RHYTHM 2015

Arrhythmias & Heart Failure: New Insights & Technological Advances

Palais du Pharo, Marseille, France May 28-30, 2015

Ablation of Post-Infarct VTs

Unmasking VT Isthmuses Using Pace-Mapping

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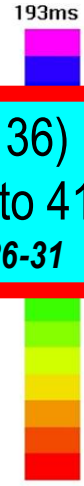
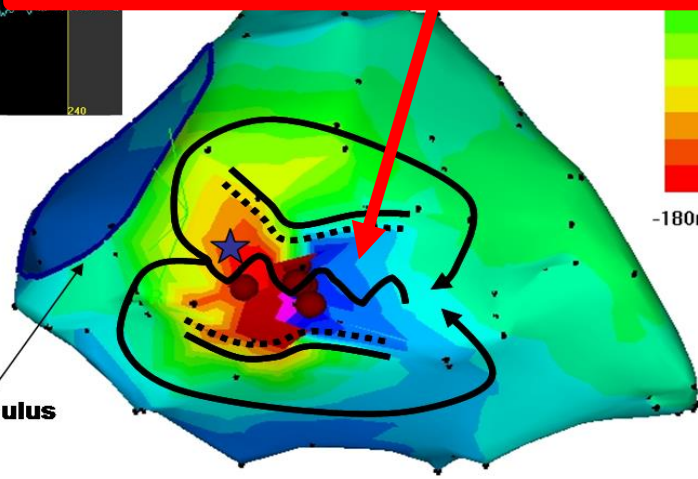
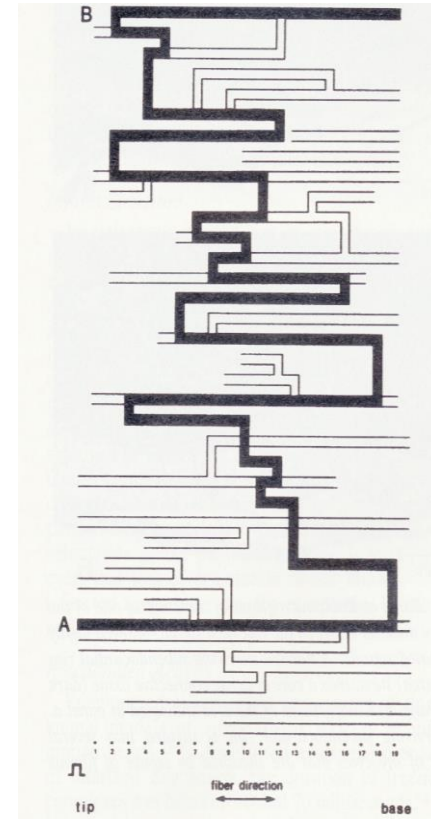
Post-infarct mappable VT



Isthmus width = 16±8 mm (6 to 36)
Isthmus length = 31±7 mm (18 to 41)
de Chillou C et al. Circulation 2002;105:726-31



Endocardial reentry > 90%
of post-MI mappable VTs



Surviving myocytes
+
Surrounding fibrosis

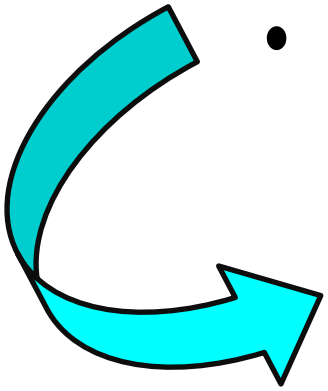
➔Slow conduction

Slow conduction perpendicular to the fiber direction in infarcted myocardial tissue is caused by a ‘‘zigzag’’ course of activation at high speed. Activation proceeds along pathways lengthened by branching and merging bundles of surviving myocytes unsheathed by collagenous septa.

de Bakker JMT. et al. Circulation 1993;88:915-26

VT circuit mapping ➔ limitations

- VT non inducible = 14%
- 12-lead ECG during VT non available = 30%
- VT non tolerated = 70%



Possibility to map at least one VT morphology in only 25% of patients

Alternative strategies ➔ scar ablation (LAVA), pace-mapping…

Pr Paolo Della Bella, Milan, Italy – ESC 2012

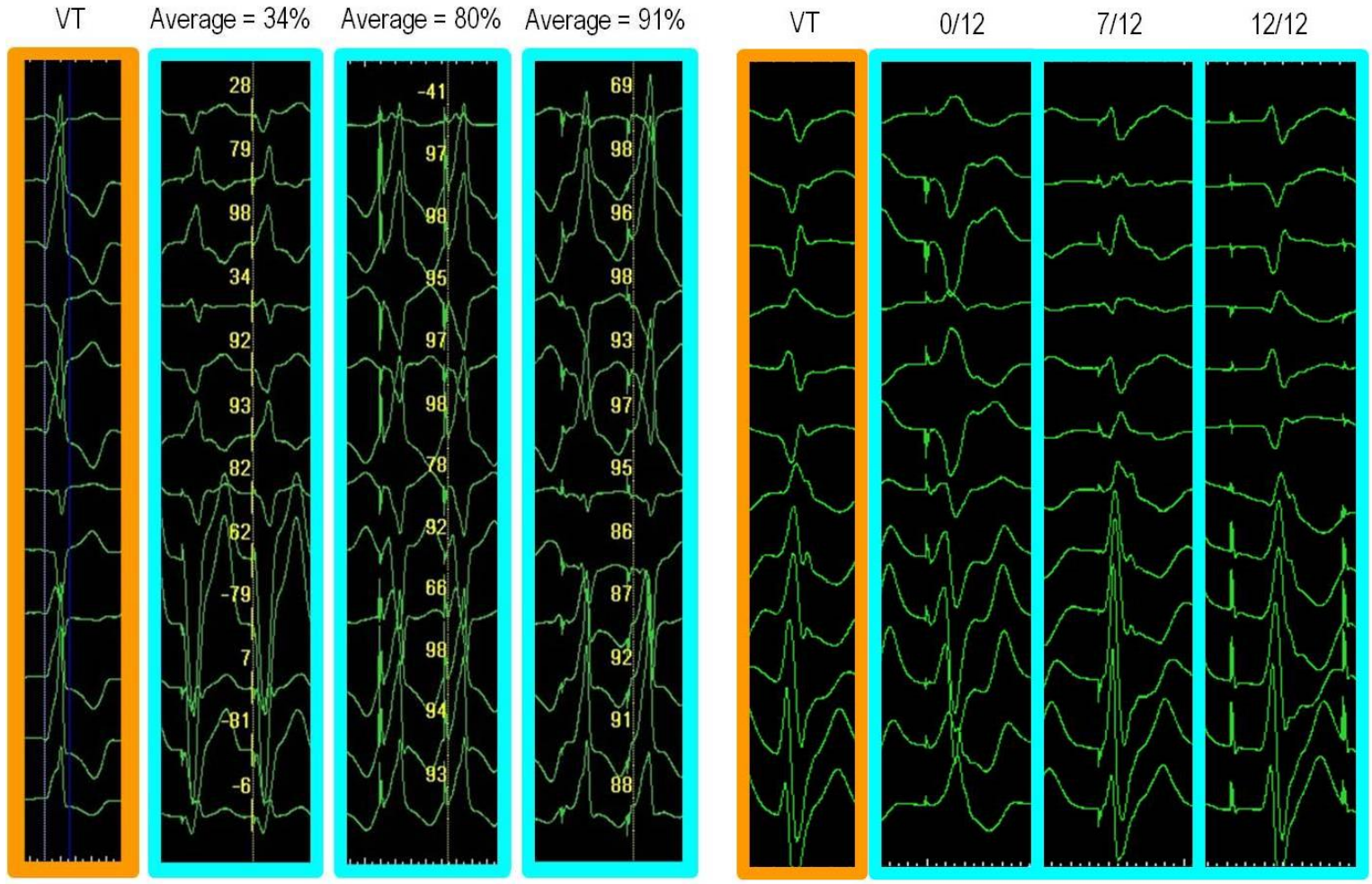
Matching evaluation : visual vs. computerized

Real-time analysis of the QRS morphology of each QRS complex on the 12-lead ECG ➔ comparison with a QRS morphology reference

BARD™ template matching

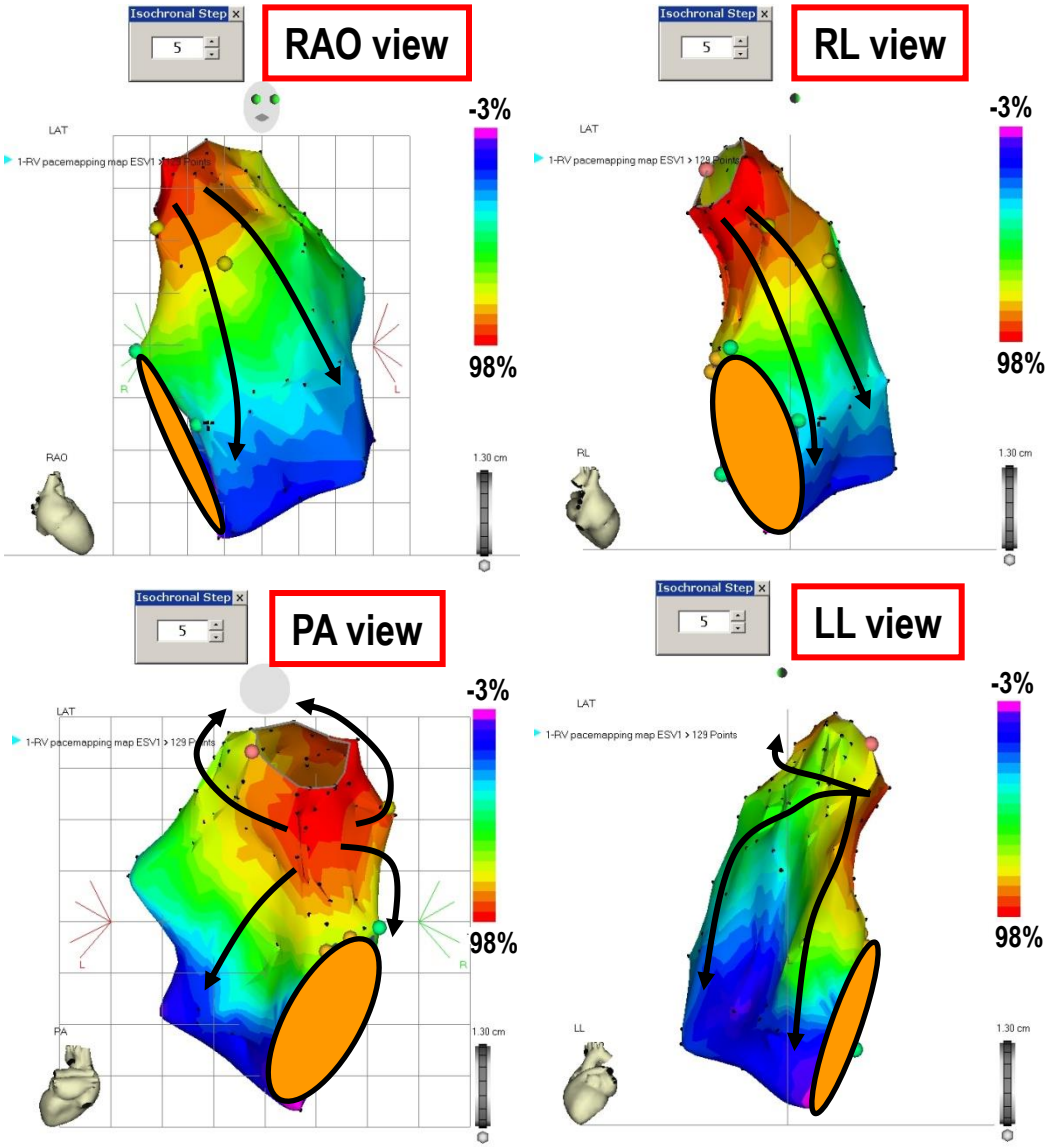
$$\mathrm{CORR} = \frac{\sum_{\text{Lead 1}}^{12}\left[\sum_{i=1}^{n}(X_i - \bar{X}) \times (Y_i - \bar{Y})\right]}{\sum_{\text{Lead 1}}^{12}\left[\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2 \times \sum_{i=1}^{n}(Y_i - \bar{Y})^2}\right]}$$

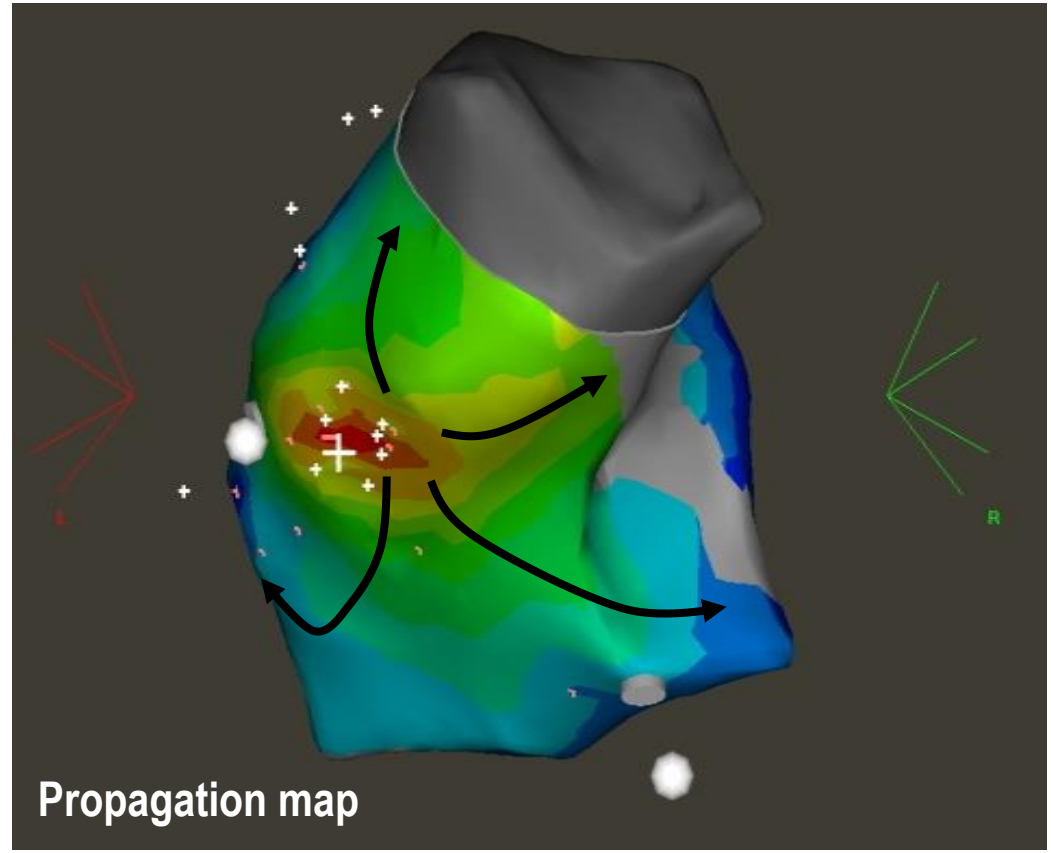
Gerstenfeld EP et al. J Am Coll Cardiol 2003;41:2046-53



Computerized matching increases the accuracy and the sharpness of pace-mapping maps

"PM-map" of a focal VT originating from the RVOT



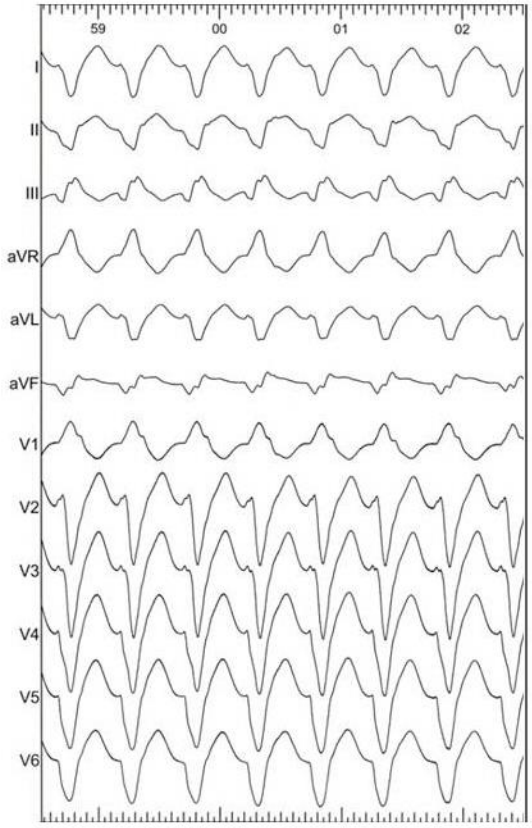


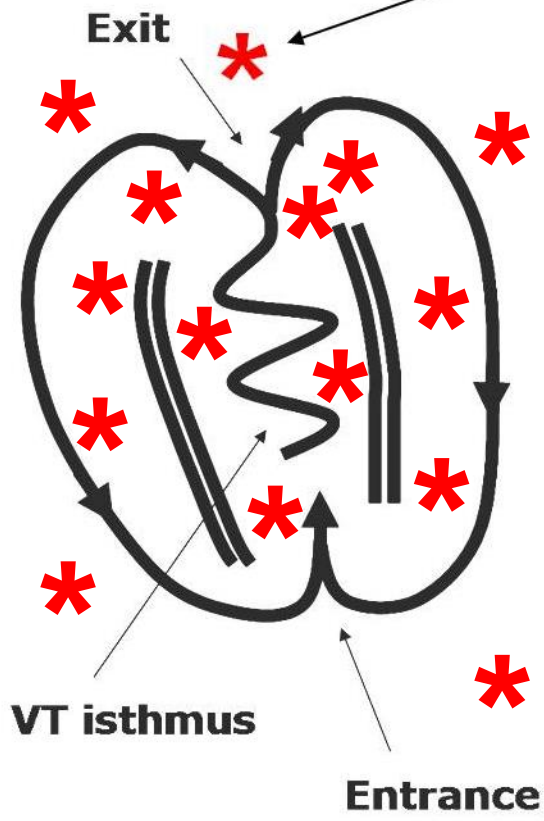
PM maps and propagation maps are highly correlated ➔ centrifugal pattern !!

Joshi S & Wilber DJ. JCE 2005;16:S52-S58

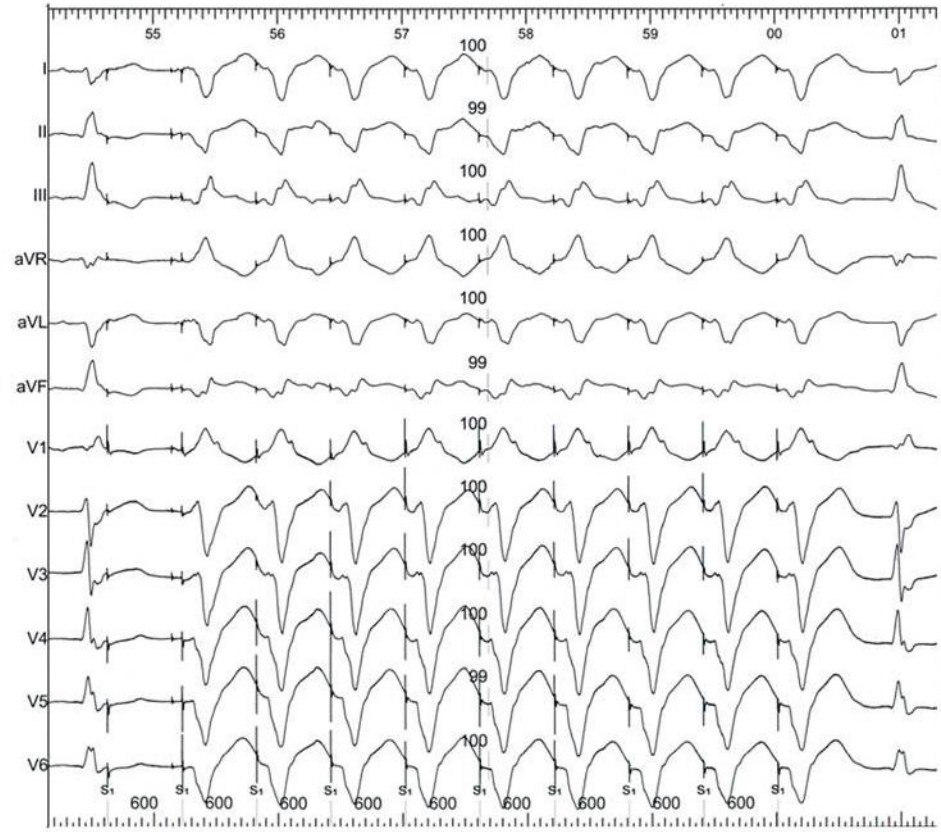
Use of pace mapping in post-infarct VT patients

VT





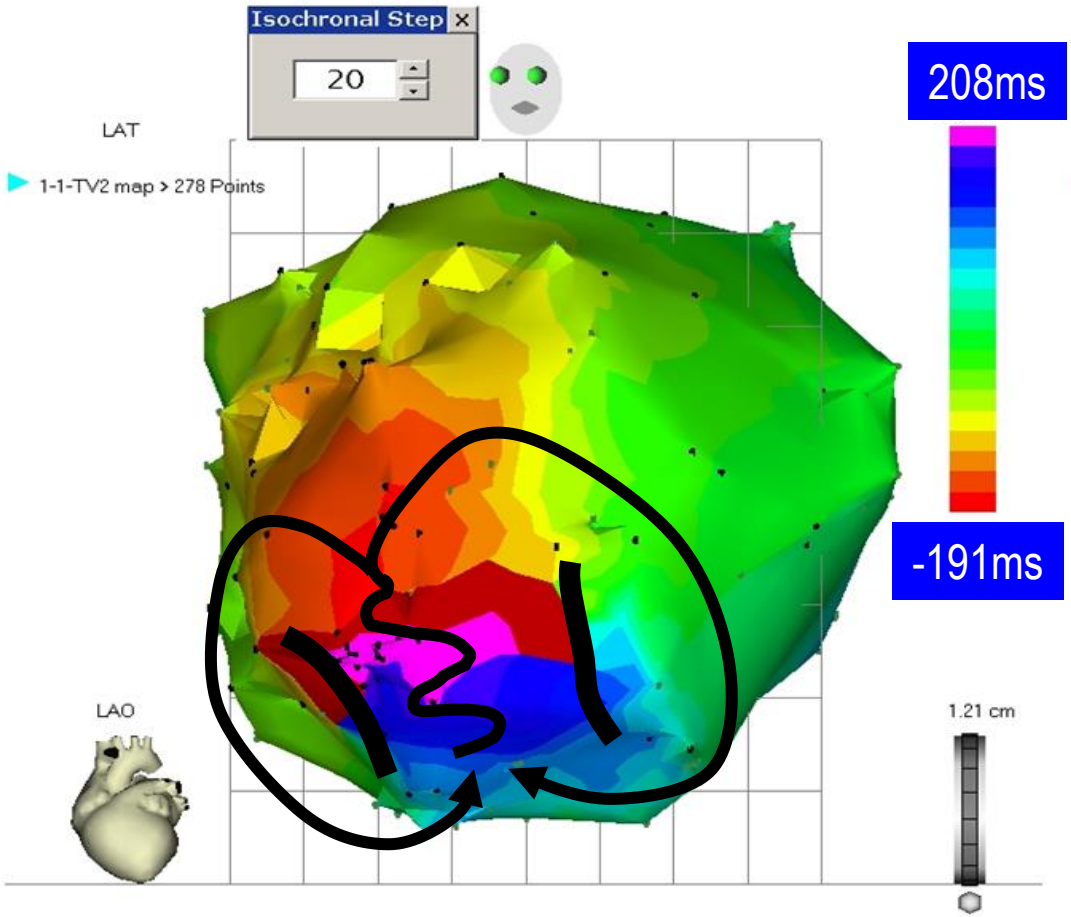
Pacing @ VT circuit exit site



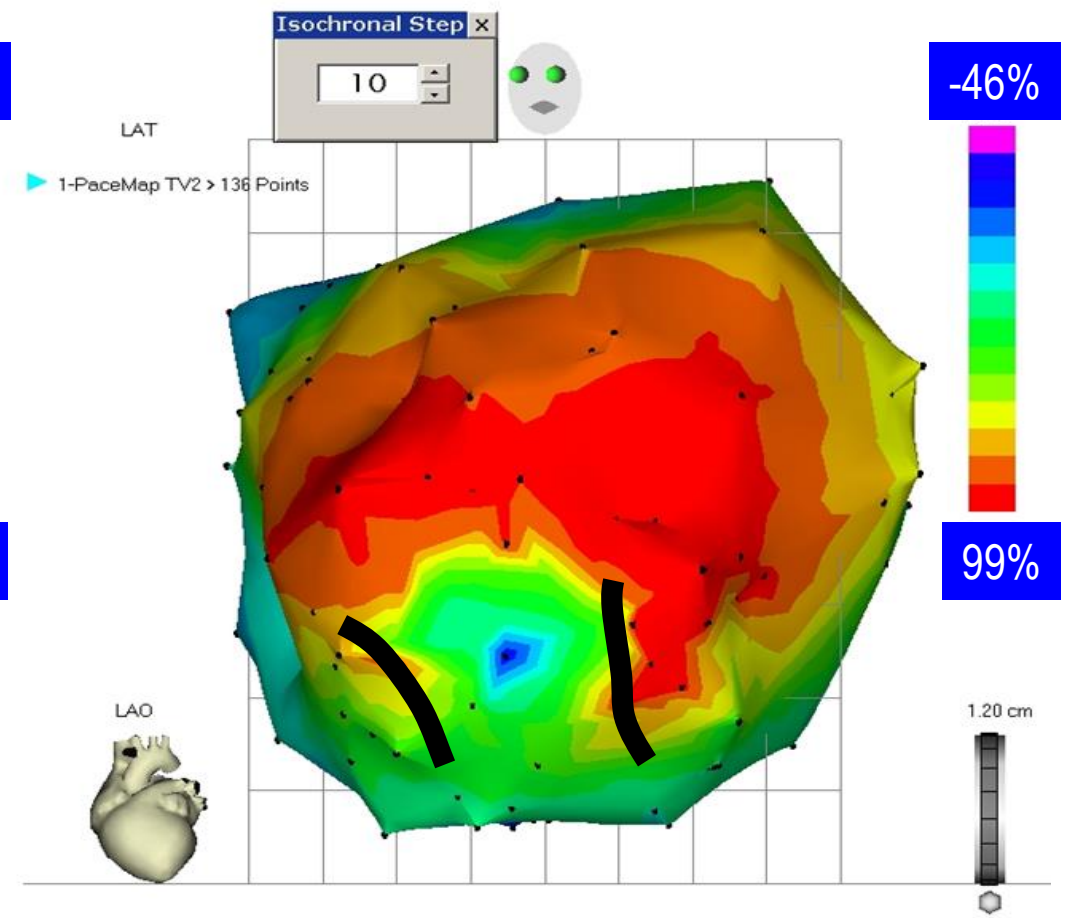
How does a pace-mapping map look like if pacing is performed at many sites within and all around a post-infarct VT isthmus ?

Relationship between VT circuit mapping & pace mapping map

VT map



PM-map

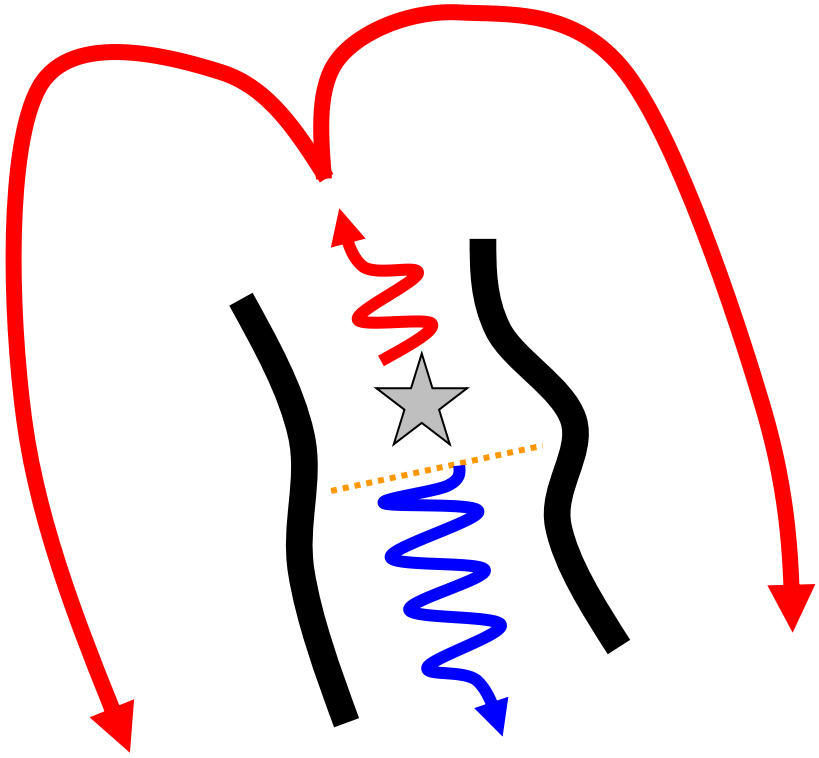


de Chillou C et al. Heart Rhythm 2014;11:175-181

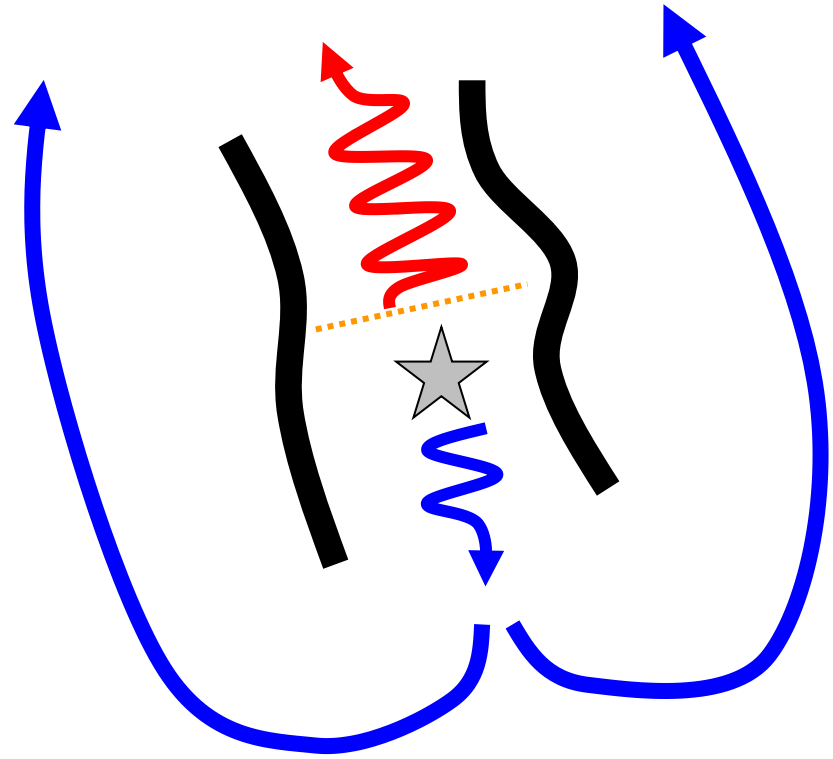
This is a consistent finding in all patients !

Explanation / Pacing within the VT isthmus

Propagation maps are different ➔ 12-lead ECGs are different



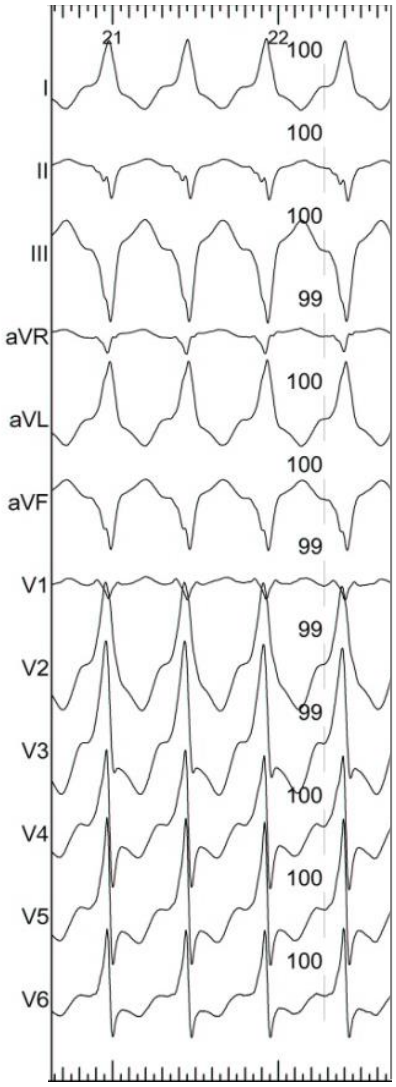
Pacing during SR immediately **after** the mid-isthmus limit



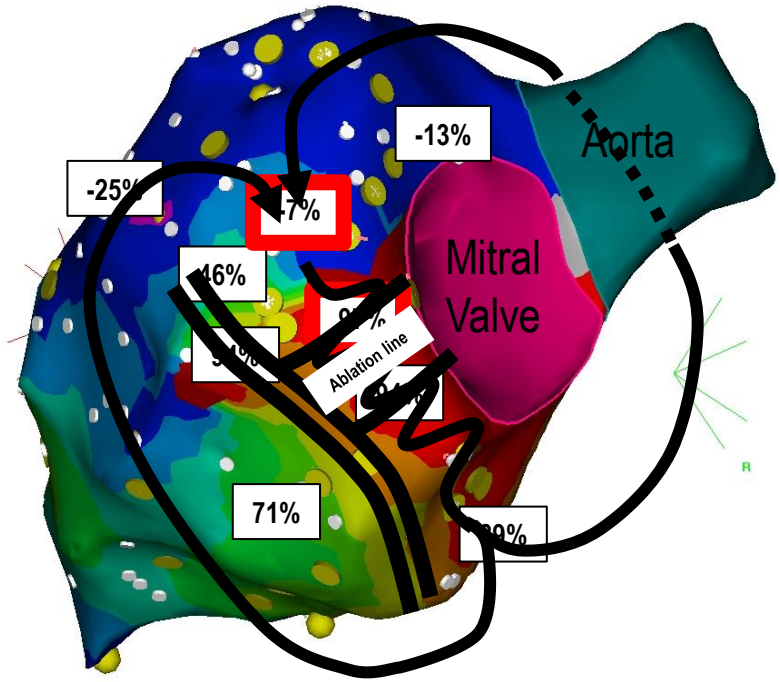
Pacing during SR immediately **before** the mid-isthmus limit

Inferior wall infarct ➔ pace mapping map

Clinical VT induced



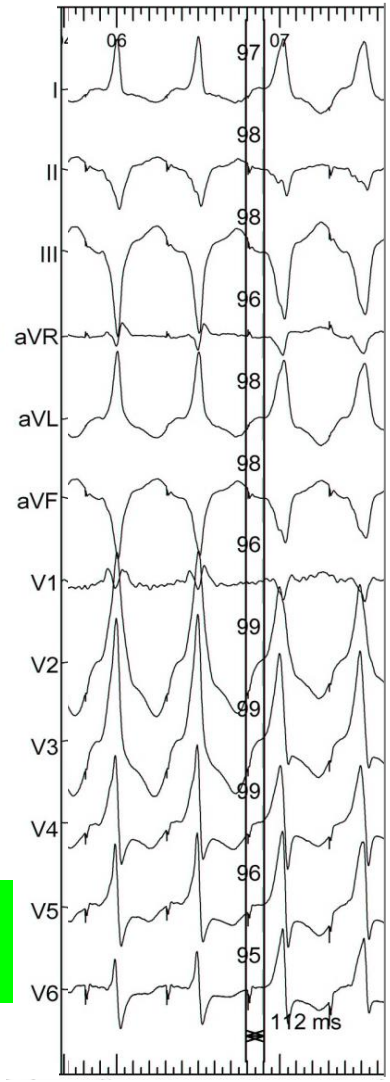
97% ➔ -29%



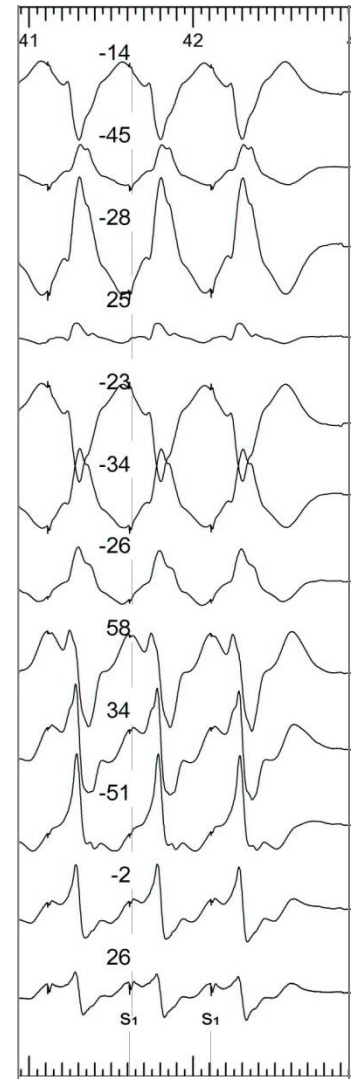
A few millimeters separate perfect pace-mapping sites from very poor pace-mapping sites !!

de Chillou C et al. Heart Rhythm 2014;11:175-181

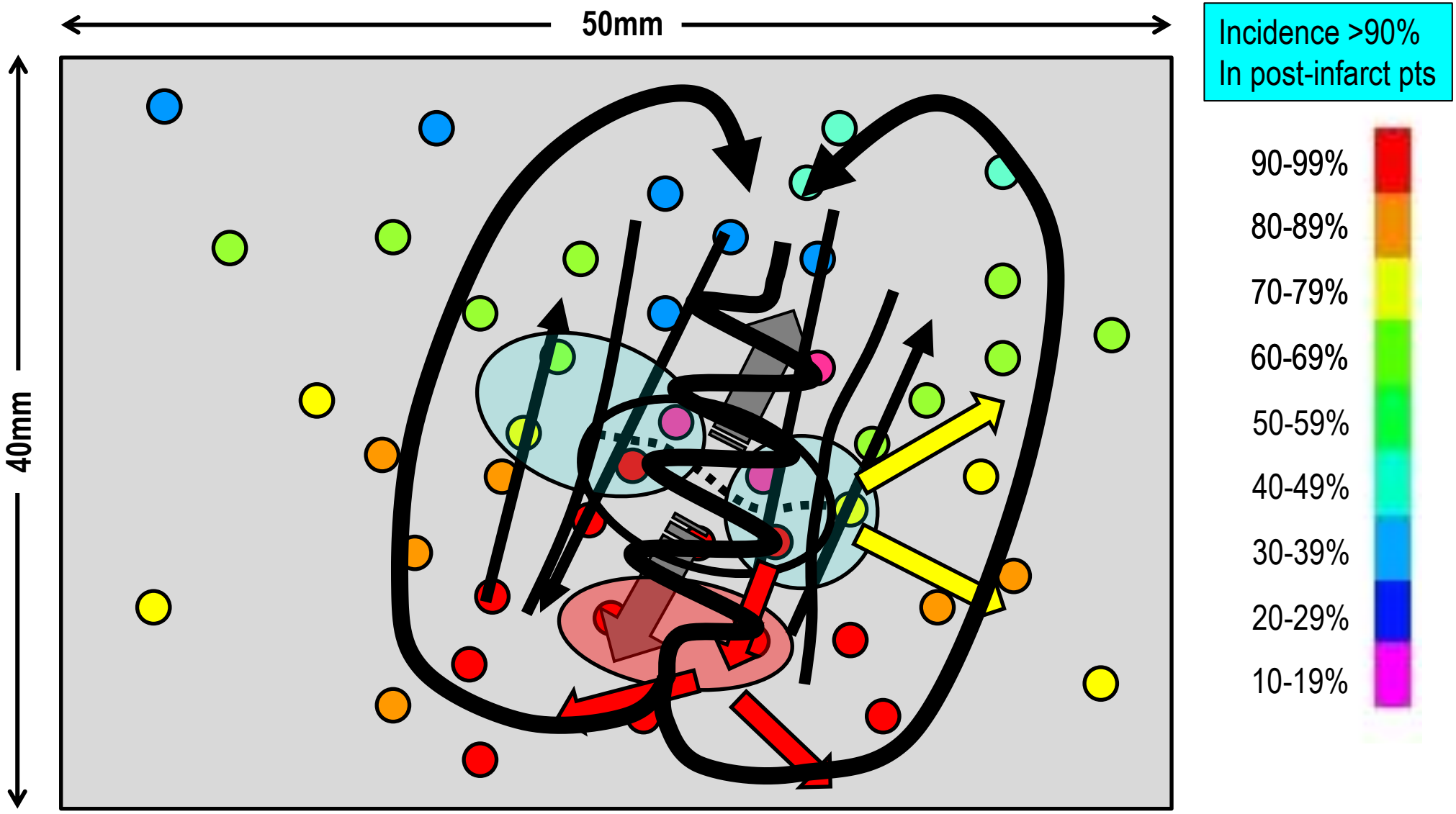
Average = 97%



Average = -7%



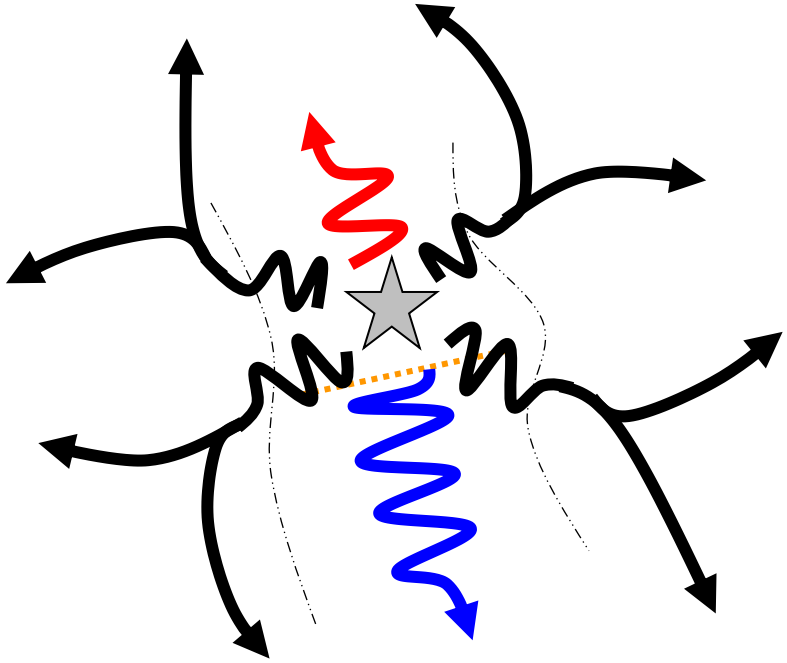
Unmasking a VT circuit using pace mapping : a simulated case…



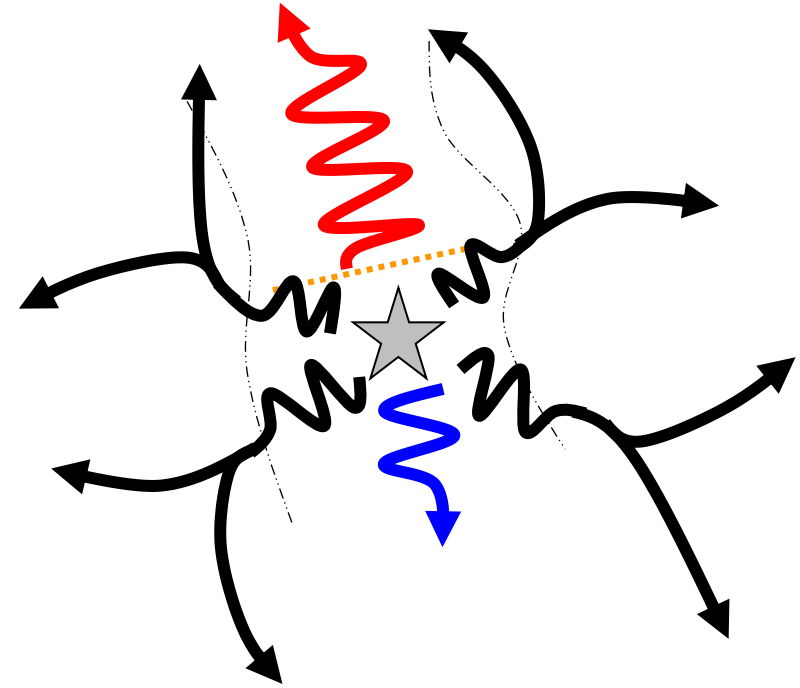
Pacing within the VT isthmus / functional barriers

Propagation maps would be very similar ➔ 12-lead ECGs would look very similar !

The actual observation is that the 12-lead ECG are very different
➔ VT isthmus barriers are not functional but are already present during SR



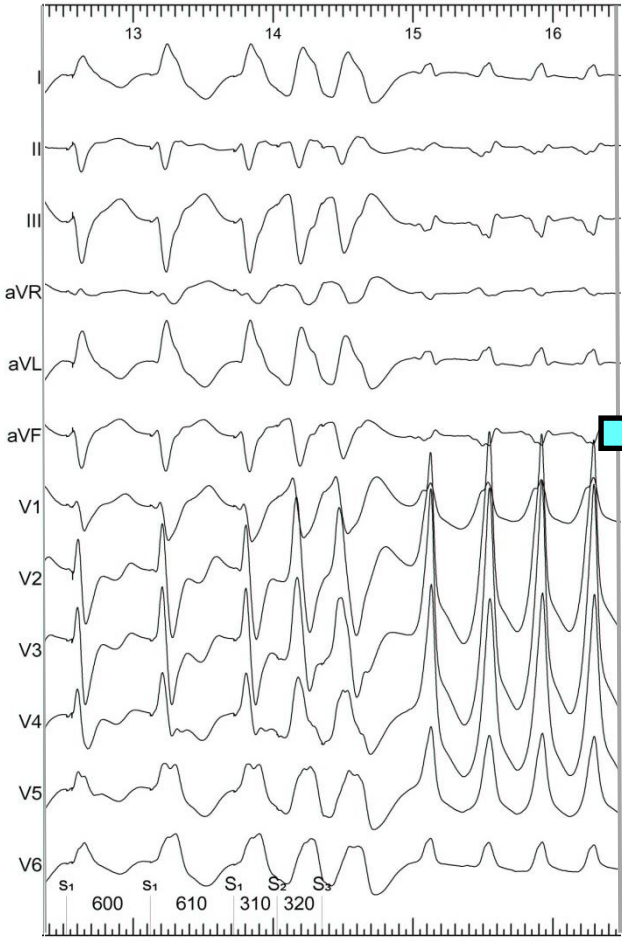
Pacing during SR immediately **after** the mid-isthmus limit



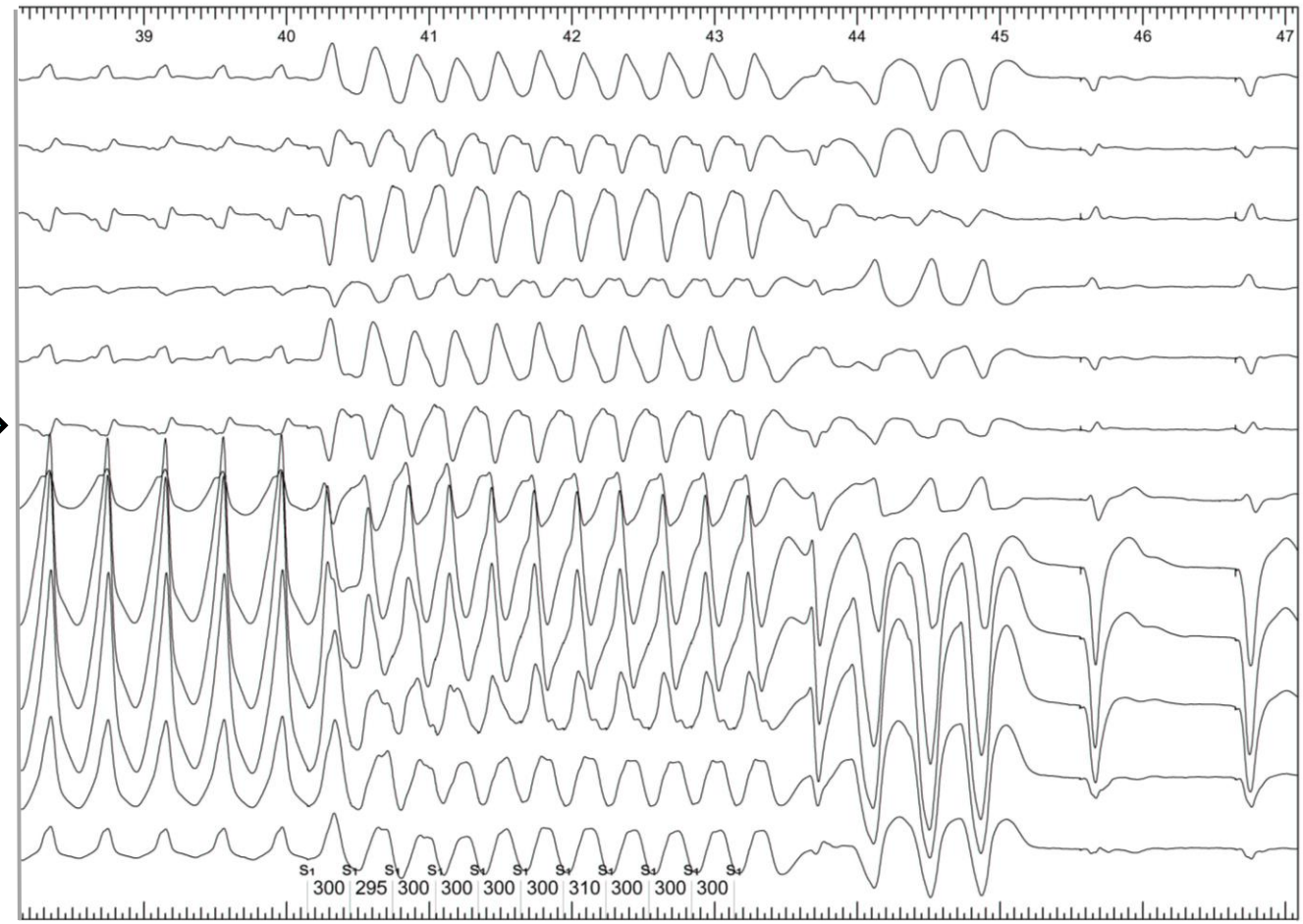
Pacing during SR immediately **before** the mid-isthmus limit

…then a real case !

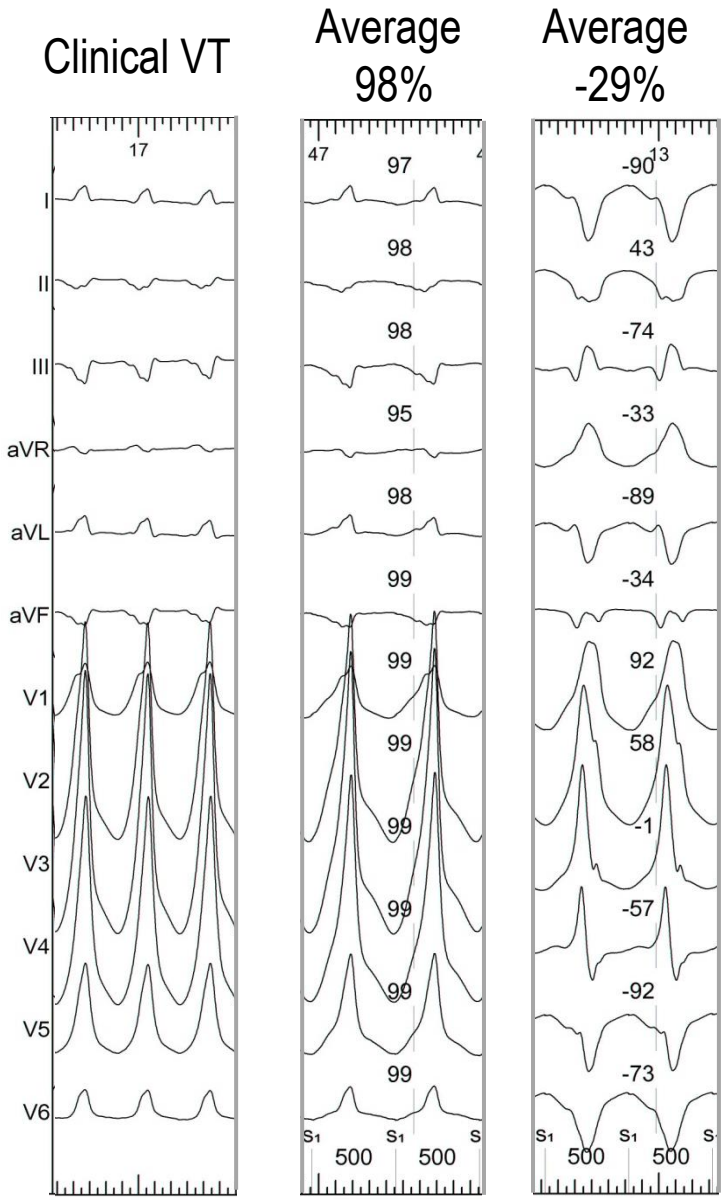
Clinical VT induced (CL=384ms)
BP = 55/25mmHg

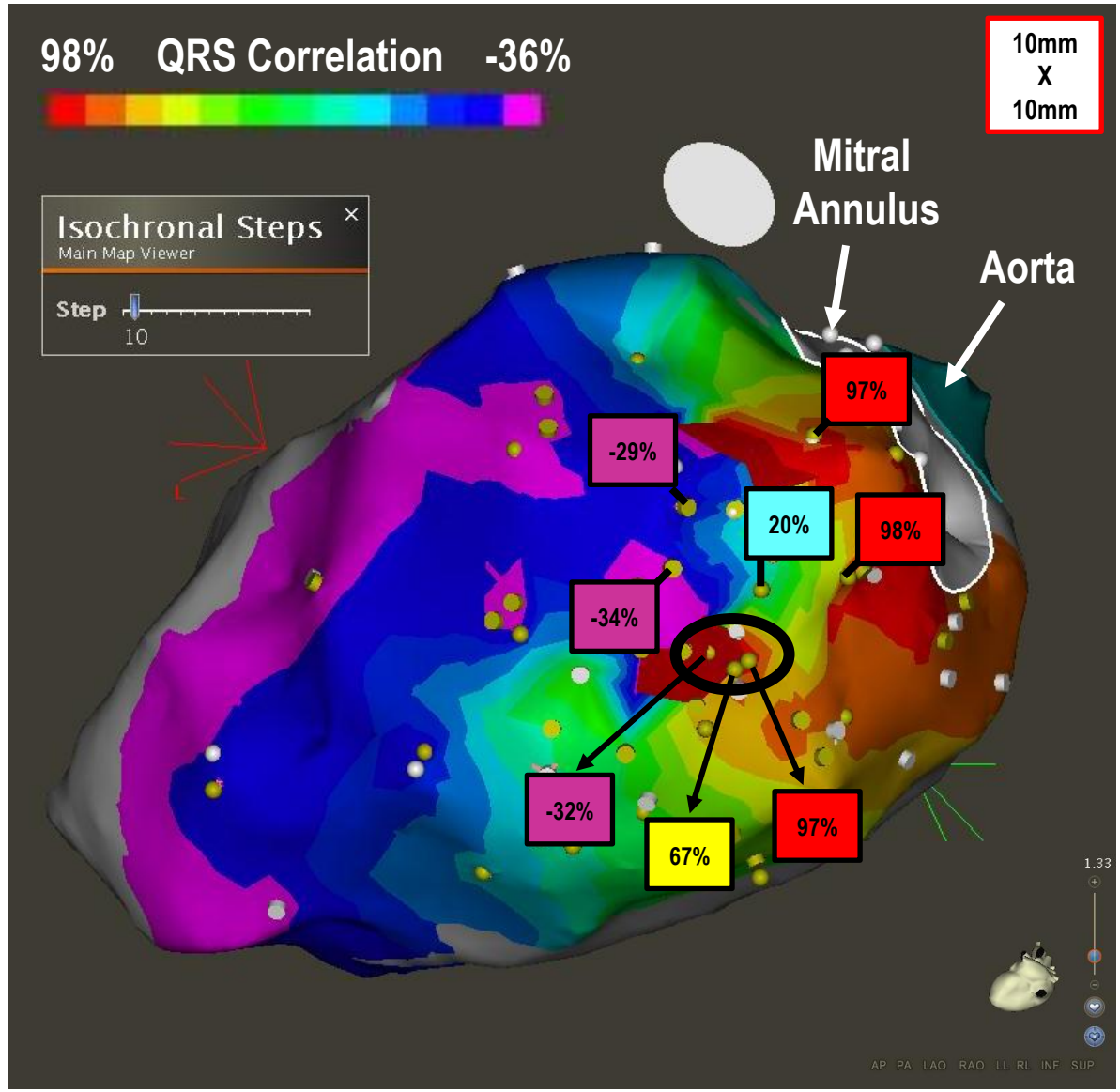


ATP to restore sinus rhythm 90 seconds after VT induction



Inferior wall infarct ➔ pace mapping map





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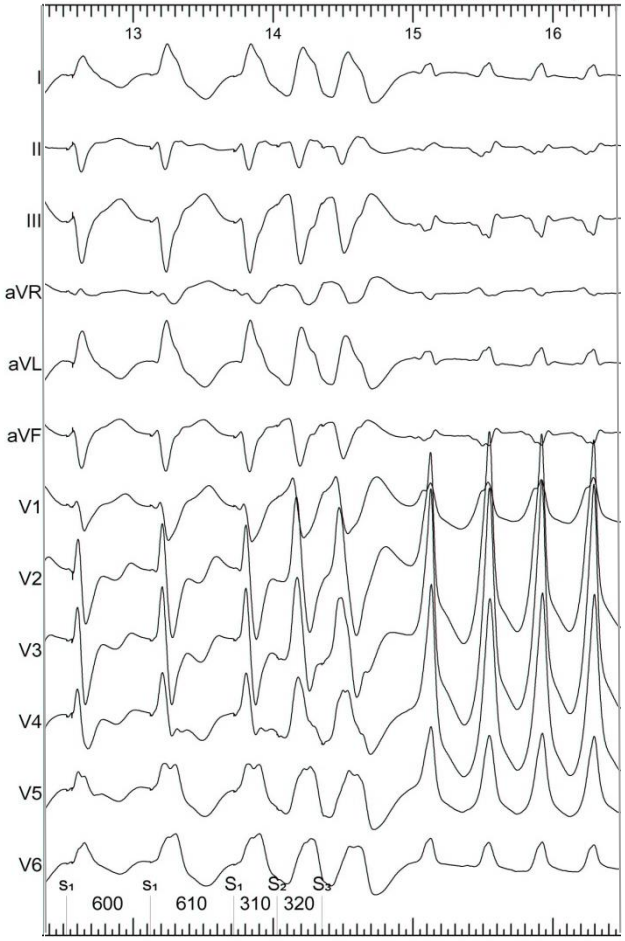
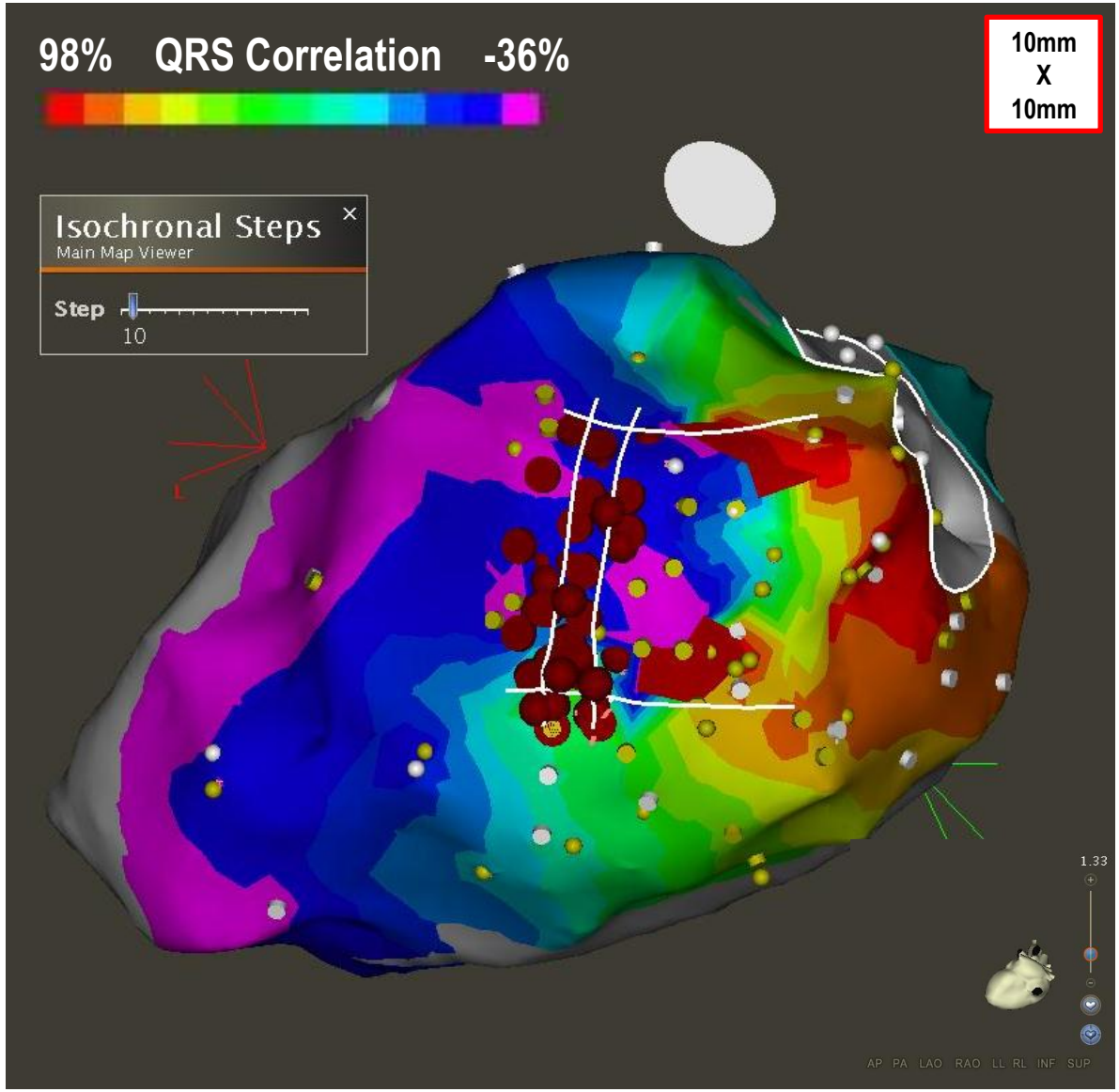
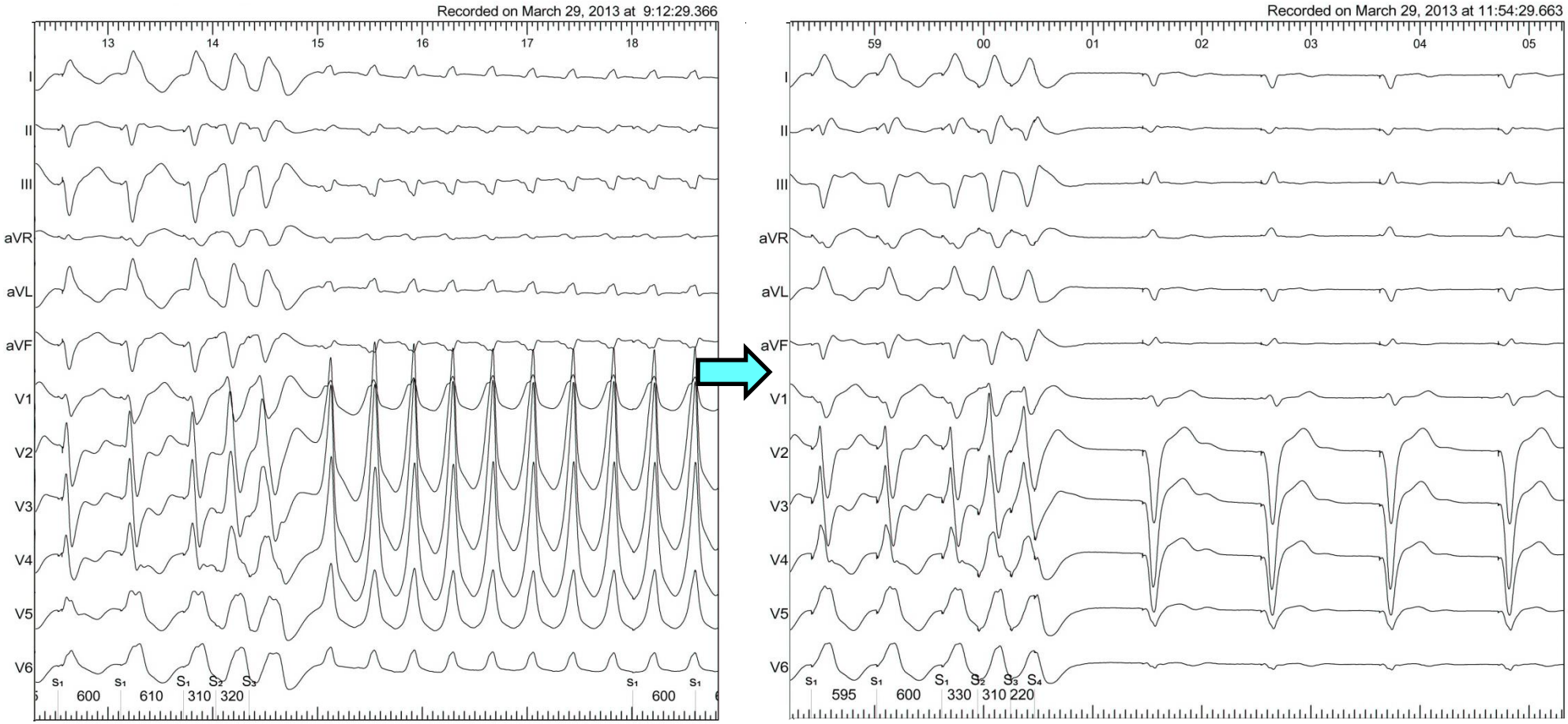
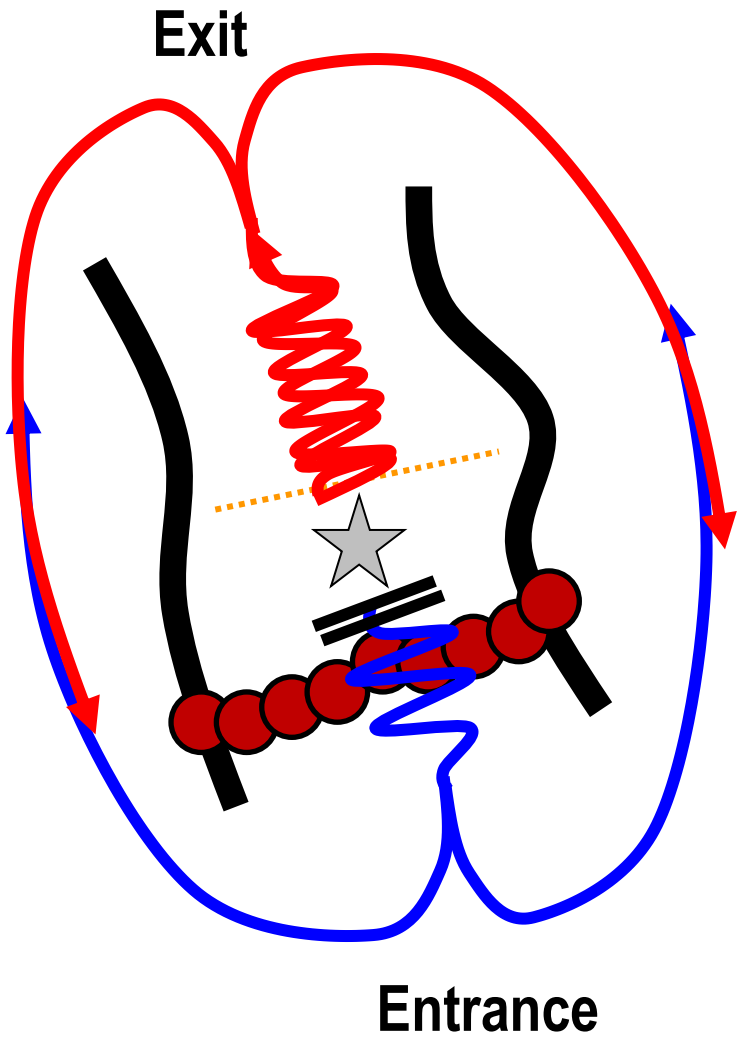


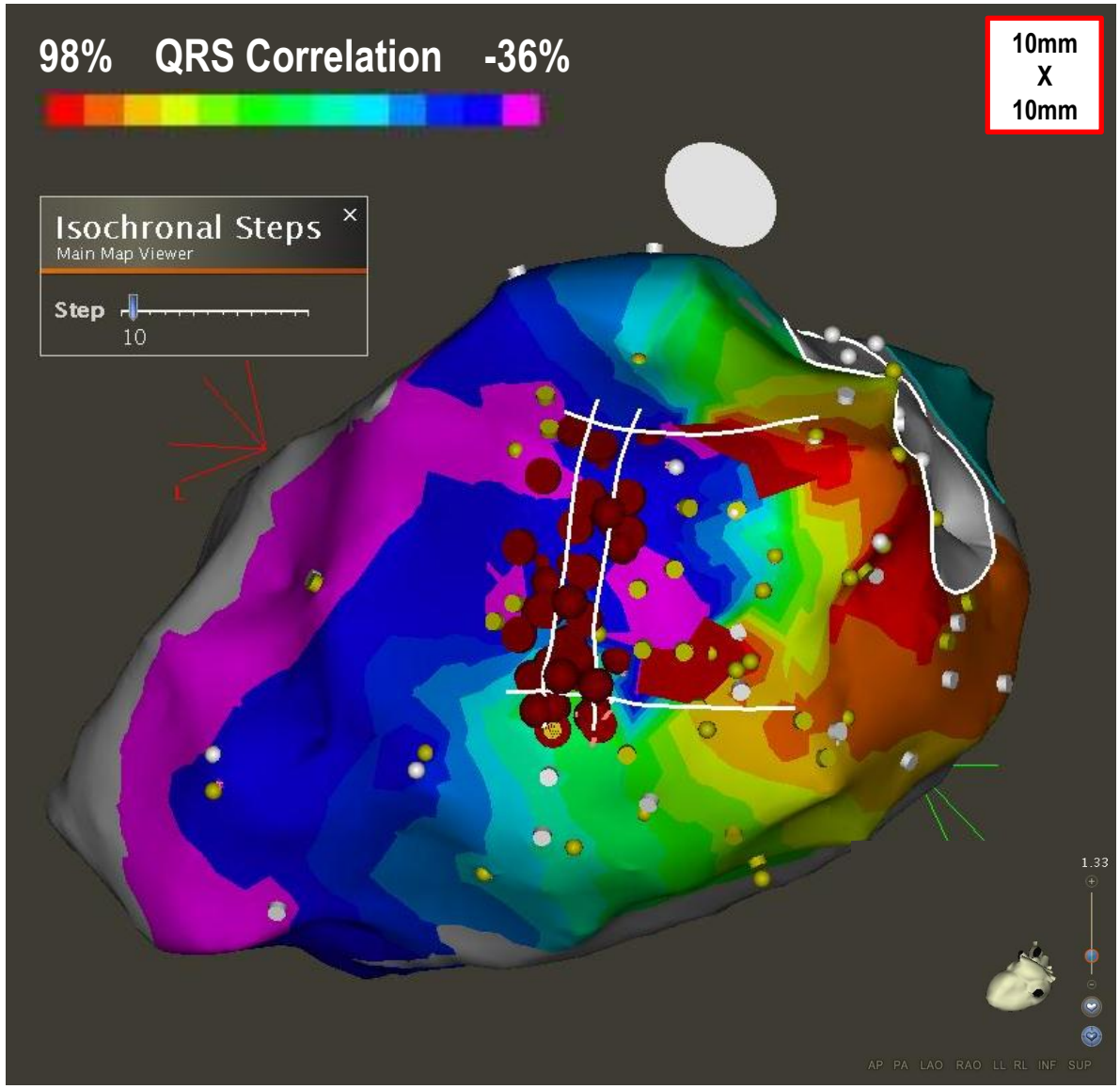


Final PES to test VT inducibility



How to prove conduction block across the RF line ?





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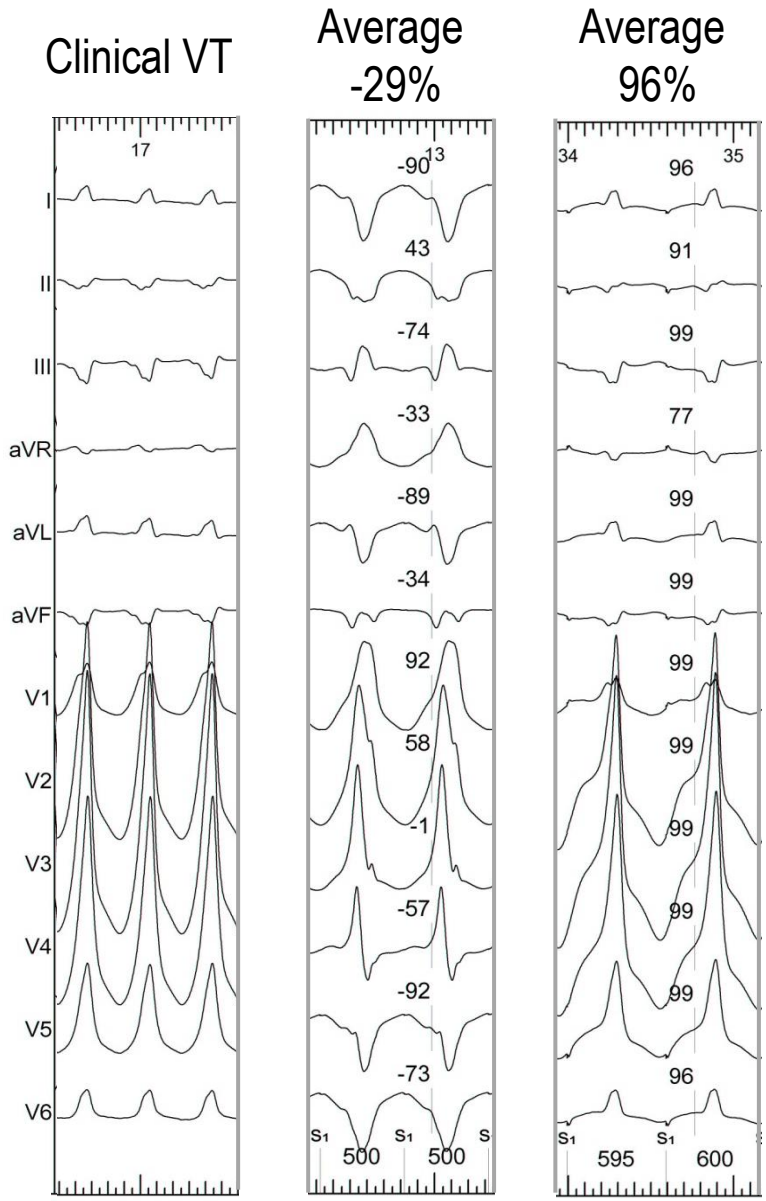

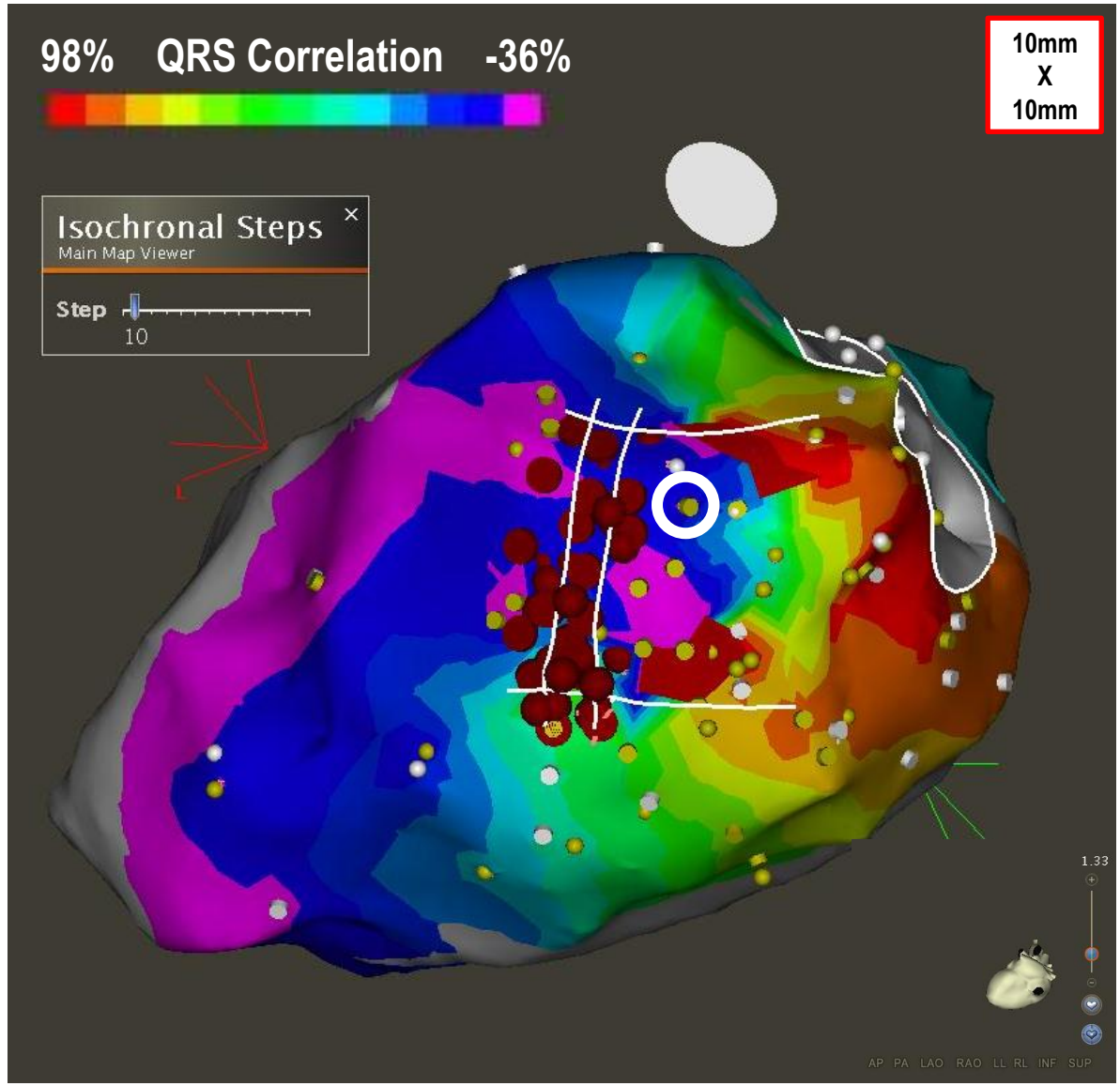

Conclusions

- Pace mapping is able to unmask post-infarct VT isthmuses…
- …because VT isthmuses borders are not functional but barriers of conduction block already present during sinus rhythm
- Pace mapping can be used as a tool to validate the presence of a conduction block through post-infarct VT isthmuses following RF applications
- Perspective: unmasking VT isthmuses in post-infarct patients with known stable VT (ICD data) regardless the availability of a 12-lead ECG during VT