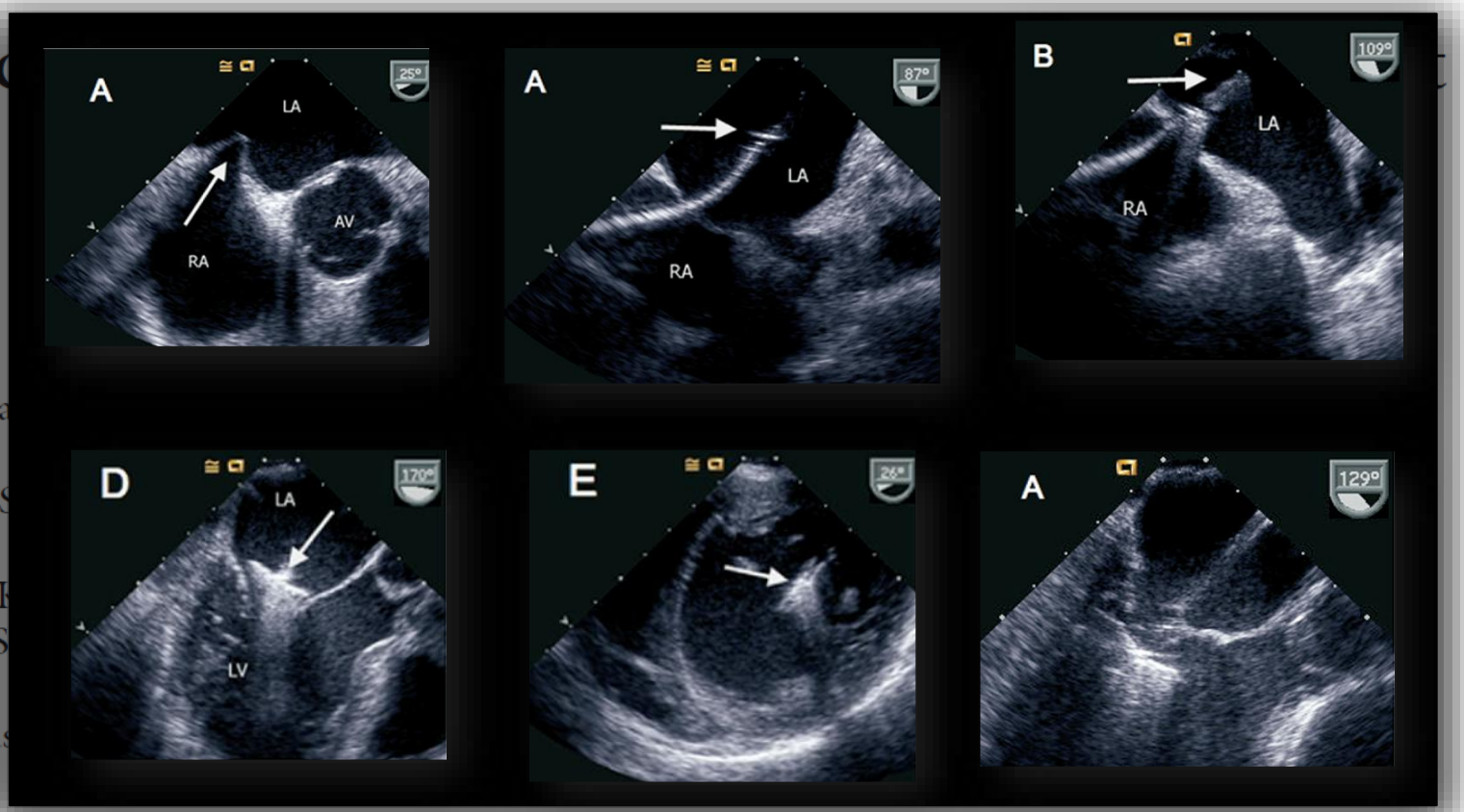
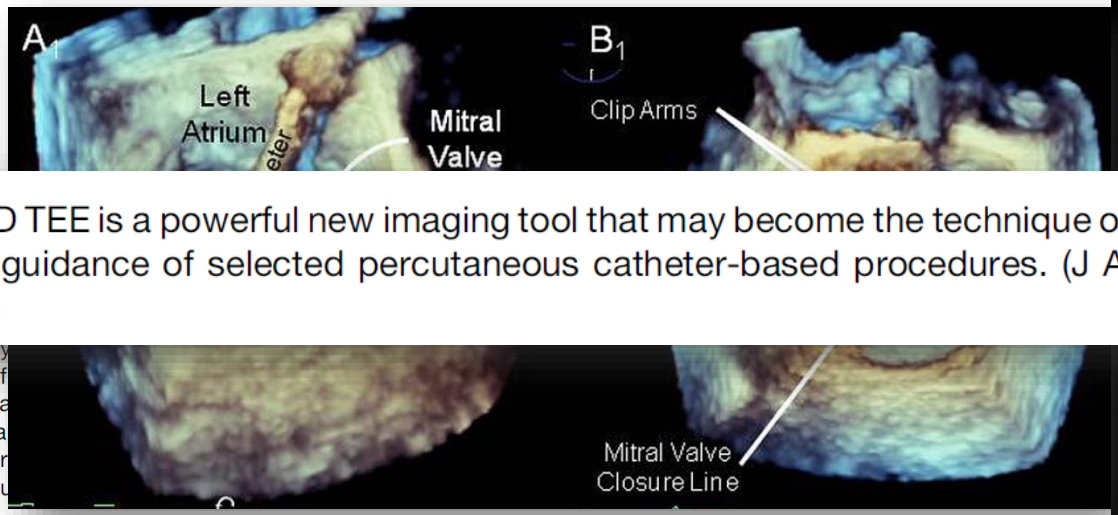
Echocardiographic-fluoroscopic fusion imaging for transcatheter mitral valve repair guidance

Francesco Faletra



J Am Soc Echocardiogr 2007;20:1131-1140

Use of Real Time Three-Dimensional Transesophageal Echocardiography in Intracardiac Catheter Based Interventions



Conclusion: RT3D TEE is a powerful new imaging tool that may become the technique of choice and the standard of care for guidance of selected percutaneous catheter-based procedures. (J Am Soc Echocardiogr 2009;22:865-82.)

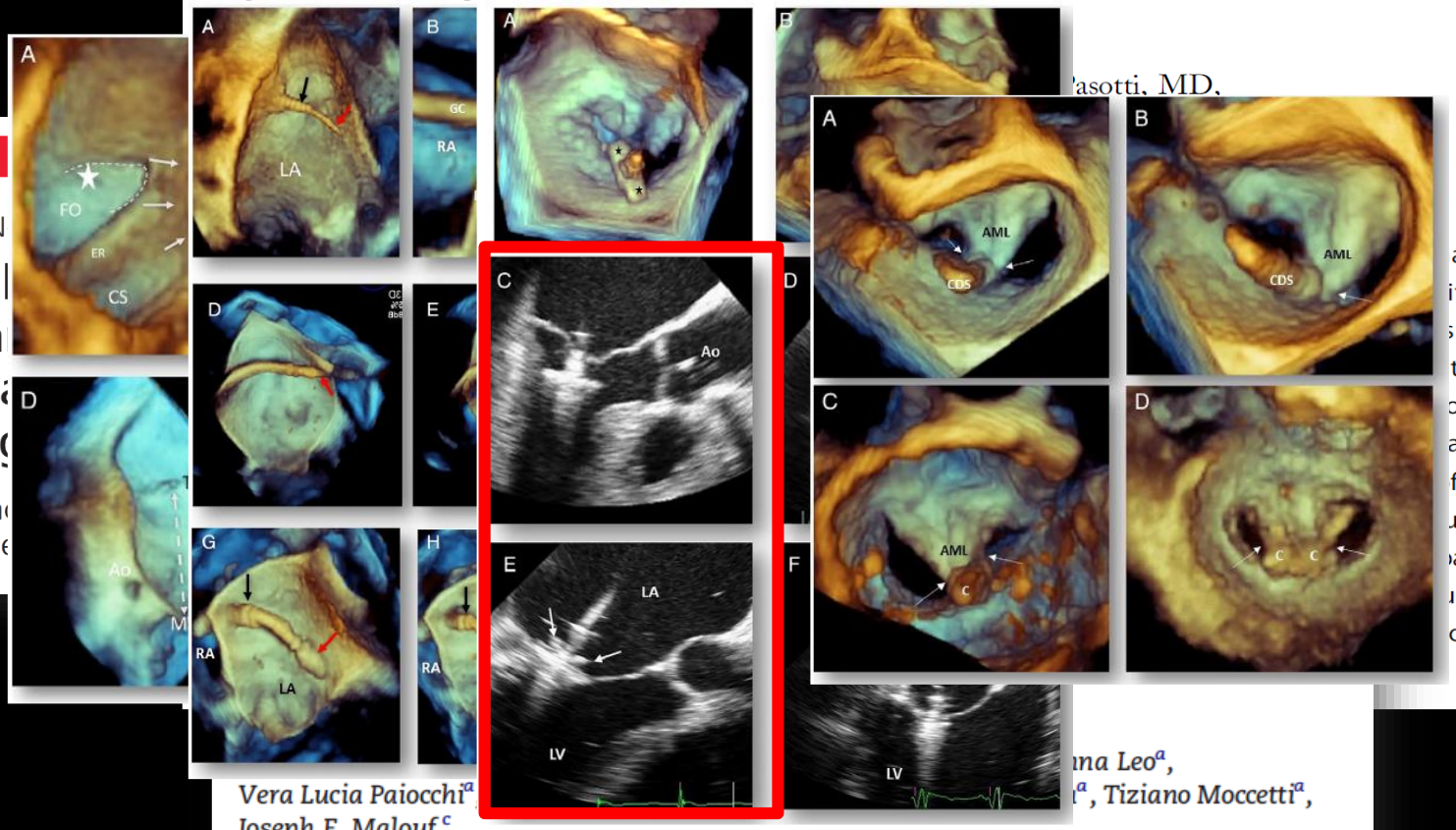
Methods: The authors used RT3D TEE to guide 72 catheter-based cardiac interventions. The procedures included the occlusion of atrial septal defects or patent foramen ovales (n = 25), percutaneous mitral valve repair (e-valve clipping; n = 3), mitral balloon valvuloplasty for mitral stenosis (n = 10), left atrial appendage obliteration (n = 11), left atrial or pulmonary vein ablation for atrial fibrillation (n = 5), percutaneous closures of prosthetic valve dehiscence (n = 10), percutaneous aortic valve replacement (n = 6), and percutaneous closures of ventricular septal defects (n = 2). In this review, the authors describe their experience with this technique, the added value over multiplanar two-dimensional TEE, and the pitfalls that were encountered.

Results: The main advantages found for the use RT3D TEE during catheter-based interventions were (1) the ability to visualize the entire lengths of intracardiac catheters, including the tips of all catheters and the balloons or devices they carry, along with a clear depiction of their positions in relation to other cardiac structures, and (2) the ability to ability to demonstrate certain structures in an ''en face'' view, which is not offered by any other currently available real-time imaging technique, enabling appreciation of the exact nature of the lesion that is undergoing intervention.

Conclusion: RT3D TEE is a powerful new imaging tool that may become the technique of choice and the standard of care for guidance of selected percutaneous catheter-based procedures. (J Am Soc Echocardiogr 2009;22:865-82.)

STATE-OF-THE-ART PAPER

3D TEE During Catheter-Based



Vera Lucia Paiocchi[a], ... Joseph F. Malouf[c]

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[c]Mayo Clinic, Rochester, MN, United States

Limitations of the dual approach (2D/3D TEE and fluoroscopy)

- *Two separates monitors*
- Need of *repeatedly and sequentially interrogate* the two monitors
- Imaging data sets shown in *different orientations*
- *Lack* of optimal eye-hand coordination

All (images) in one (screen)

Fusion imaging

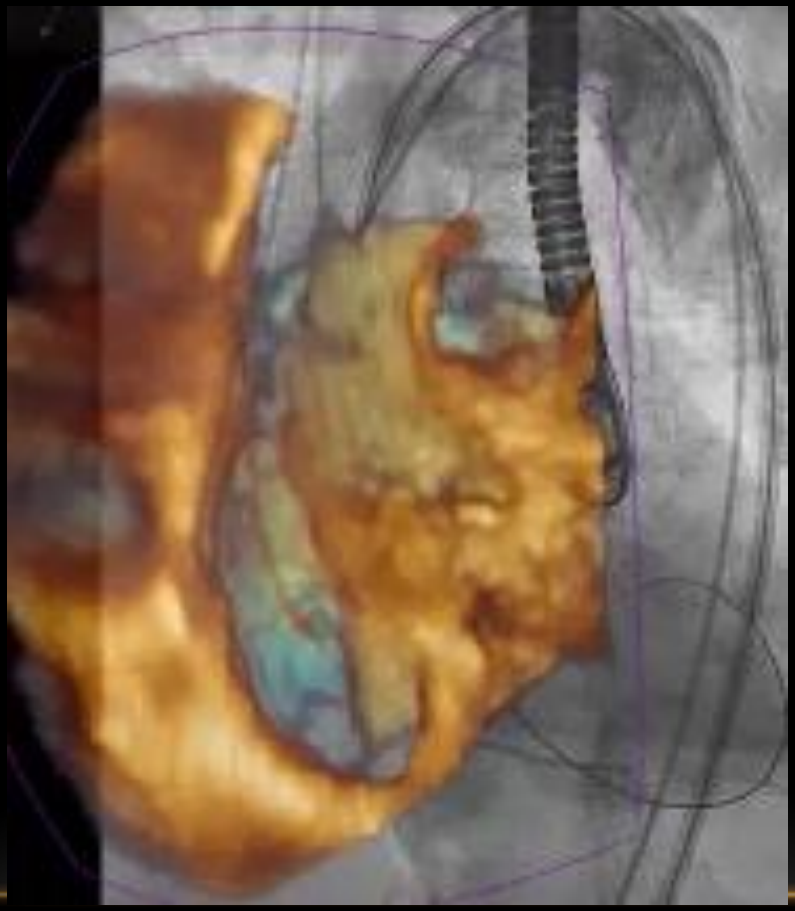
Echo and fluoroscopy are based on different physical principles *(ultrasound mechanical waves versus electromagnetic waves)* and remarkable differences in imaging generation (*echoes versus attenuation*).

They fit well when fused together in a single *"hybrid" image* because:

- Both are *real-time and complementary* imaging techniques:
- *Catheters and devices* are better visualized by fluoroscopy
- *Soft tissues* are better visualized by echocardiography

Fusion imaging

Co-registration: integration in space and time



Fusion or *con*fusion?

Tools can avoid

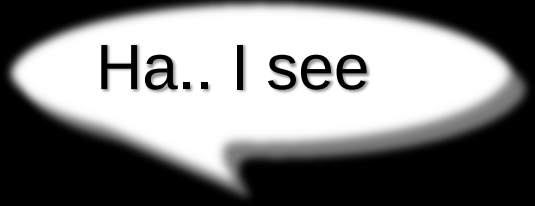
*con*fusion

Fusion or *con*fusion?

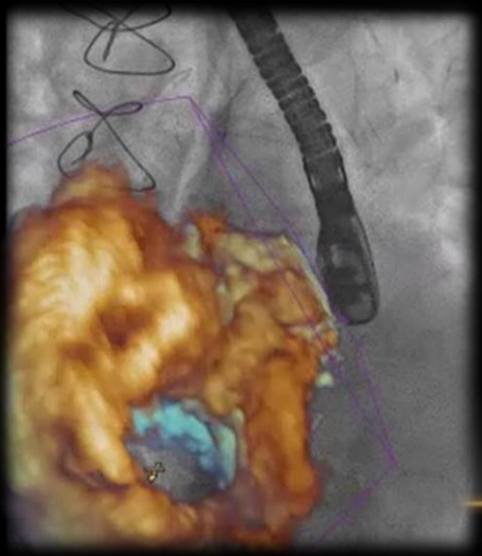
Tools: cropping

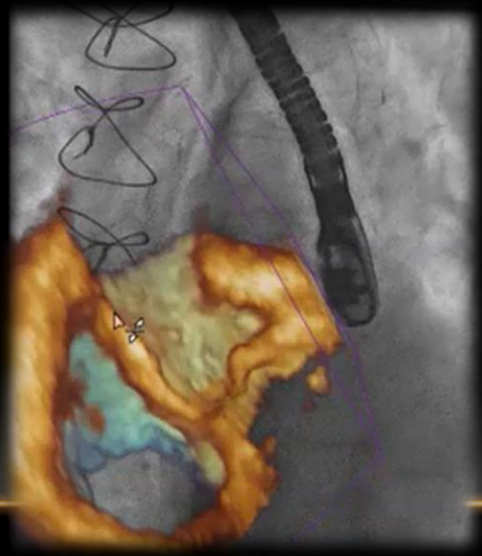
*Con*fusion

Cropping



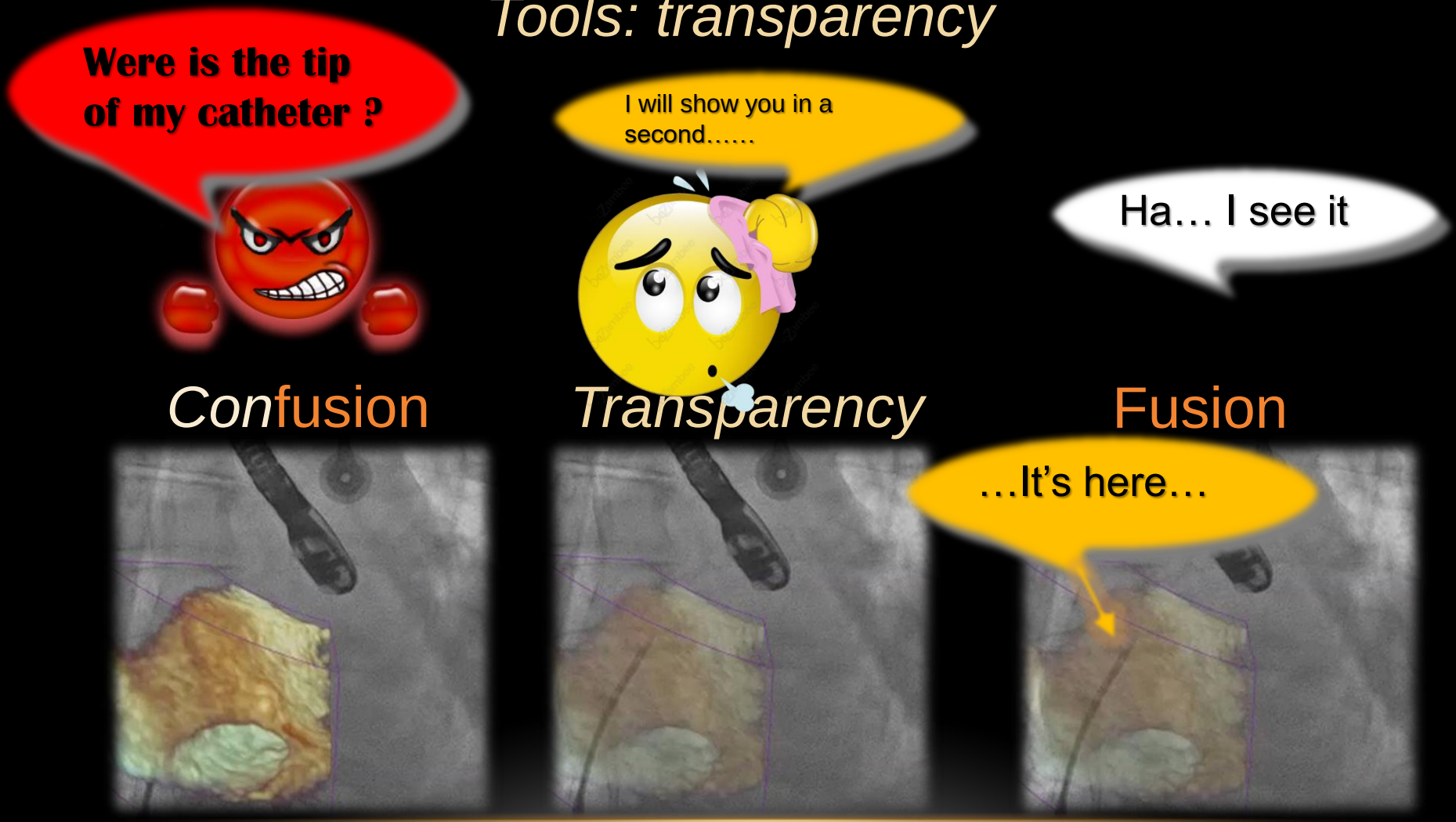
Fusion





Fusion or *con*fusion?

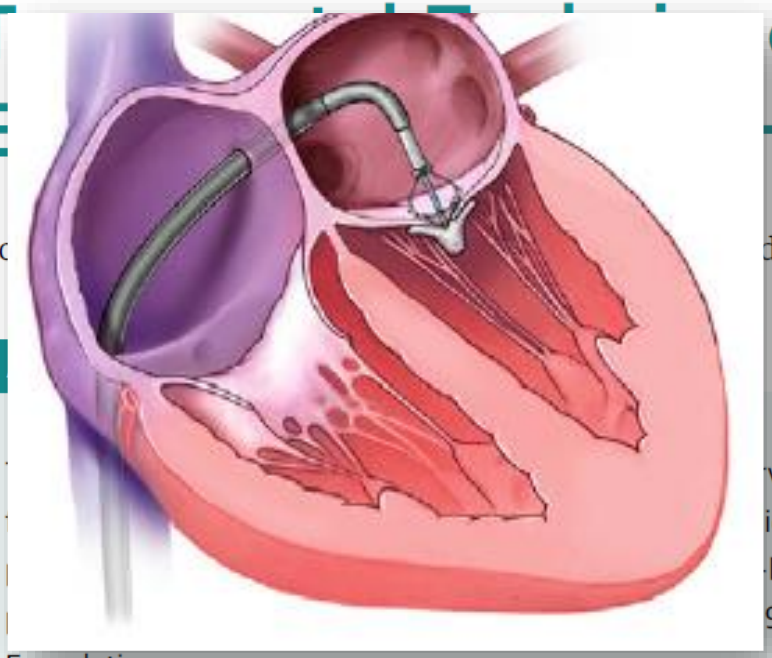
Tools: transparency

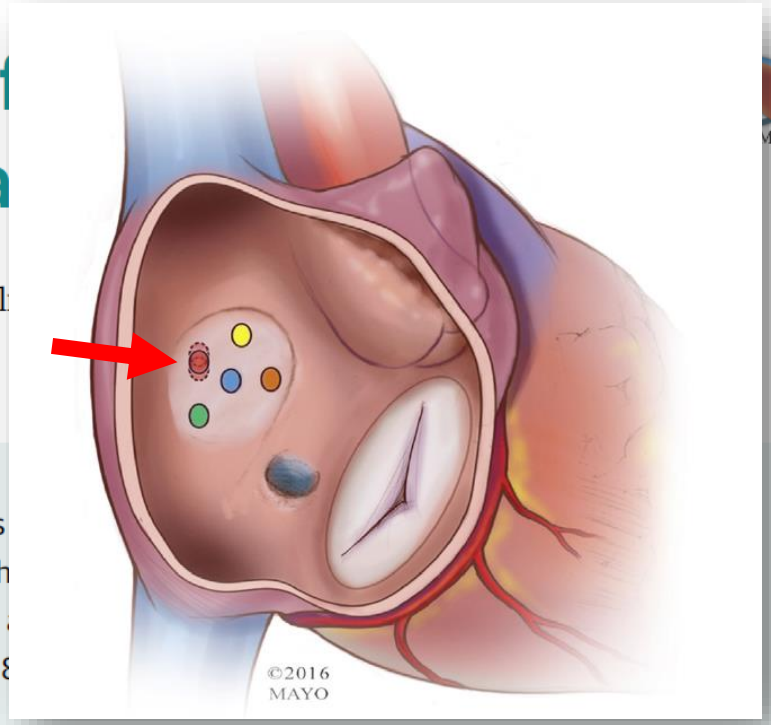


Transseptal puncture

Transseptal puncture

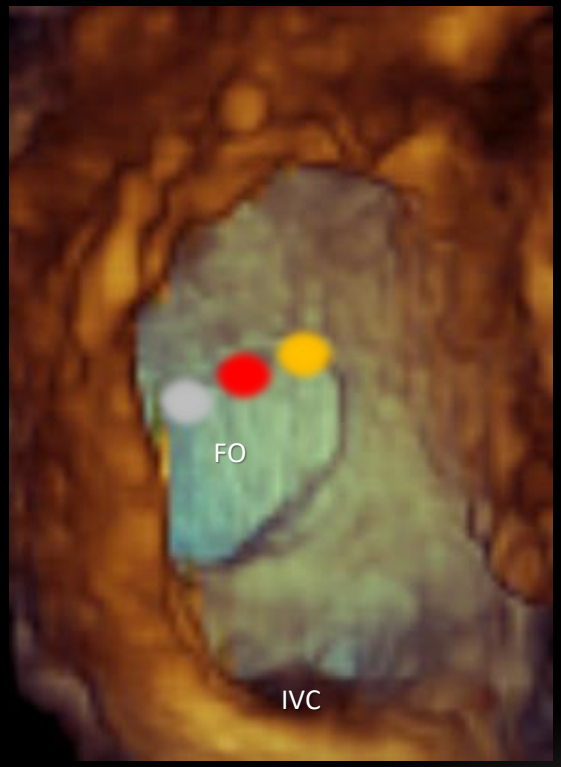
Site-Specific

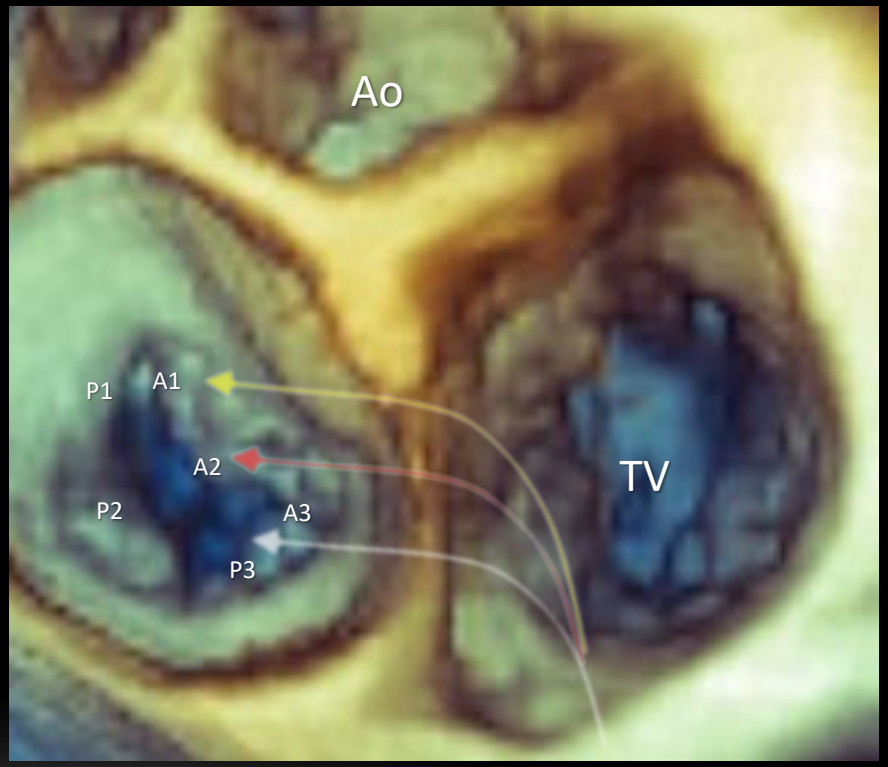




Transseptal puncture

Site-Specific

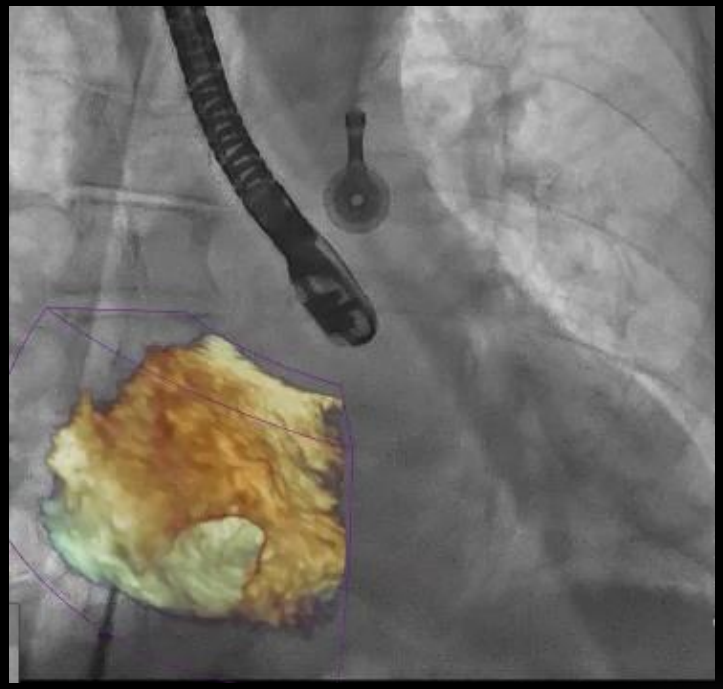




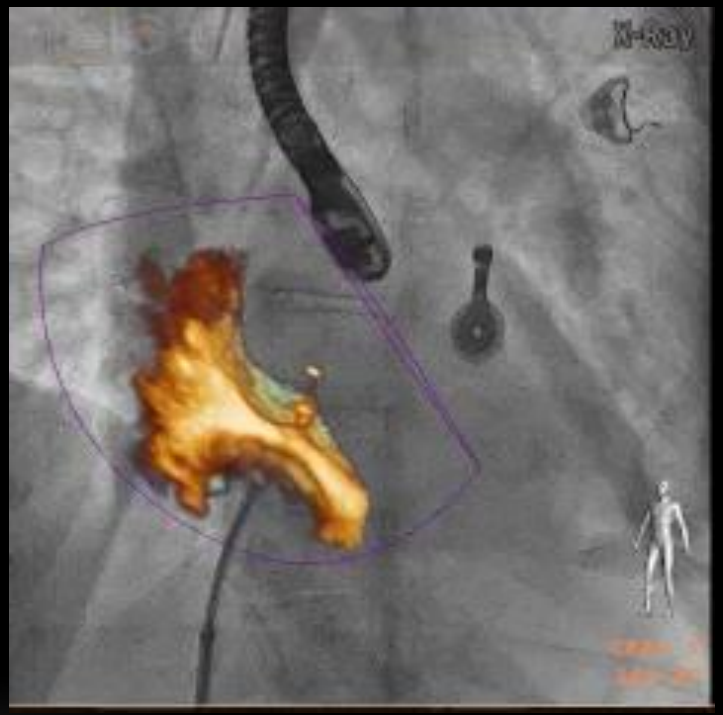
Transseptal puncture

Site-Specific

RAO 30°

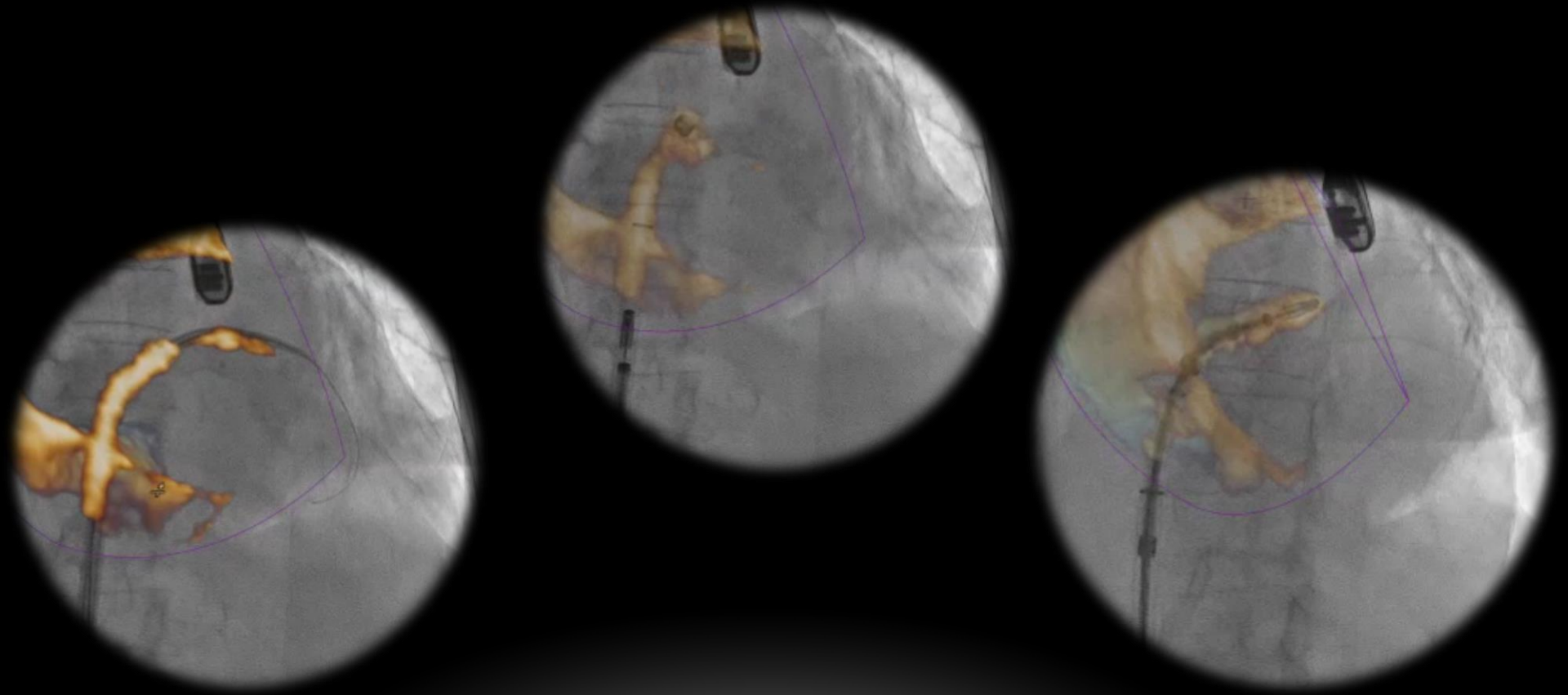


LAO 30°



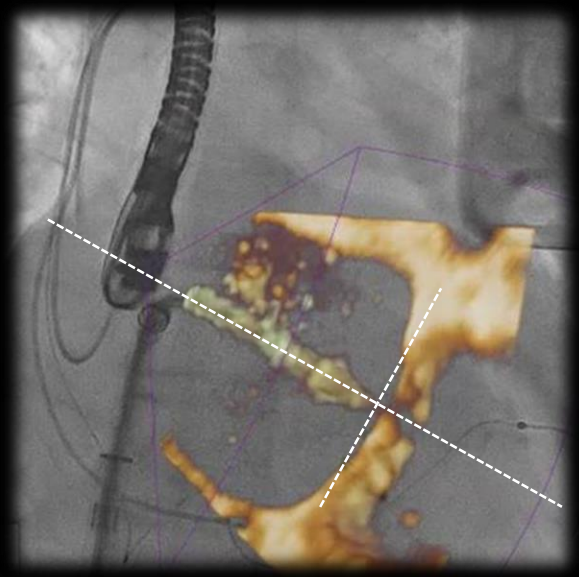
Advancement of clip delivery system into the LA

Advancement of clip delivery system into LA

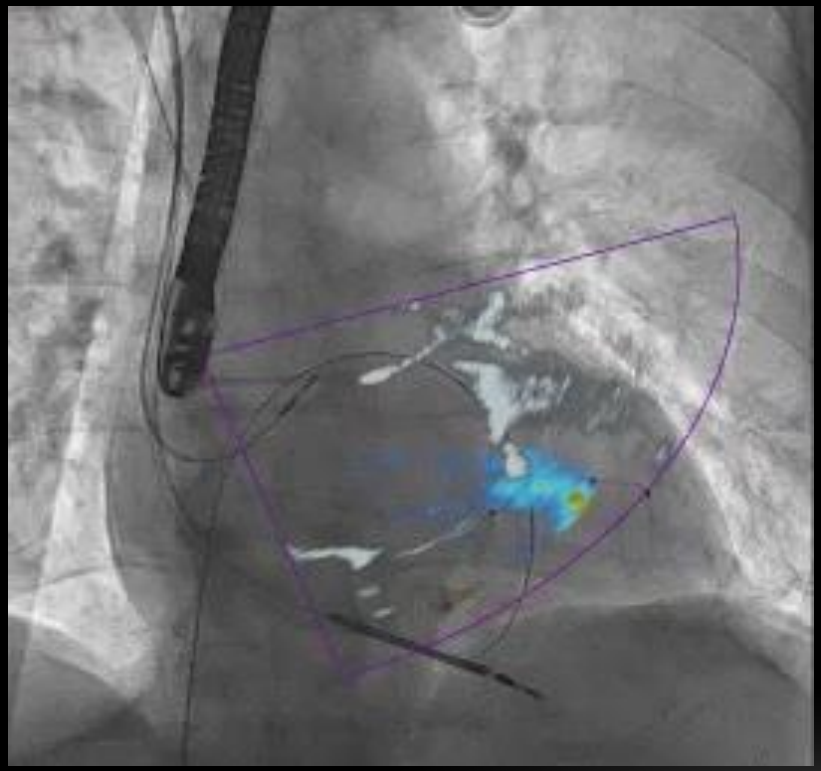


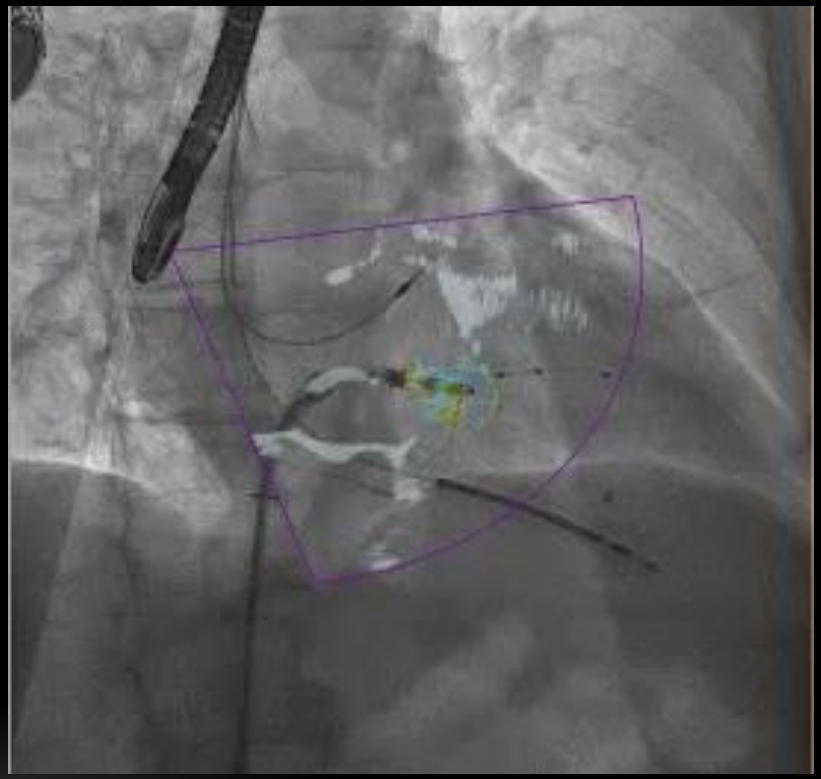
Positioning the clip delivery system perpendicular to MV orifice

Positioning the clip delivery system perpendicular to MV orifice



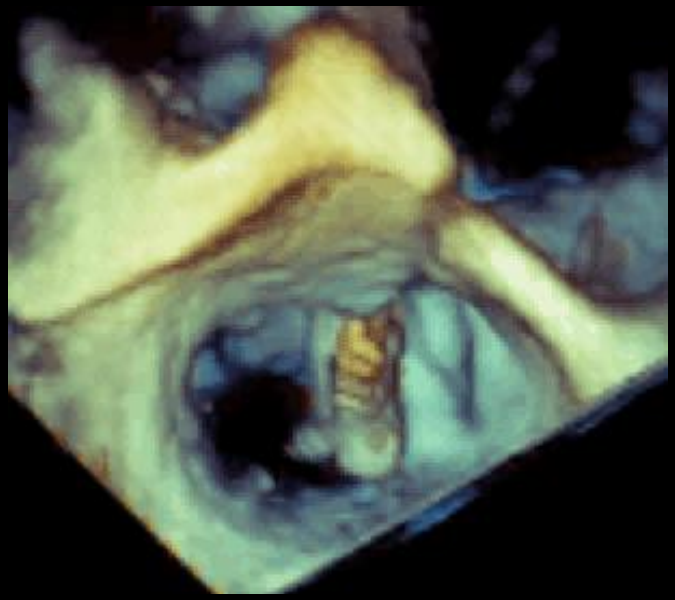
Positioning the clip delivery system over the regurgitant jet

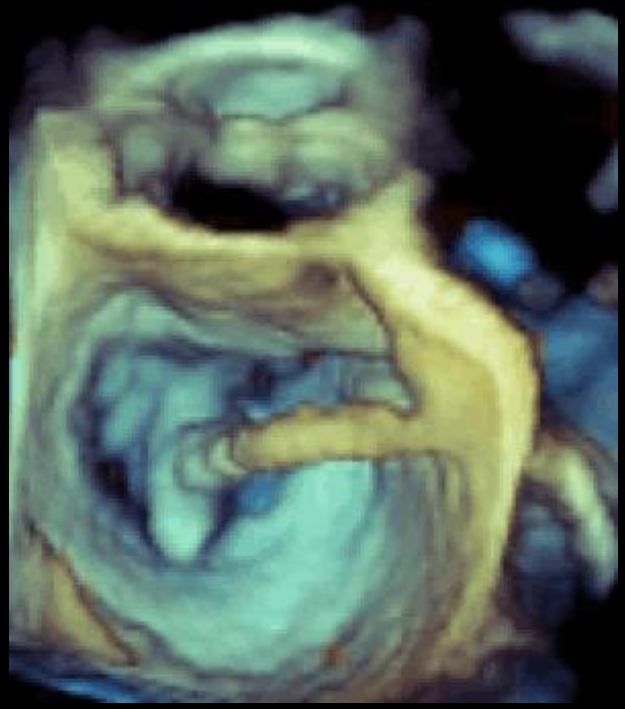




Positioning the clip arms perpendicular to the coaptation line

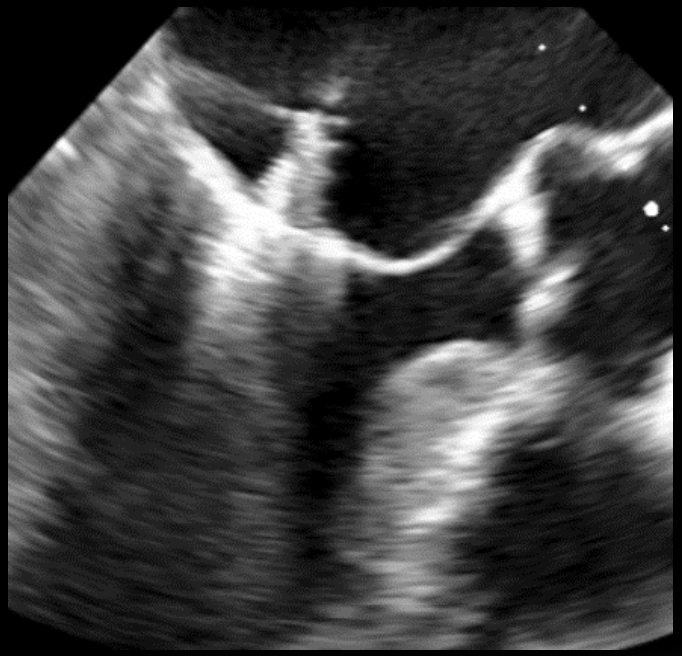
Positioning the clip arms perpendicular to the coaptation line

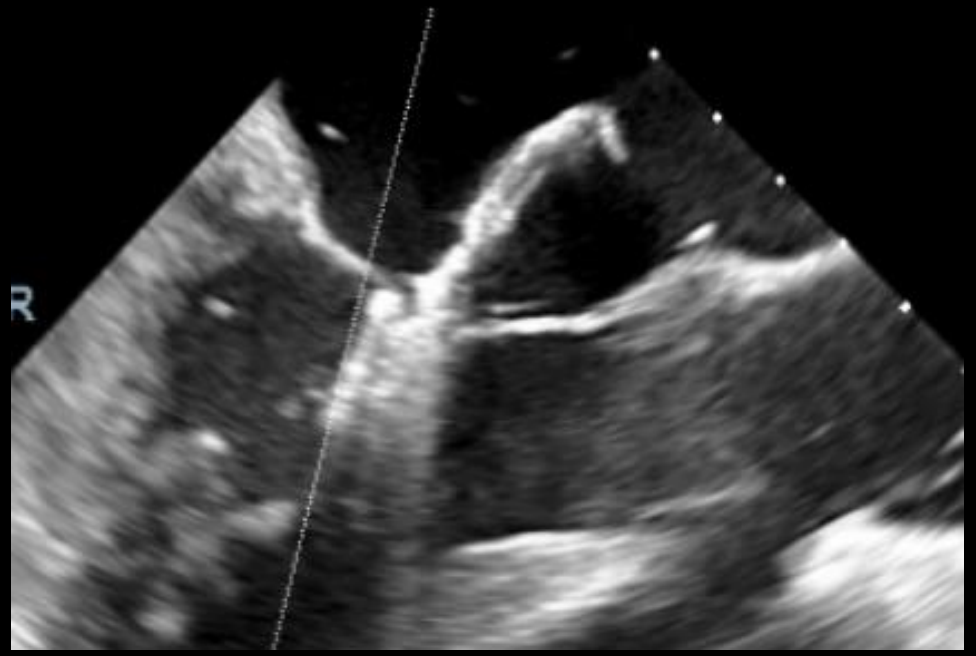




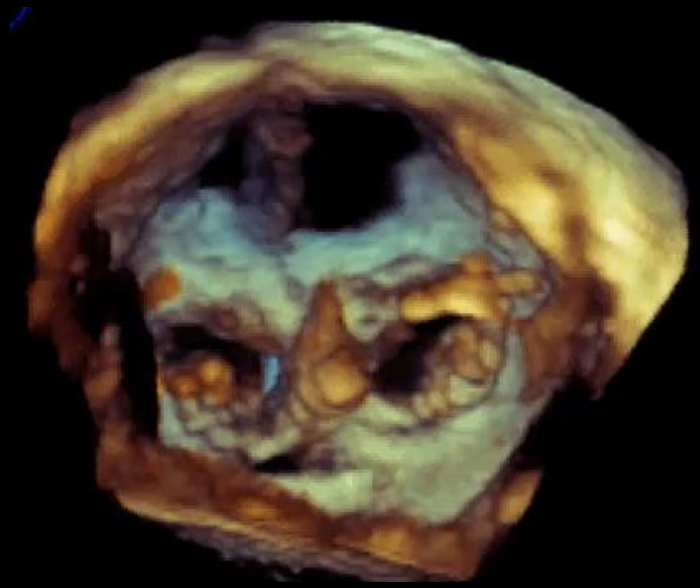
Grasping

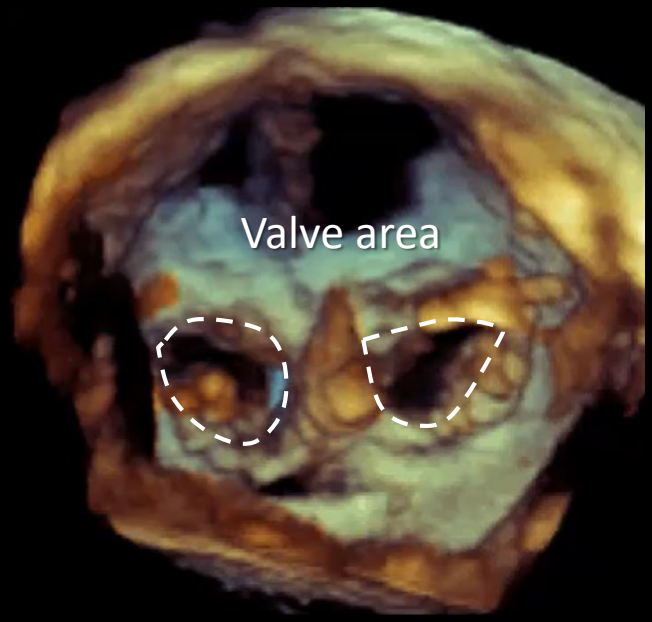
Grasping



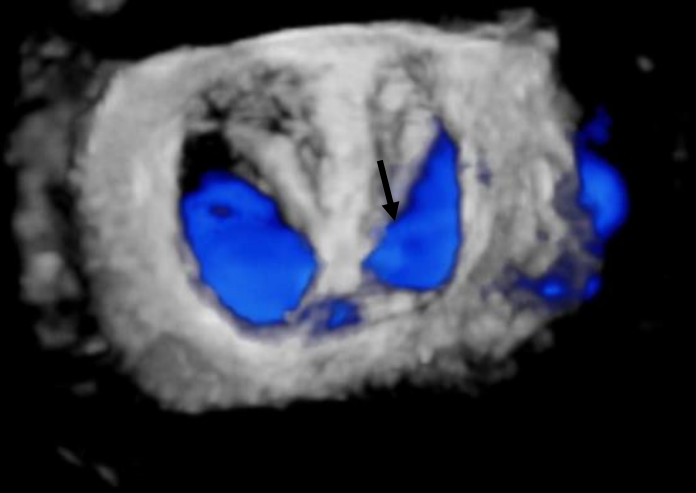


After any clip

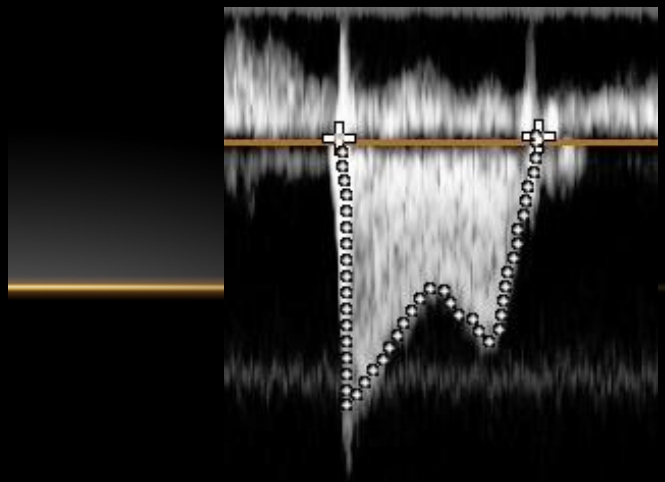




Residual mitral regurgitation



Gradient



Key questions

When compared with traditional 2D or 3D TEE guidance, does this novel technology add advantages in terms of *reduction* of procedural time, radiation exposure, incidence of complications ?

Does it increase operator's confidence?

Safety and feasibility of novel technology fusing echocardiography and fluoroscopy images during MitraClip interventions

Simon H. Sünder… Gessat[1,4], PhD; Christian Felix[3], … rti[2], MD, PhD

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S. H. Sündermann and…

This paper also includ… ention/69th_issue/203

Table 2. Procedural data.

	Total (n=42)	with EchoNavigator (n=21)	without EchoNavigator (n=21)	*p*
Number of clips implanted, n (%)	81 (100%)	45 (56%)	36 (44%)	0.3
Patients with 1/2/3/4 clips (n)	12/23/5/2	4/12/3/2	8/11/2/0	–
Length (minutes) all patients	131±50.3	136.2±50.2	125.7±51.2	0.5
Length (minutes) patients ≤2 clips	112.7±26.8	113.9±29.9	111.8±24.9	0.8
Fluoroscopy time (minutes) all patients	31.4±15.8	32.3±16.8	30.6±15.3	0.8
Fluoroscopy time (minutes) patients ≤2 clips	25.1±7.1	23.9±8.1	26.1±6.4	0.4
Radiation dose (Gy/cm²) all patients	146.7±127.4	146.5±123.6	146.8±134.1	1.0
Radiation dose (Gy/cm²) patients ≤2 clips	112.8±73	102.1±65	119.8±78.9	0.5
Time to first clip (minutes)	53.6±15.8	52.4±17.6 (n=21)	53.7±14.0 (n=21)	0.8
Time to second clip (minutes)	85.7±27.7	83.2±27.4 (n=17)	88.9±29.0 (n=13)	0.6
Time to third clip (minutes)	152.86±47.5	134.2±23.2 (n=5)	199.5±72.8 (n=2)	0.4

The numbers in brackets indicate the number of patients who had implantation of one, two or three clips in the respective group. Gy: gray

KEYWORDS

- EchoNavigator
- MitraClip
- mitral valve disea…
- percutaneous mitral valve repai…
- real-time fusion
- structural heart disease interventions

…rlands) enables real-time …raphy probe on the x-ray … MitraClip procedures.

…Navigator software (EN+ …dpoints were fluoroscopy …ents treated immediately …6) were implanted in the … radiation dose (Gy/cm²) …procedure time (minutes) … p=0.5). The main benefit …oroscopy, leading to eas-

Conclusions: The use of EchoNavigator software was feasible and safe in all study patients. Further studies are necessary to confirm the benefits of using this software.

Echo… …ng

for tr… …e

Francesc… …,
Luigi Bia…
Kuwata[3], …
Nietlispa…

[1]Department of Ca… …Milan,
Italy; and [3]Universit…

Received 7 February…

The echocardi… …sal to fa-
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Keywords transoesophageal echocardiography • fluoroscopy • mitral valve repair • fusion images

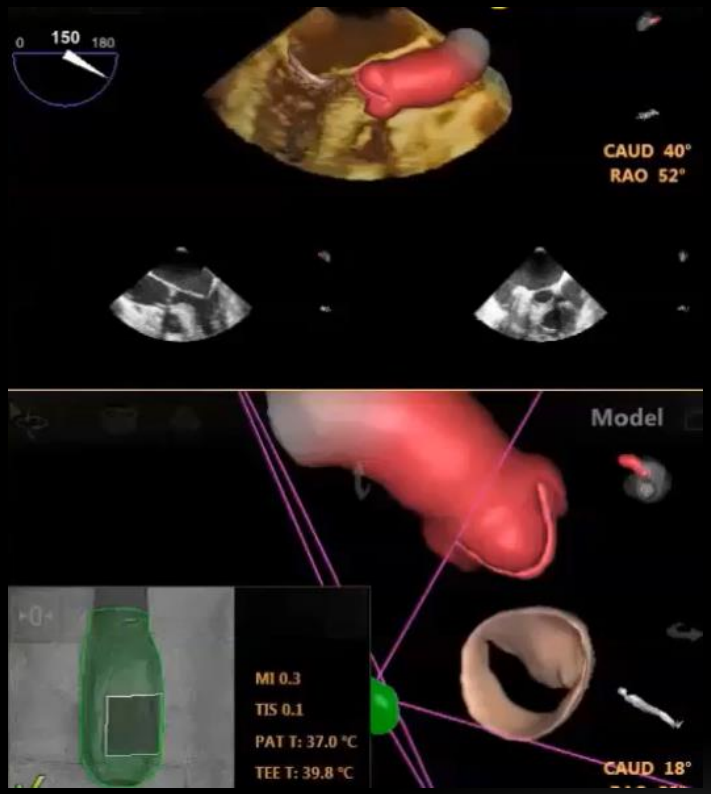
Table 2 Unpublished data from University Heart Center Zurich on procedural length, fluoroscopic time, and radiation dose with a without fusion

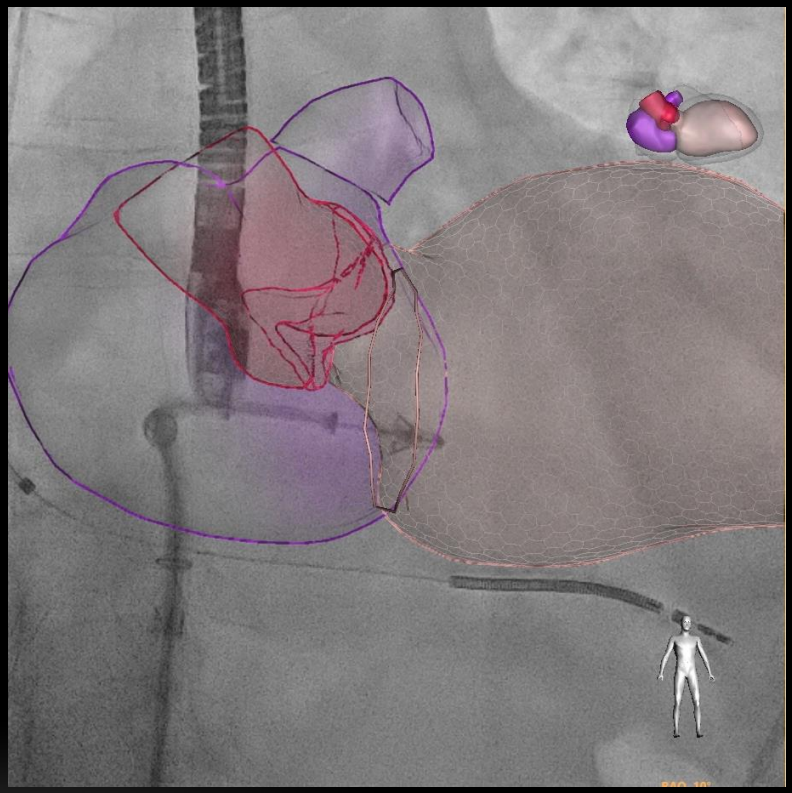
Mitral clip	With fusion	Without fusion	P-value
Degenerative/functional	11/8	11/8	
1, 2, and 3 clips	9/9/1	9/9/1	
Procedural length (min ± ds)			
1 clip	56 ± 20	61 ± 15	0.25 ns
2 clips	65 ± 16	75 ± 21	0.12 ns
3 clips	99 ± 35	108 ± 43	0.51 ns
Fluoroscopy time (min ± ds)			
1 clip	18 ± 7	17 ± 7	0.7 ns
2 clips	22 ± 6	23 ± 10	0.41 ns
3 clips	31 ± 15	33 ± 19	0.93 ns
Radiation dose (Gy/cm^2 ± ds)			
1 clip	25 ± 12	24 ± 15	0.61 ns
2 clip	31 ± 15	32 ± 19	0.73 ns
3 clip	66 ± 21	70 ± 19	0.71 ns
Cardioband	**With fusion**	**Without fusion**	**P-value**
Procedural length (min ± ds)	143 ± 36	125 ± 21	0.41 ns
Fluoroscopy time (min ± ds)	47 ± 12	52 ± 9	0.61 ns
Radiation dose (Gy/cm^2 ± ds)	36 ± 28	40 ± 31	0.85 ns
Paravalvular leak	**With EchoNav (2)**	**Without EchoNav (2)**	**P-value**
	2	2	1 ns
Procedural length (min ± ds)	128 ± 11	115 ± 35	0.65 ns
Fluoroscopy time (min ± ds)	83 ± 27	86 ± 36	0.9 ns

Associated Institute of the University of Zurich
University of Zurich
CARDIOCENTROTICINO

Fusion Imaging

Future scenarios Valve modeling





Courtesy of Philip

Echocardiographic-fluoroscopic fusion imaging for tra…nce

Francesco …dotti[3], Luigi Biasc… …go Kuwata[3], M… Nietlispach…

[1]Department of Cardio… …na 60, 20132 Milan, Italy; and [3]University H…

Received 7 February 201…

The echocardiogr… …he proposal to facilitate catheters … …ave described the early developmen… …ging technology to mitral valve transc… …ew, we, therefore, describe the role … The technical principles and the fluc…

Keywords

Conclusion

Echocardiograpy-fluoroscopic fusion imaging couples two 'real-time' imaging techniques showing in the same screen a sort of 'hybrid image' where soft tissues appear onto the fluoroscopic cardiac silhouette. This new imaging modality has the potential to become the main imaging technique in catheter-based SHD interventions. However, the absence of data showing a reduction in terms of procedural and fluoroscopic times, radiation exposure and improved outcomes, hampers its clinical applicability. Though new approach to fusion imaging from different manufactures are likely to emerge in the near future, the fact that this imaging modality is currently provided by a single vendor limits its more widespread use, experience and data collection.

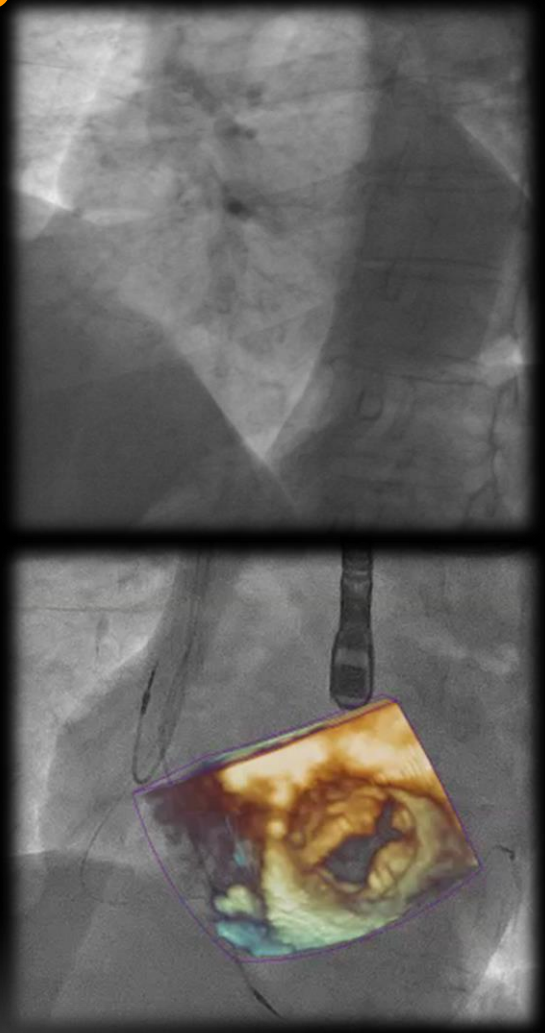
Take home message

Without fusion…

interventional

cardiologists…

“Oculos habent et non videbunt….”



New advent Bible:

Salm 114/115

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University of Zurich

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Thank you for your patience

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