

1. Intelligent imaging
2. The digital twin
3. Predictive AI
4. Robotics

Personalized mitral intervention
2030

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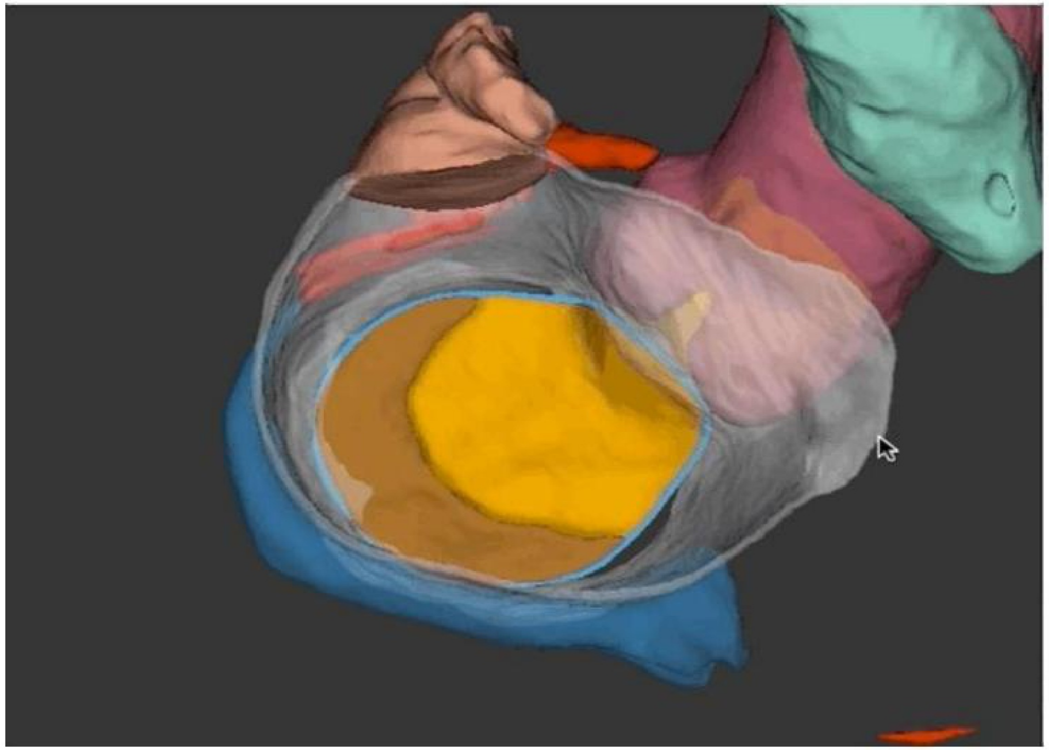
FORCE 01 · FOUR

Intelligent imaging

The eyes — automatic, operator-independent, four-dimensional.



AI deep-learning reconstruction of leaflets & annulus

One-click segmentation of the entire mitral apparatus from CT.

Automated sizing reproducible and operator-independent.

4-D leaflet tracking follows annulus & leaflets across the whole cycle.

44 h → 3.5 min

manual → AI-assisted segmentation

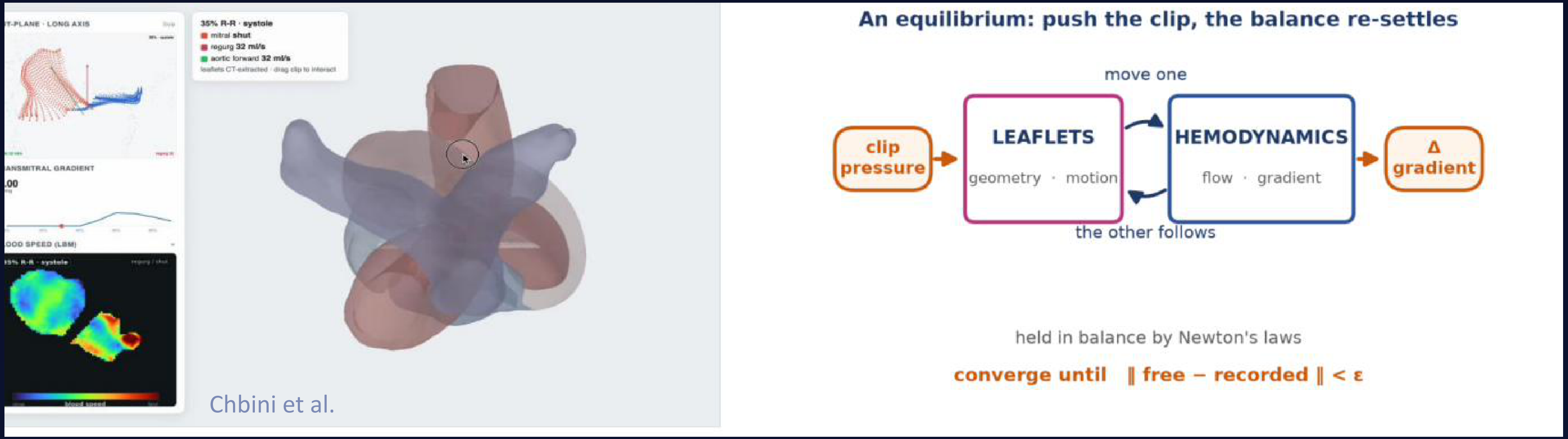
von Bardeleben et al. · LARALAB

FORCE 02 · FOUR

The digital twin

A patient-specific virtual mitral valve.

CT (4-D) → AI segmentation → Beating reconstruction → In-silico simulation



Beating patient model built from a standard cardiac CT.

Virtual device place the clip before touching the patient.

In-silico result read the predicted hemodynamics in advance.

CT → digital twin → virtual clip → hemodynamic assessment

Before we deploy the clip :
can we predict the result?

FORCE 03 · FOUR

Predictive AI

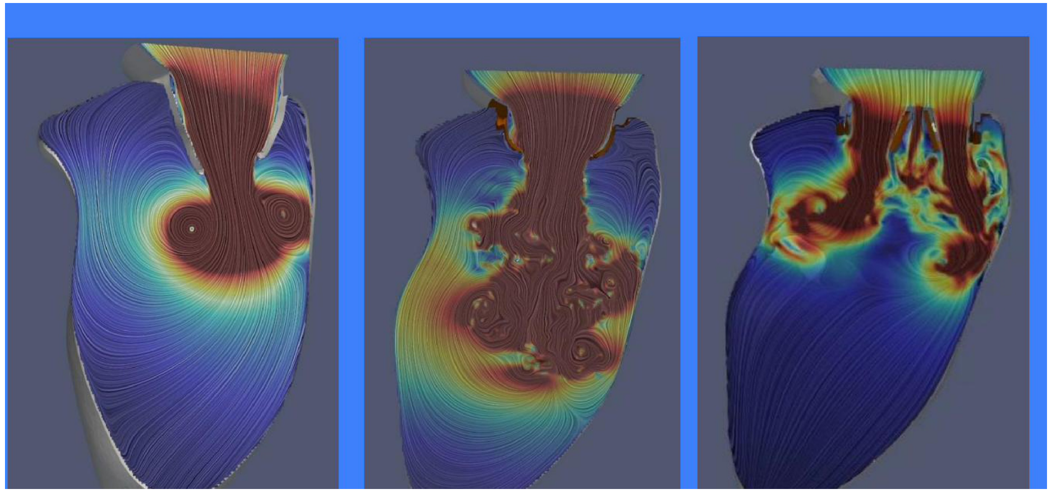
From images to physics-informed prediction.

Patient-specific CFD predicts transmitral flow and Doppler gradients.

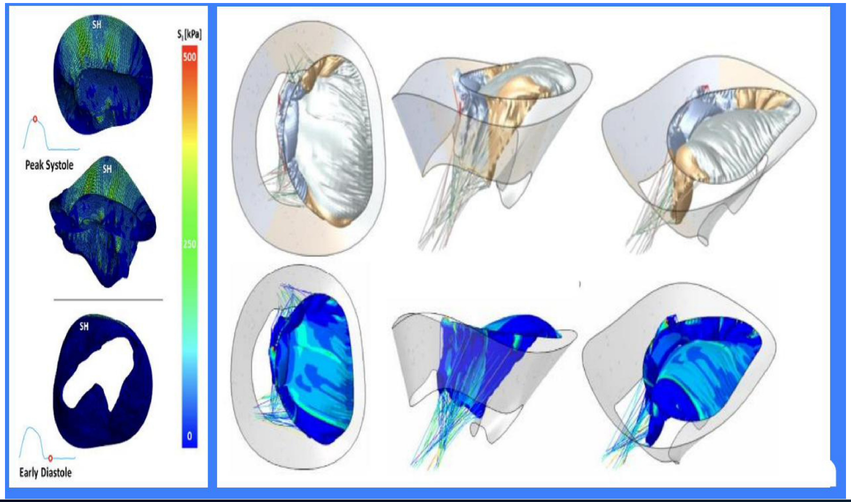
Finite-element stress informs leaflet durability and stenosis risk.

Learning algorithms recommend the device and predict the outcome.

Which strategy minimises the post-procedure gradient?



Patient-specific computational flow (CFD)

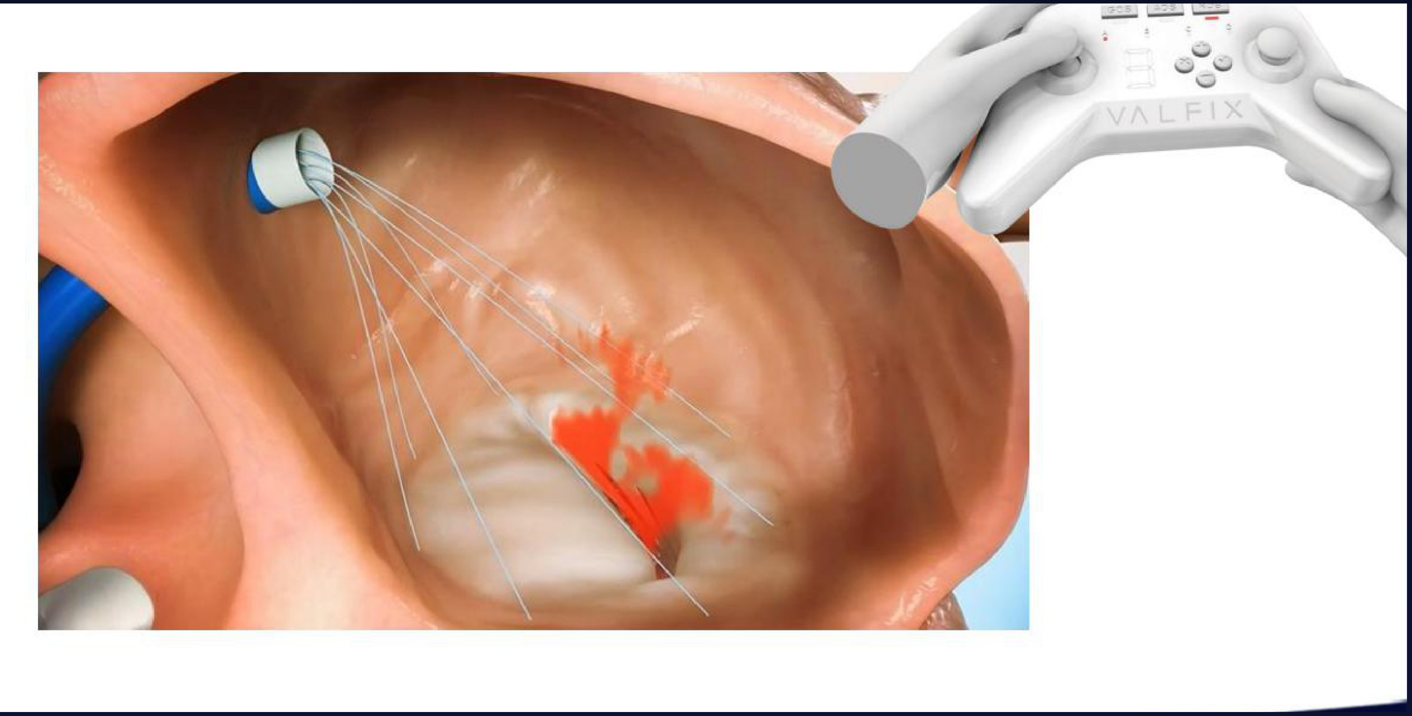


Finite-element leaflet stress mapping

FORCE 04 · FOUR

Robotics

The hands : sub-millimetre, reproducible, remote-capable.

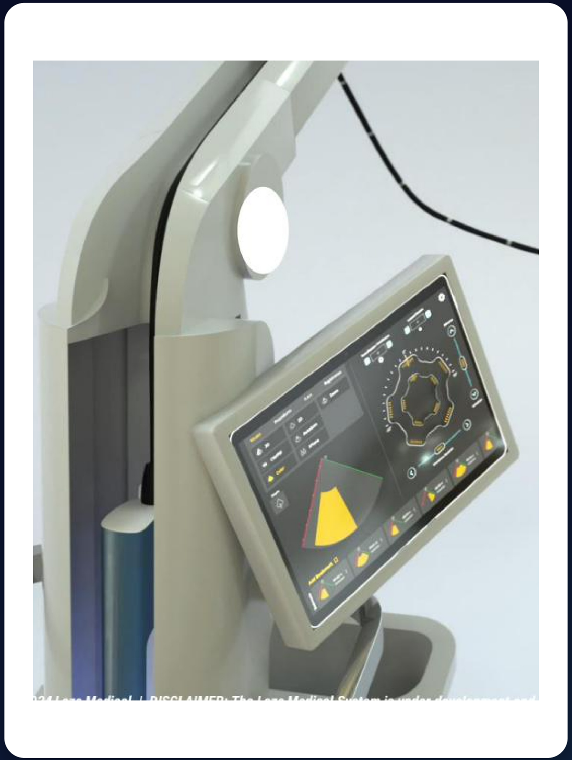


Robotic transcatheter annuloplasty · physician controller

A robotic platform controller, patient-side arms, disposable catheters.

Sub-millimetre control reproducible, precise device placement.

On the horizon robotic imaging, less radiation, remote procedures.



Robotic TEE navigation

INTEGRATION

The 2030 closed-loop workflow

Imaging feeds the twin, the twin guides the robot, the outcome teaches the model.

THE HARDWARE

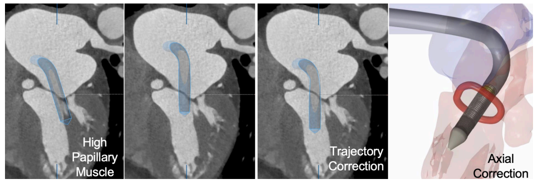
Devices that fit the patient, not the reverse!

- Adaptable, shape-conforming frames.
- Smaller profiles, fully percutaneous transseptal delivery.
- Electrosurgical leaflet modification (LAMPOON-type) to prevent LVOT obstruction.
- Axial-correction and steerable delivery systems.

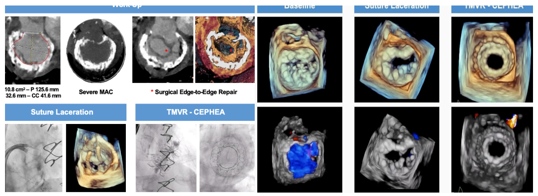
Personalised sizing closes the screening gap.

Shape-conforming frame

Adaptive design



Steerable / axial-correction delivery



Electrosurgical leaflet modification

REALITY CHECK

What still has to be solved

Tempered optimism.

Validation

Prospective outcome data, not just feasibility.

Regulation

EU AI Act & FDA oversight of learning models.

Data & bias

Small cohorts, generalizability, core-lab independence.

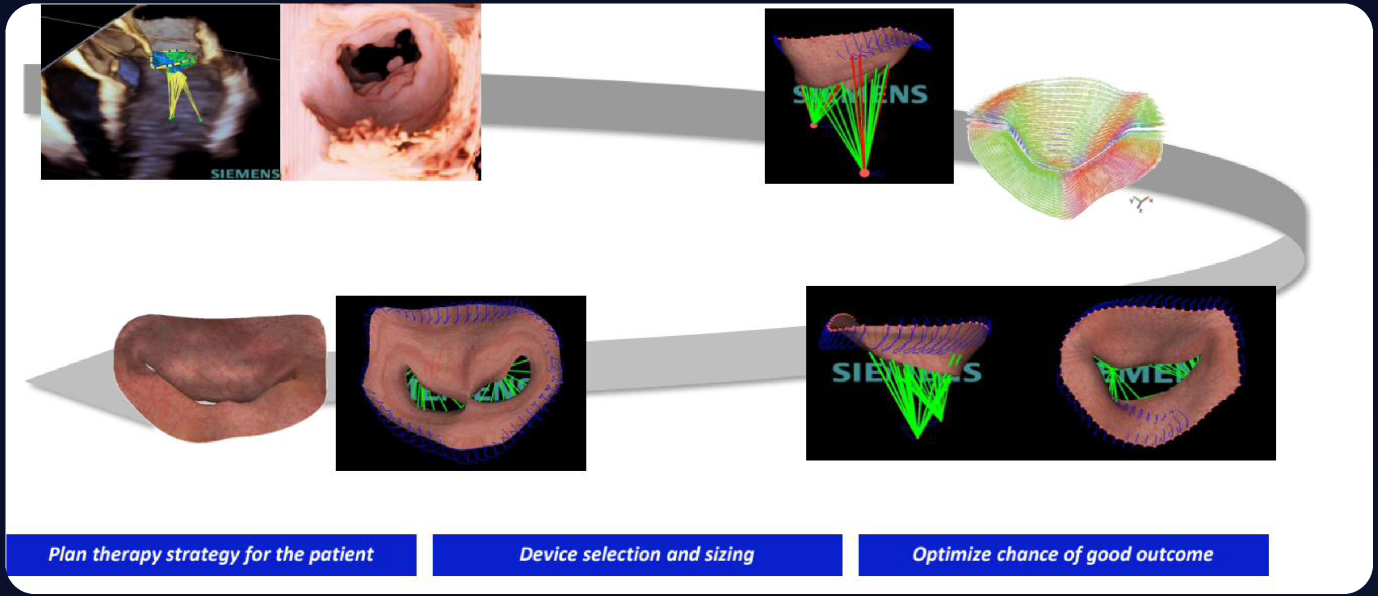
Human in the loop

AI augments the Heart Team:
it does not replace it.

The technology will mature before the evidence does, that gap is ours to close!

TAKE-HOME

What to remember



1. The bottleneck is anatomy, not enthusiasm: 70–90% are screened out today.
2. Four forces are converging now: imaging, the digital twin, predictive AI, robotics.
3. By 2030: test-before-treat, devices that fit the patient, robots that extend the operator.
4. The judgment stays human.

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The future is already arriving

Personalised · predictive · precise

Grazie

Alessandro Sticchi · Interventional Cardiology · Pisa