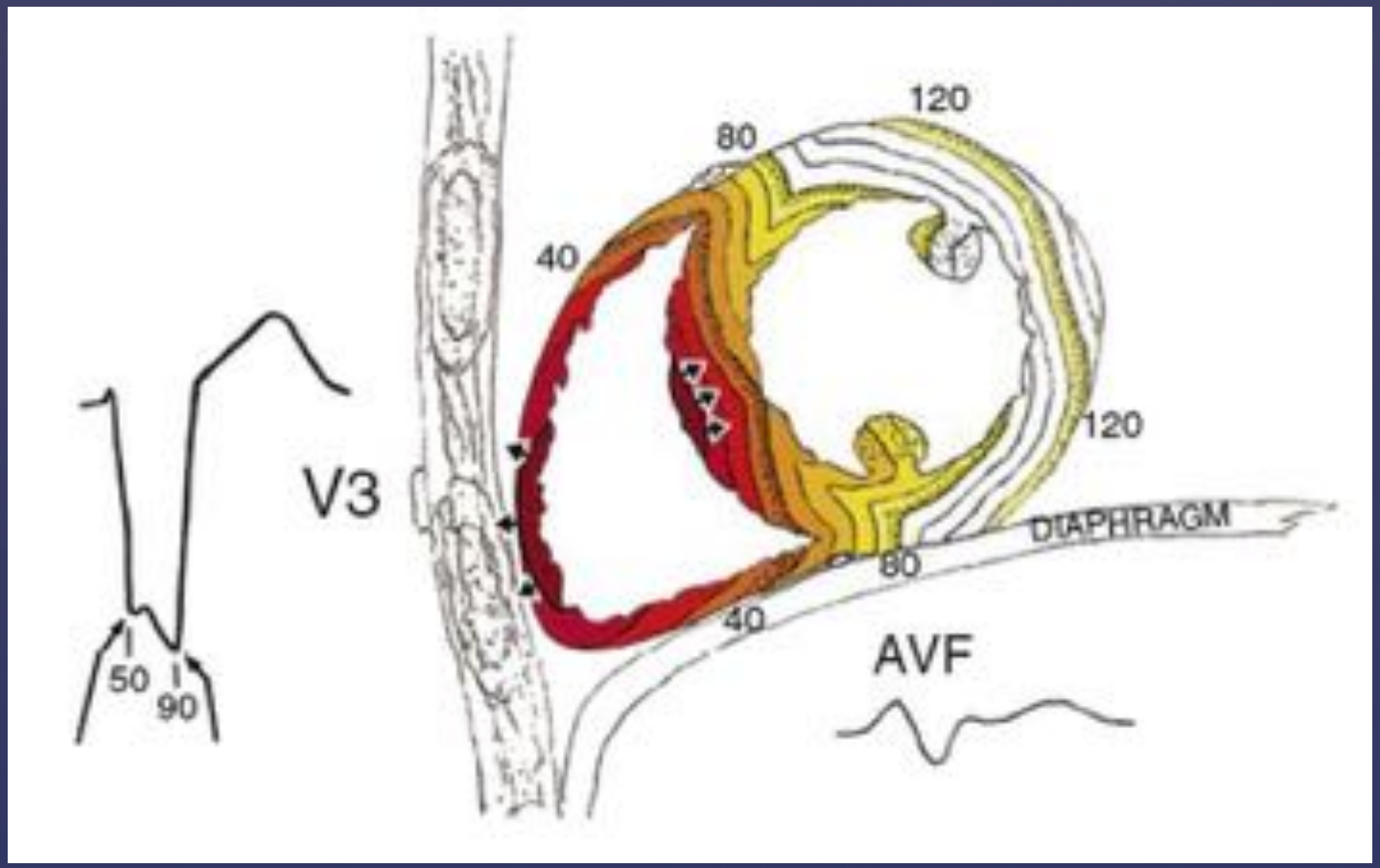
VENICE 2015 ARRHYTHMIAS

The role of echo to guide LV lead placement

Alessandro Paoletti Perini, MD
Università di Firenze

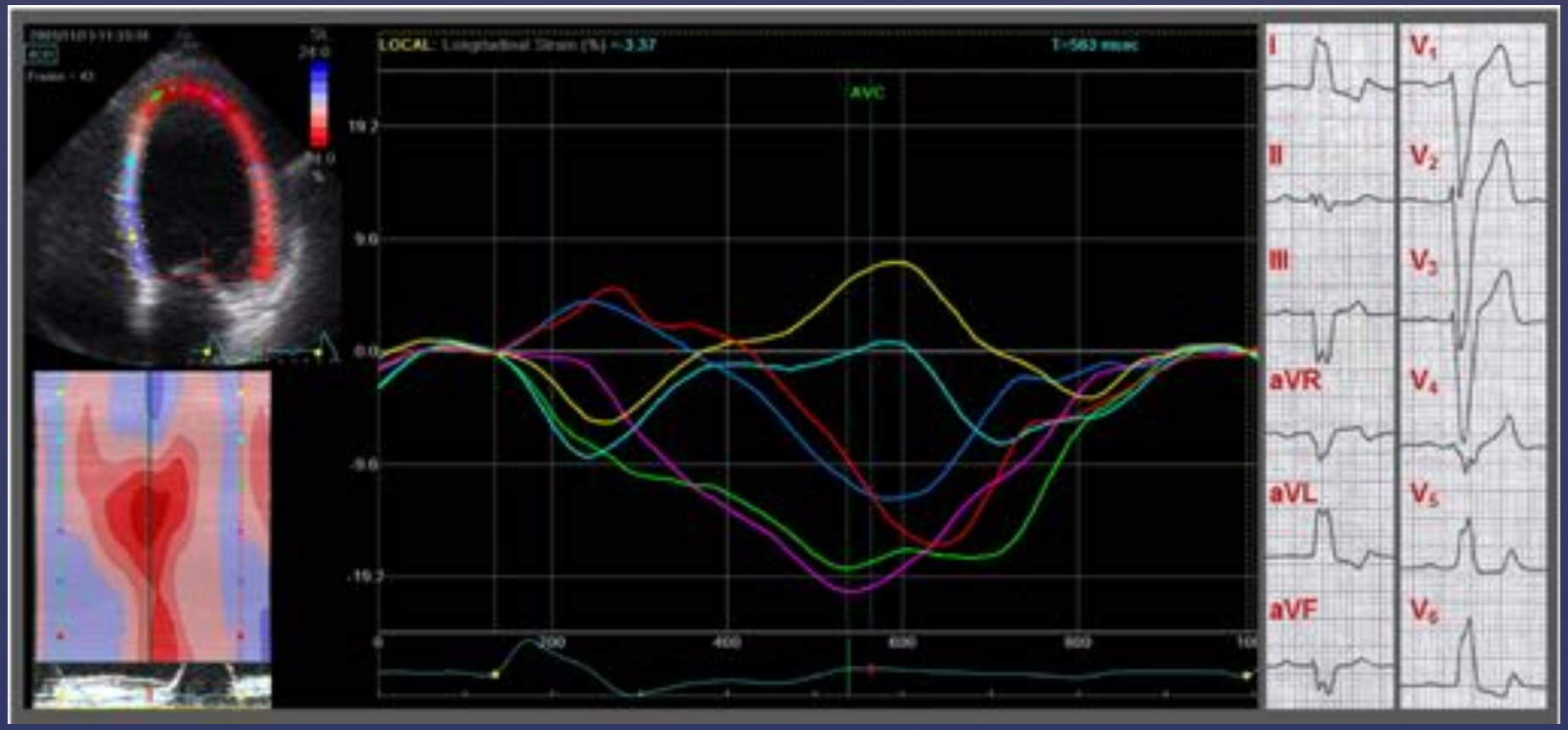
Venezia, October 18th 2015

Defining Left Bundle Branch Block in the era of Cardiac Resynchronization Therapy



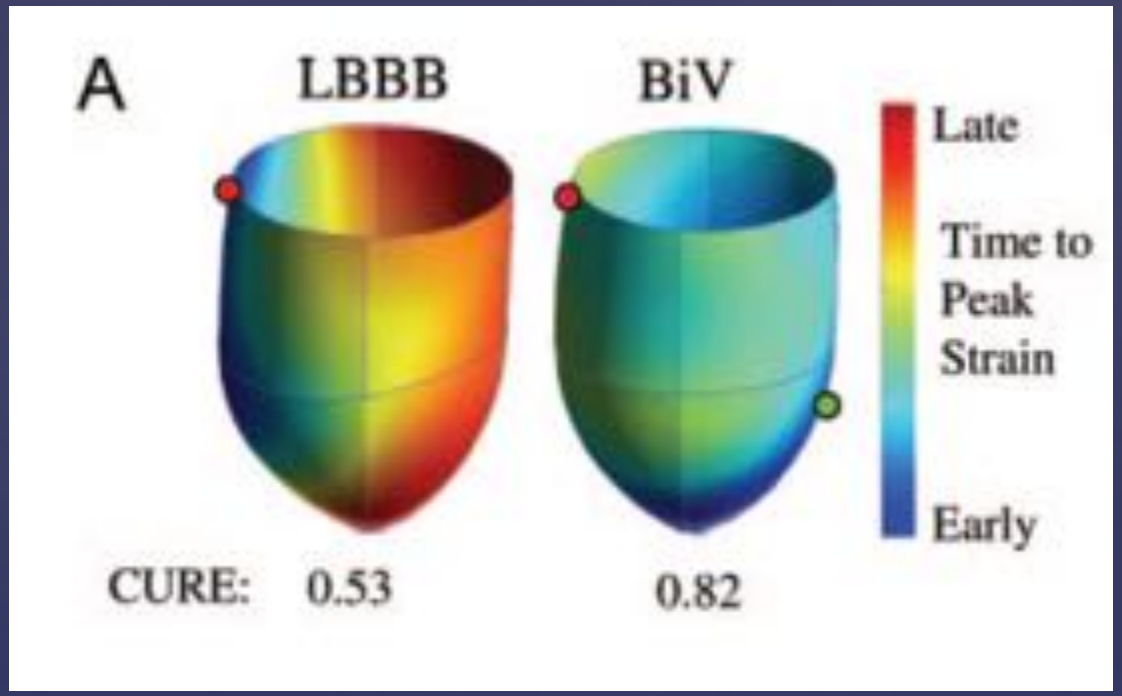
Strauss et al. Am J Cardiol 2011

“True” LBBB: relationship between electrical activation and mechanical contraction



Risum et al. Am Heart J 2013

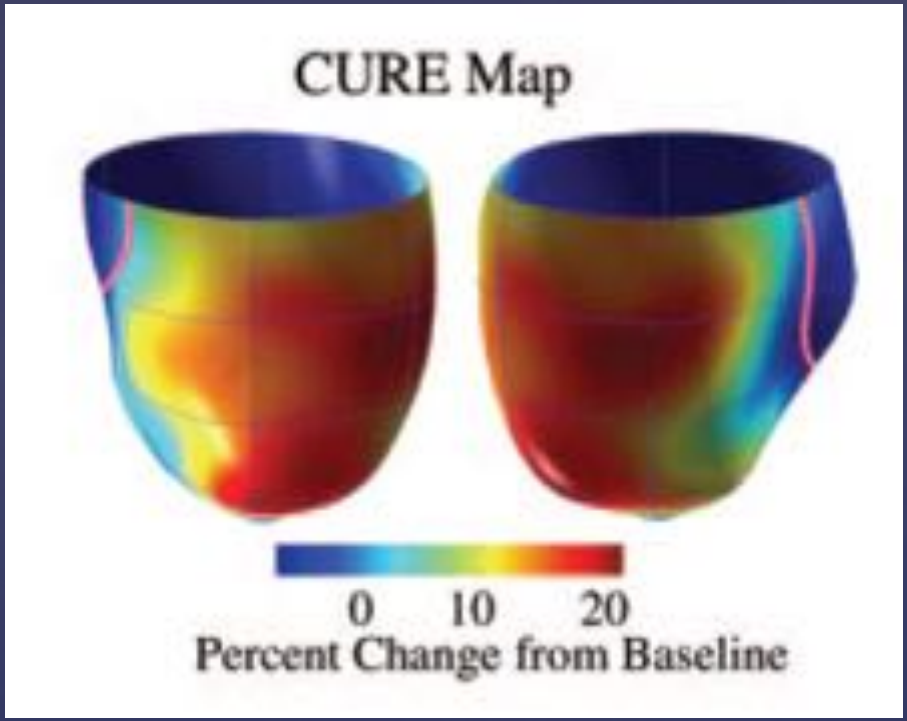
Three-Dimensional Mapping of Optimal Left Ventricular Pacing Site for Cardiac Resynchronization



CURE: circumferential uniformity ratio estimate

Helm et al. Circulation 2007

Three-Dimensional Mapping of Optimal Left Ventricular Pacing Site for Cardiac Resynchronization

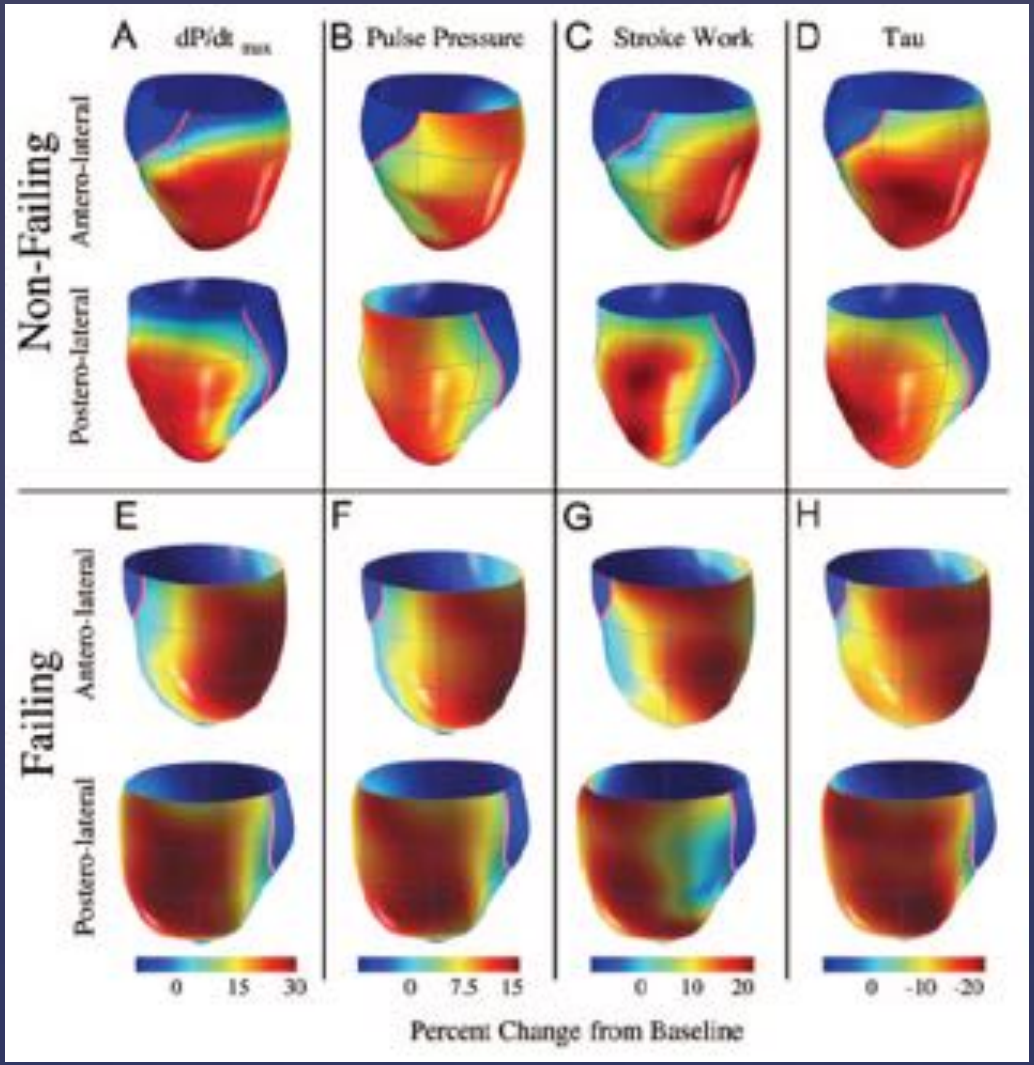


Helm et al. Circulation 2007

Three-Dimensional Mapping of Optimal Left Ventricular Pacing Site for Cardiac Resynchronization

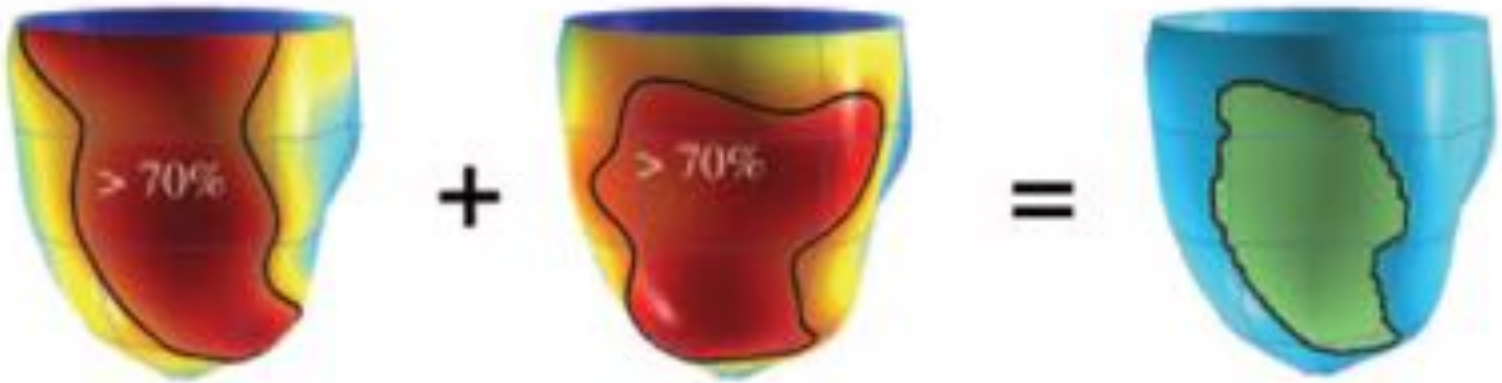
RV pacing

LBB ablation +
3-week tachypacing



Helm et al. Circulation 2007

Three-Dimensional Mapping of Optimal Left Ventricular Pacing Site for Cardiac Resynchronization



Optimal Function Map (Stroke Work)

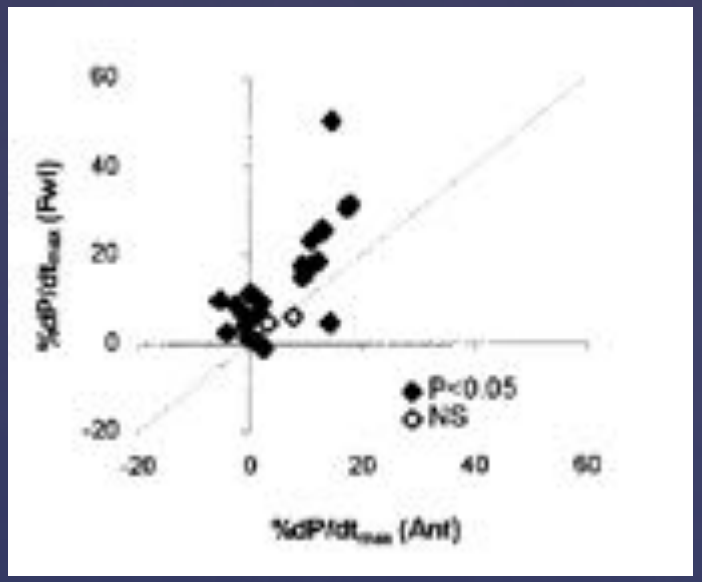
Optimal Mechanical Synchrony Map (CURE)

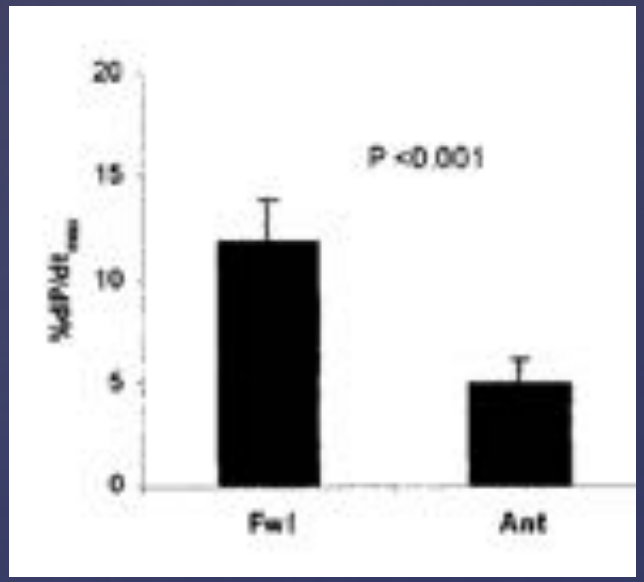
Optimal Function and Mechanical Synchrony Map (Overlay)

Helm et al. Circulation 2007

Effect of Resynchronization Therapy Stimulation Site on the Systolic Function of Heart Failure Patients

PATH-CHF-II Study





CONCLUSION: "CRT with LV free wall stimulation produced significantly better LV systolic performance compared with anterior stimulation."

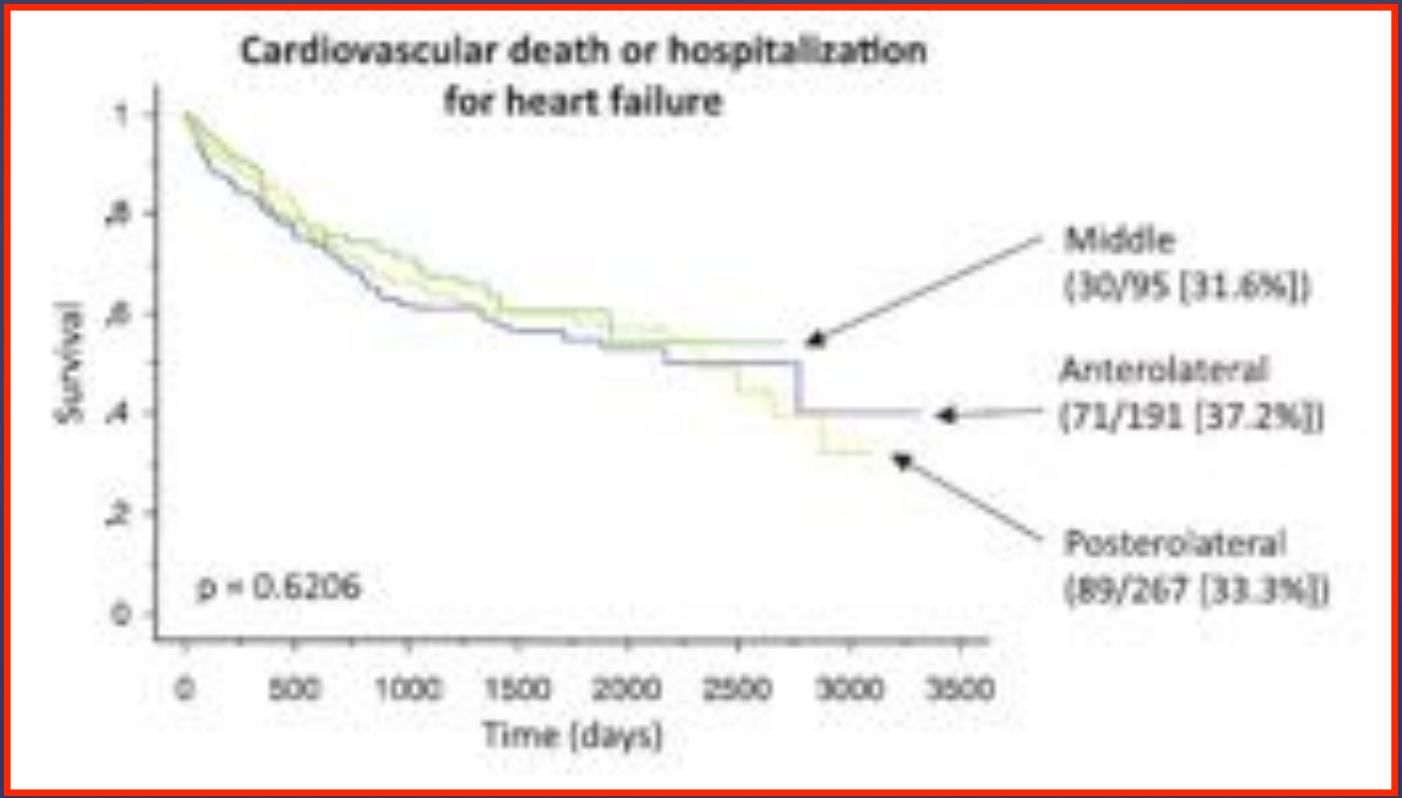
Butter et al. Circulation 2001

Is the Left Ventricular Lateral Wall the Best lead implantation Site for Cardiac Resynchronization Theraphy?

A significant improvement in cardiac function and increase in exercise capacity were observed over time regardless of the LV stimulation sites, either considered singly or grouped as lateral versus septal sites.

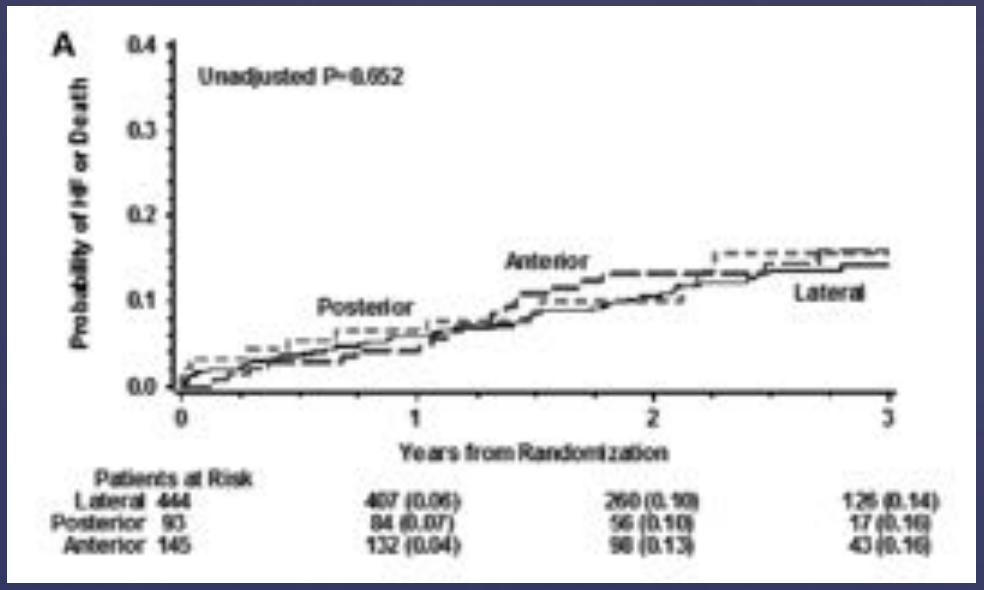
Gasparini et al PACE 2003

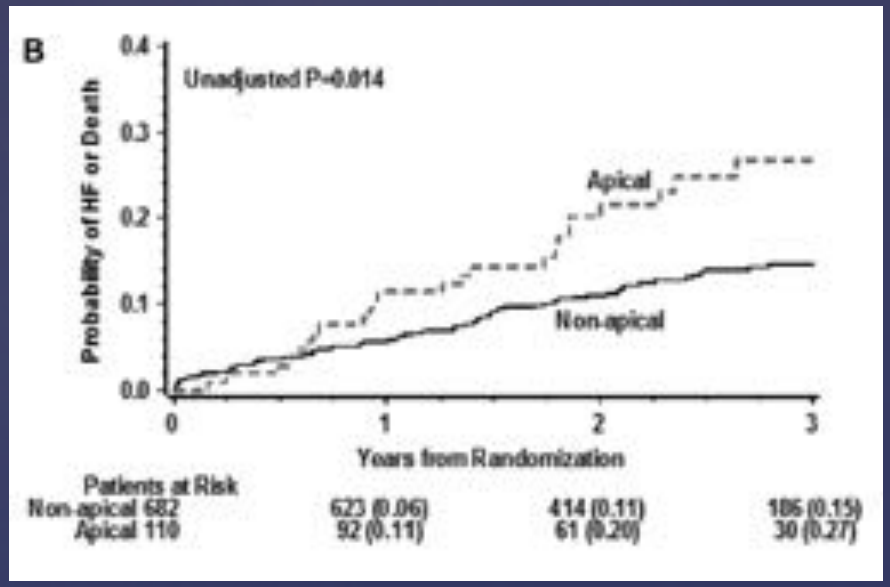
Fluoroscopic Left Ventricular Lead Position and the Long-Term Clinical Outcome of Cardiac Resynchronization Therapy



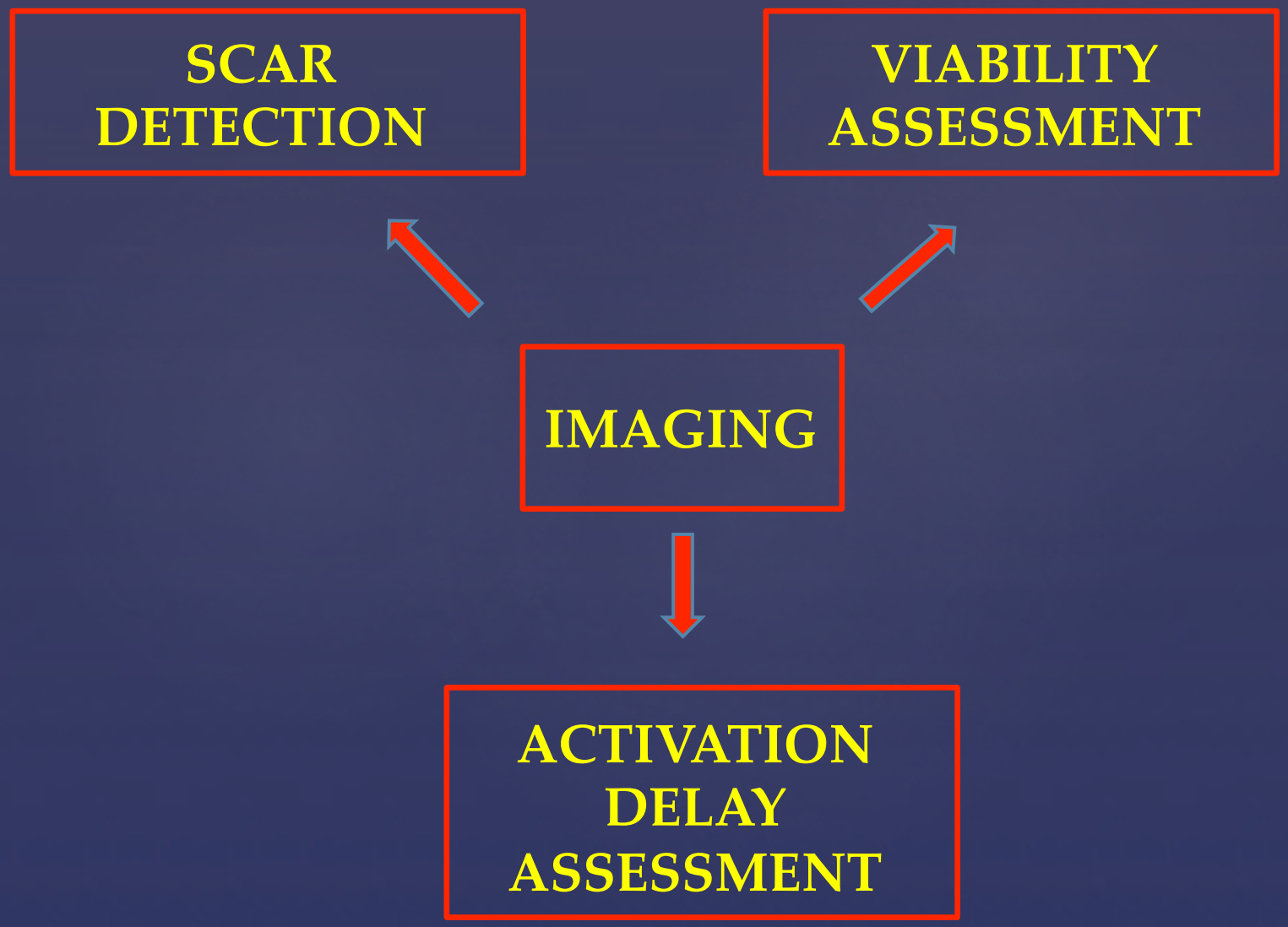
Foley et al PACE 2011

Left Ventricular Lead Position and Clinical Outcome in the Multicenter Automatic Defibrillator Implantation Trial–Cardiac Resynchronization Therapy (MADIT-CRT) Trial





Sing et al. Circulation 2011


SCAR DETECTION
VIABILITY ASSESSMENT
IMAGING
ACTIVATION DELAY ASSESSMENT

Doppler Myocardial Imaging to Evaluate the Effectiveness of Pacing Sites in Patients Receiving Biventricular Pacing

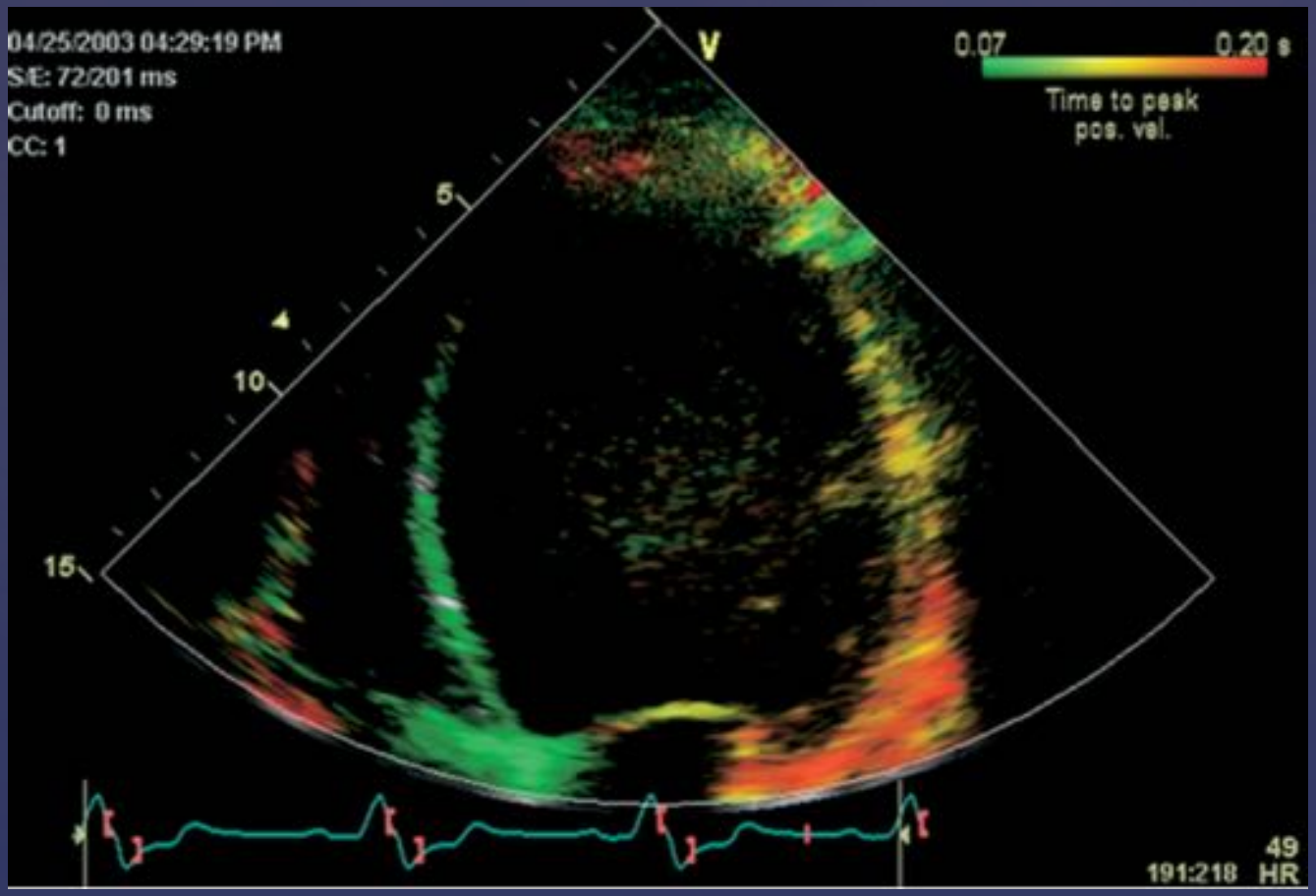
Conclusions: Regional TDI (Tissue Doppler Imaging) quantitative analysis is an effective non-invasive technique that can assess the severity of the regional delay in activation at each LV wall in LBBB and HF patients who are candidates for BIV treatment.

Even if LV performance improved significantly in all patients after BIV, **the greatest improvement was found in patients paced at the most delayed site.**

Ansalone et al. J Am Coll Card 2002

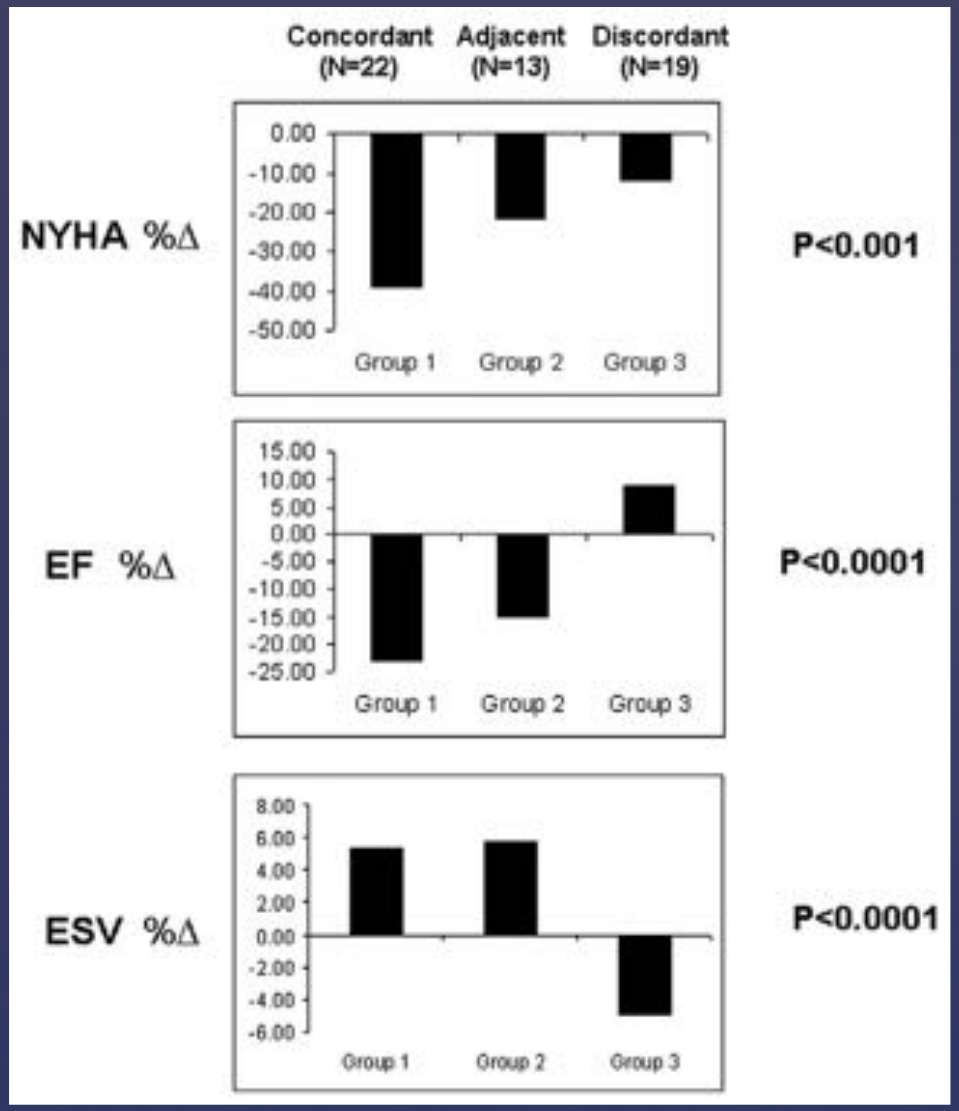
Heart Failure/ LV Pacing Site in CRT

Tissue synchronization imaging



Murphy et al. Am J Cardiol 2006

Heart Failure/ LV Pacing Site in CRT



Group 1(n°22 pts) had lead placement corresponding to the segment of maximal delay

Group 2 (n°13 pts) had lead placement 1 segment adjacent

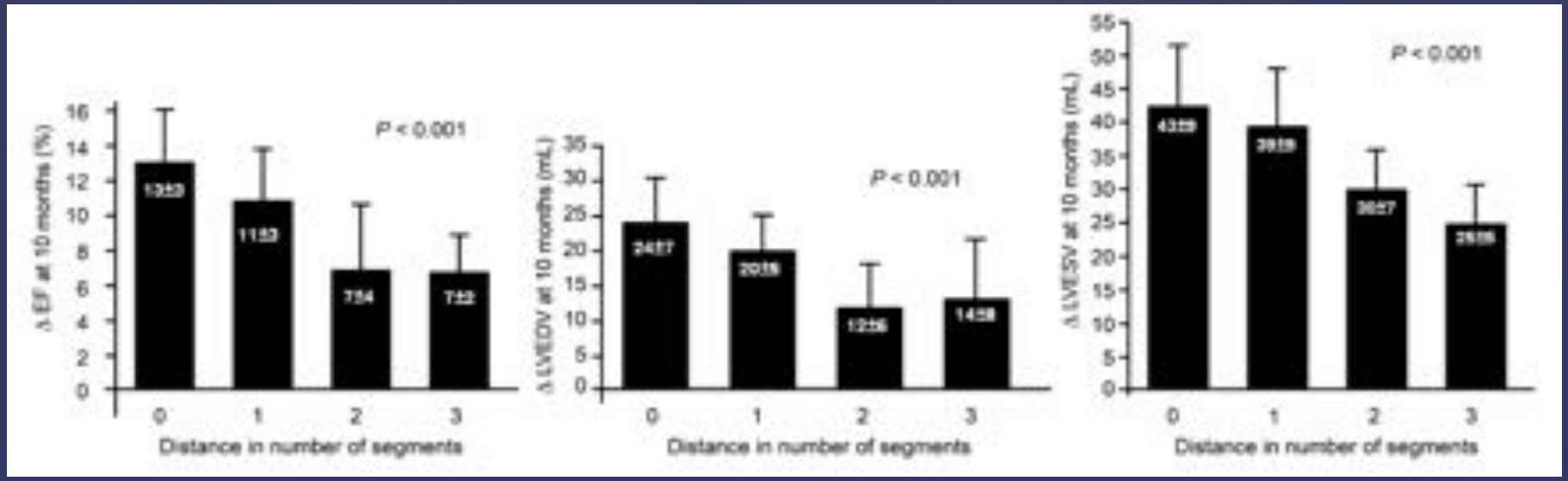
Group 3 (n°19 pts) had lead placement remote from the site

Murphy et al. Am J Cardiol 2006

Heart Failure/ LV Pacing Site in CRT

Speckle-tracking echocardiography

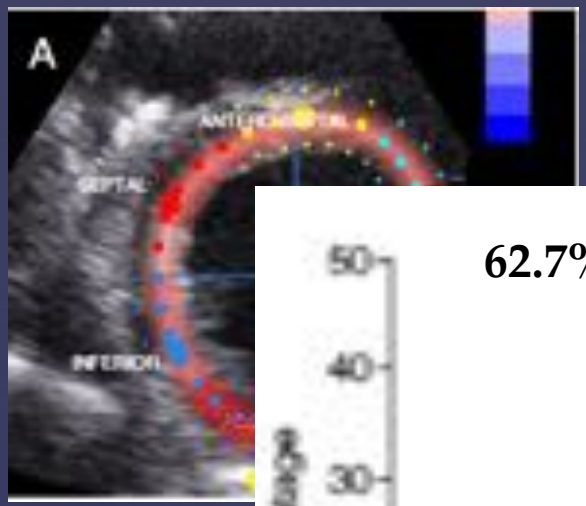
47 wide QRS patients, 21 (44.7%) highest delay lateral wall
82% second most delayed segments next to the first
28 concordant LV lead position (59.5%)

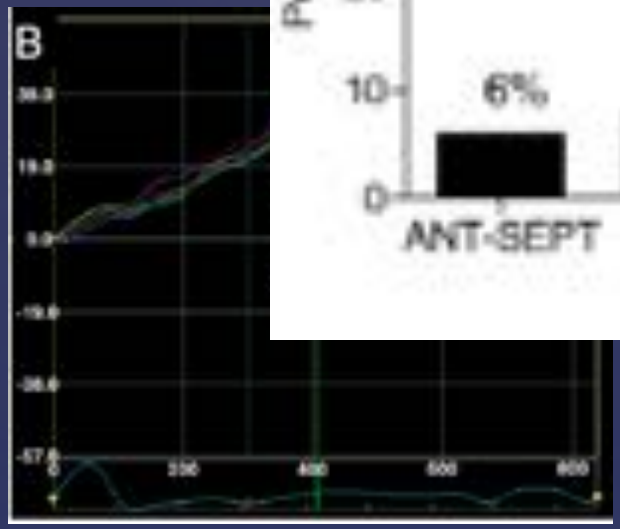


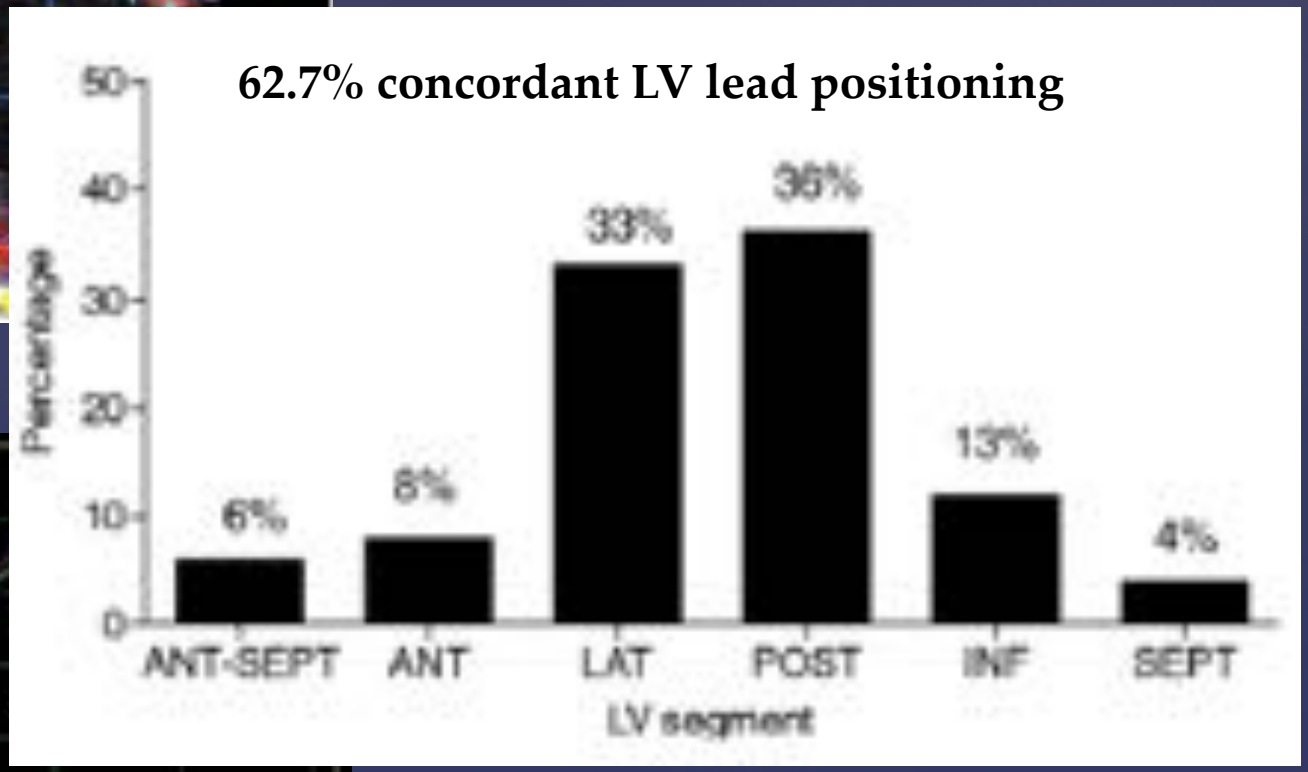
Becker et al. Eur. Heart J 2007

LV Lead Position and Response to CRT

257pts (70% LBBB)

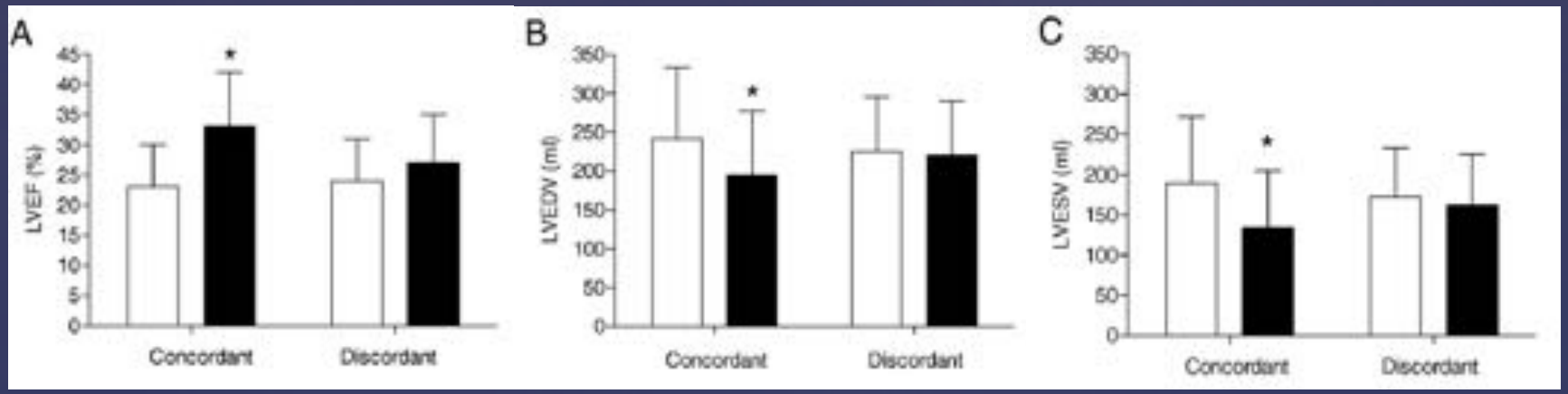






Ypenburg et al J Am Coll Cardiol 2008

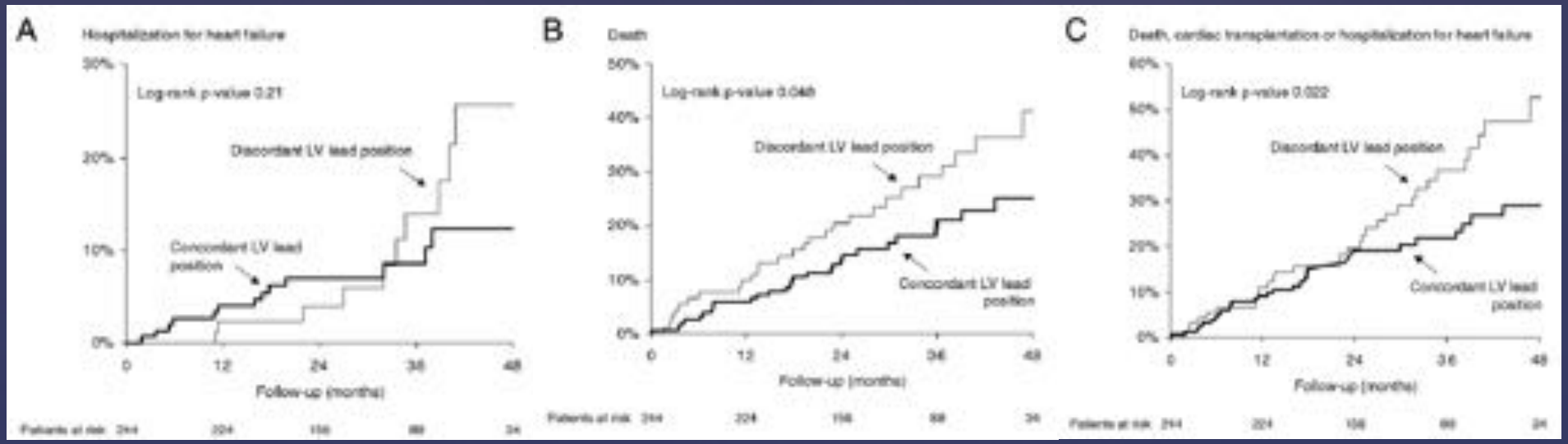
LV Lead Position and Response to CRT



LV EF concordant: from 23±7% to 33±9% ($p<0.001$)
LV EF discordant: from 24±7% to 27±8% (N.S.)

Ypenburg et al J Am Coll Cardiol 2008

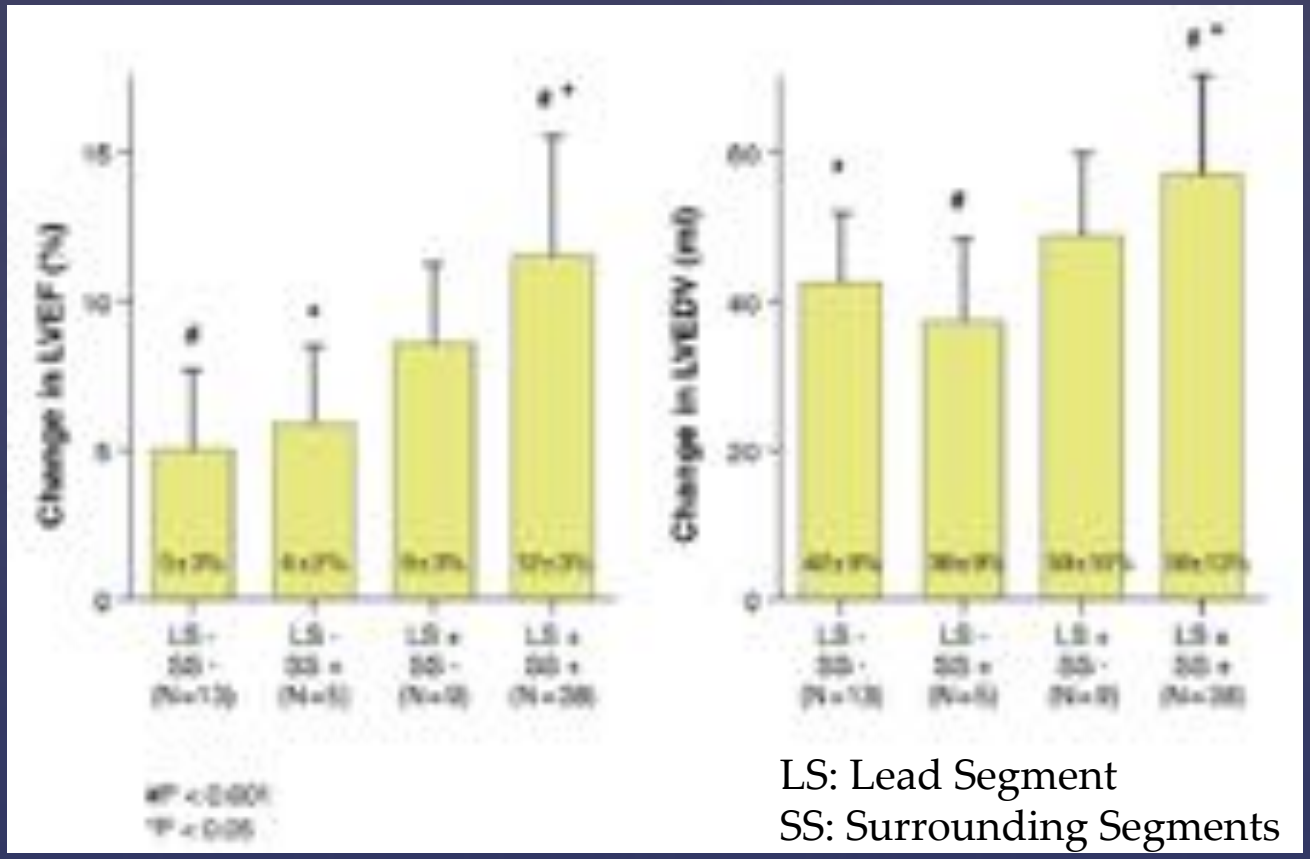
LV Lead Position and Response to CRT



32 ± 16 months follow-up
55 HF hospitalizations in 25 pts (10%) (20 vs 35, p 0.04)
56 deaths (23%) + 1 heart transplantation (24-month survival 85% vs 79%)

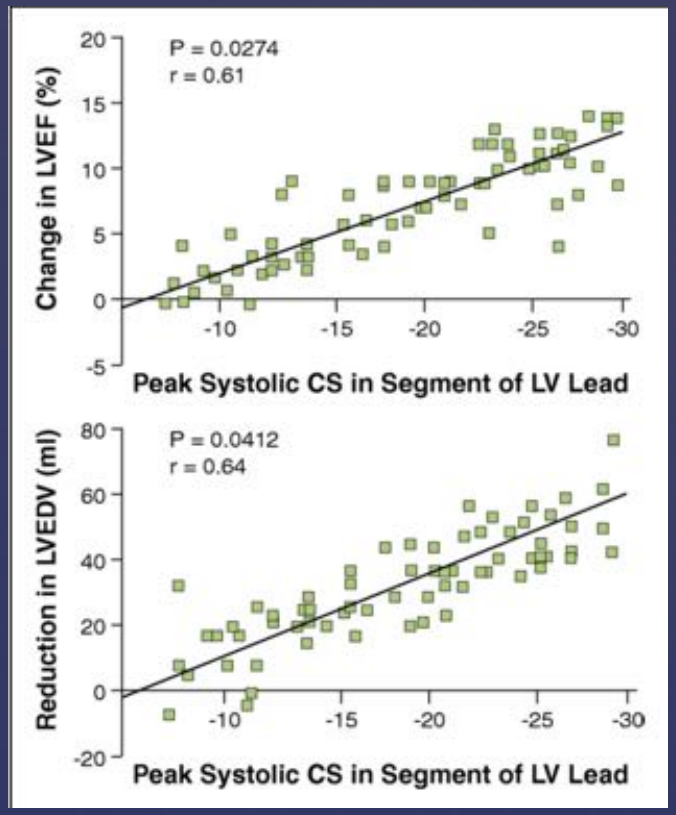
Ypenburg et al J Am Coll Cardiol 2008

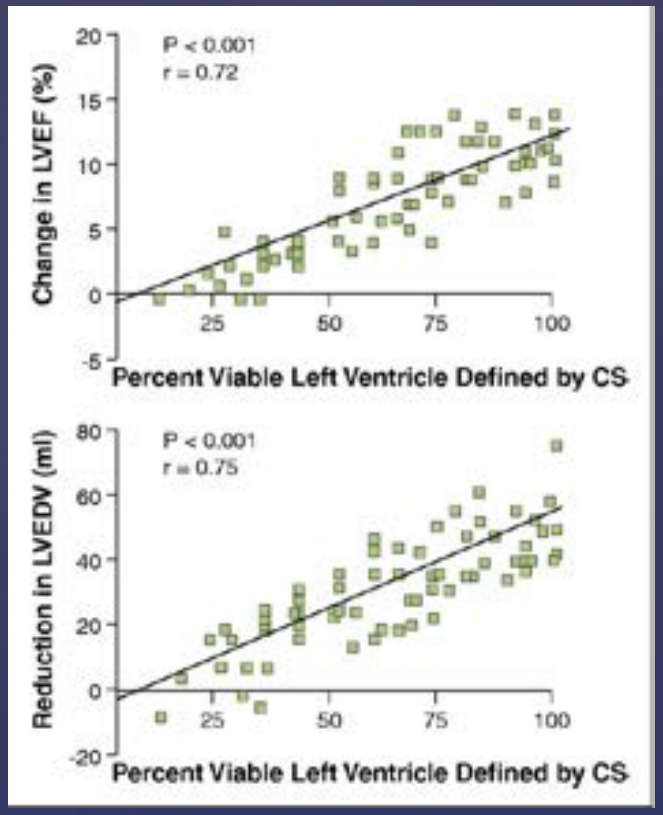
Dependency of CRT on Myocardial Viability at the LV Lead Position



Becker J Am Coll Cardiol Img 2011

Dependency of CRT on Myocardial Viability at the LV Lead Position

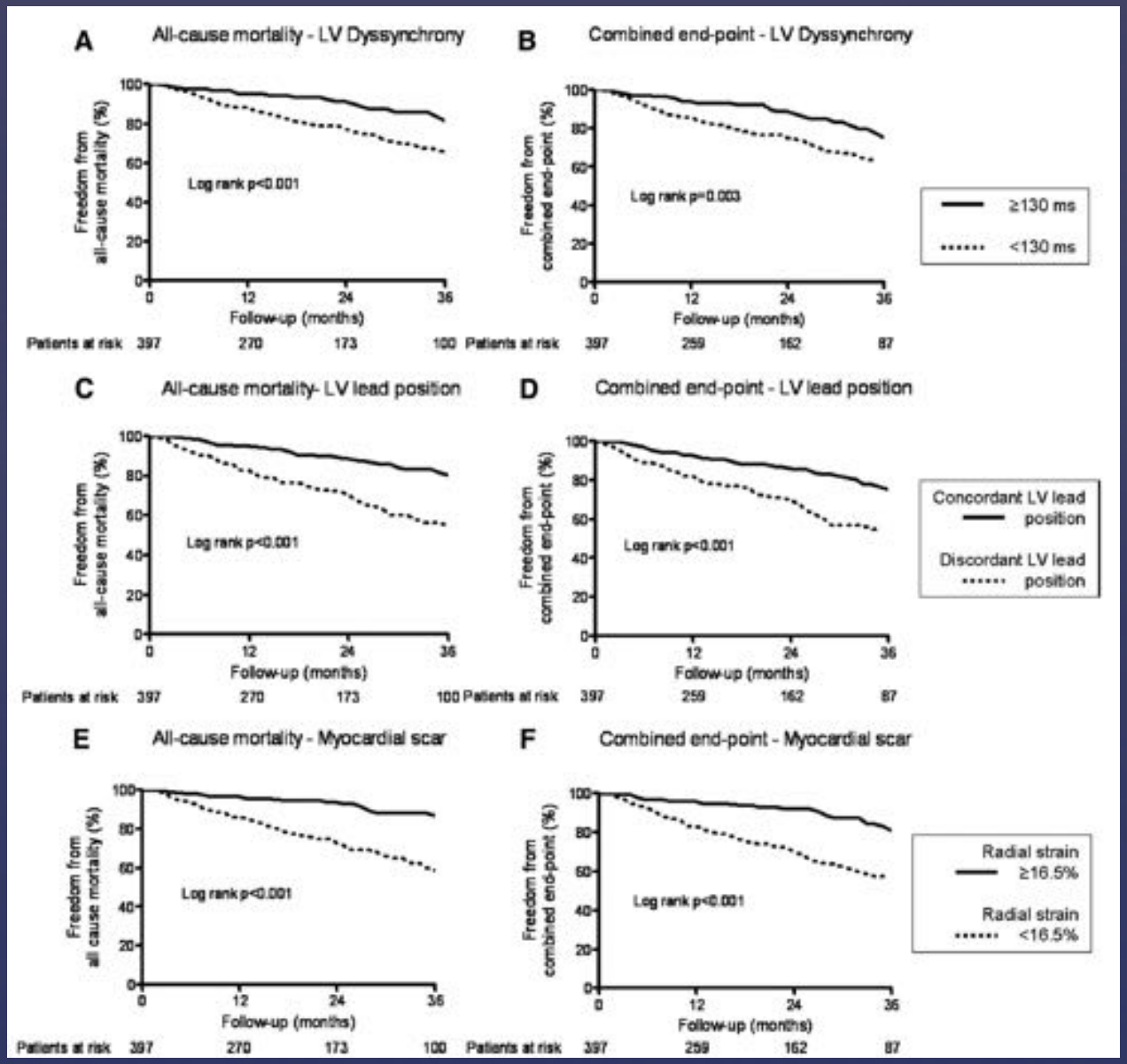




CS: Circumferential Strain
Cut-off: -11.1%

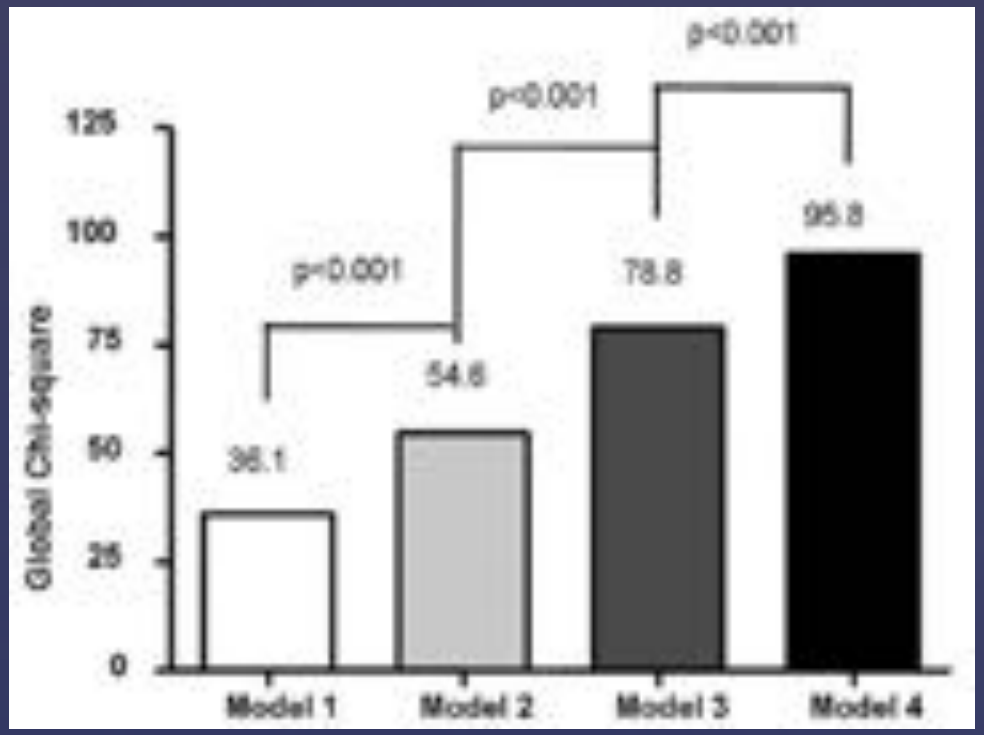
Becker J Am Coll Cardiol Img 2011

Survival in Ischemic Heart Failure After CRT



Delgado Circulation 2011

Survival in Ischemic Heart Failure After CRT



Model 1, clinical variable (age, plasma levels of creatinine).

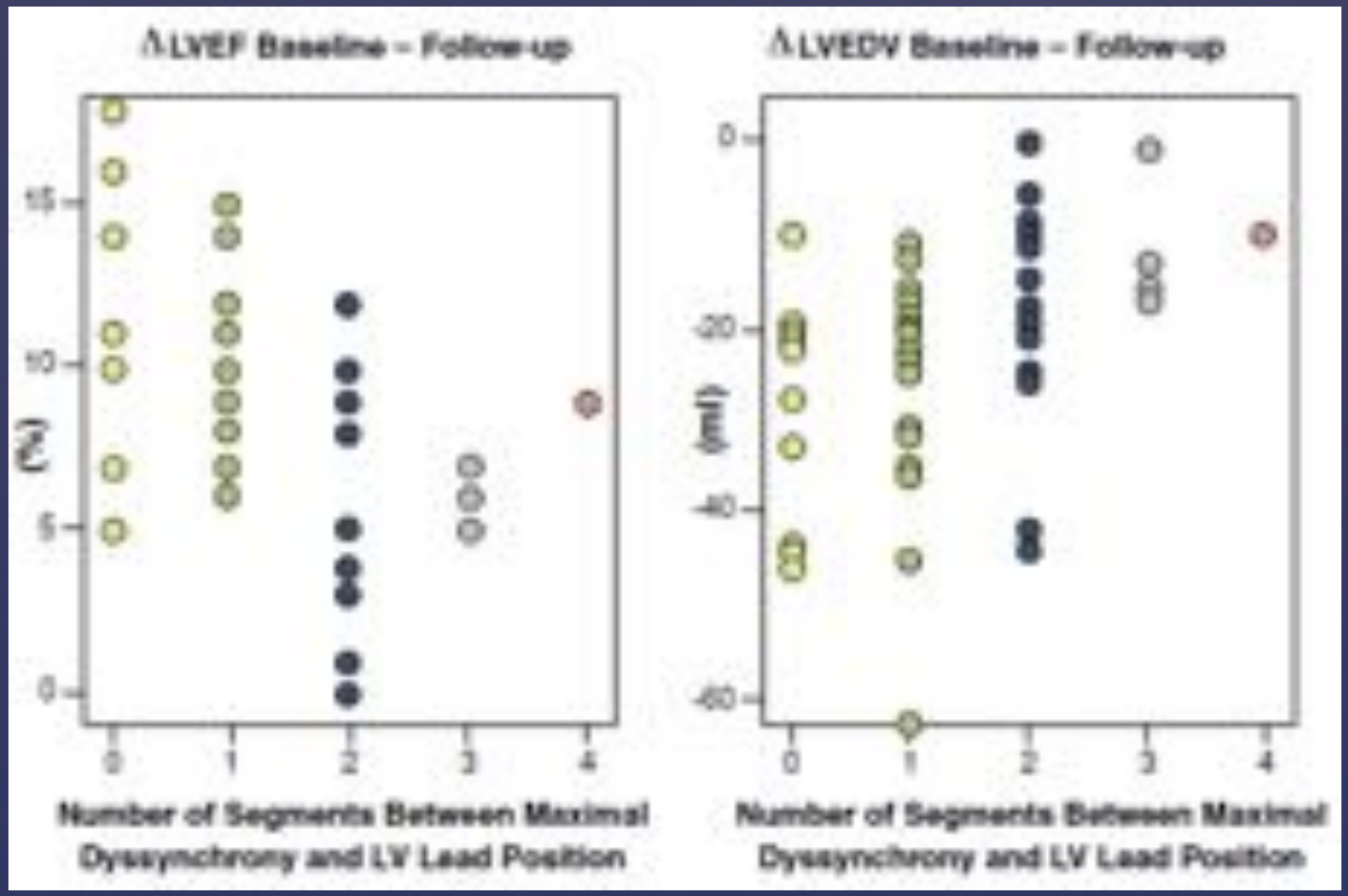
Model 2, model 1 plus dyssy-chrony.

Model 3, model 2 plus discordant LV lead position

Model 4, model 3 plus myocardial Scar in the targeted segment

Delgado Circulation 2011

Analysis of LV Lead Position in Cardiac Resynchronization Theraphy Using Different Imaging Modalities



Becker et al. J Am Coll Card Img 2010

Targeted Left Ventricular Lead Placement to Guide Cardiac Resynchronization Therapy

The TARGET Study: A Randomized, Controlled Trial

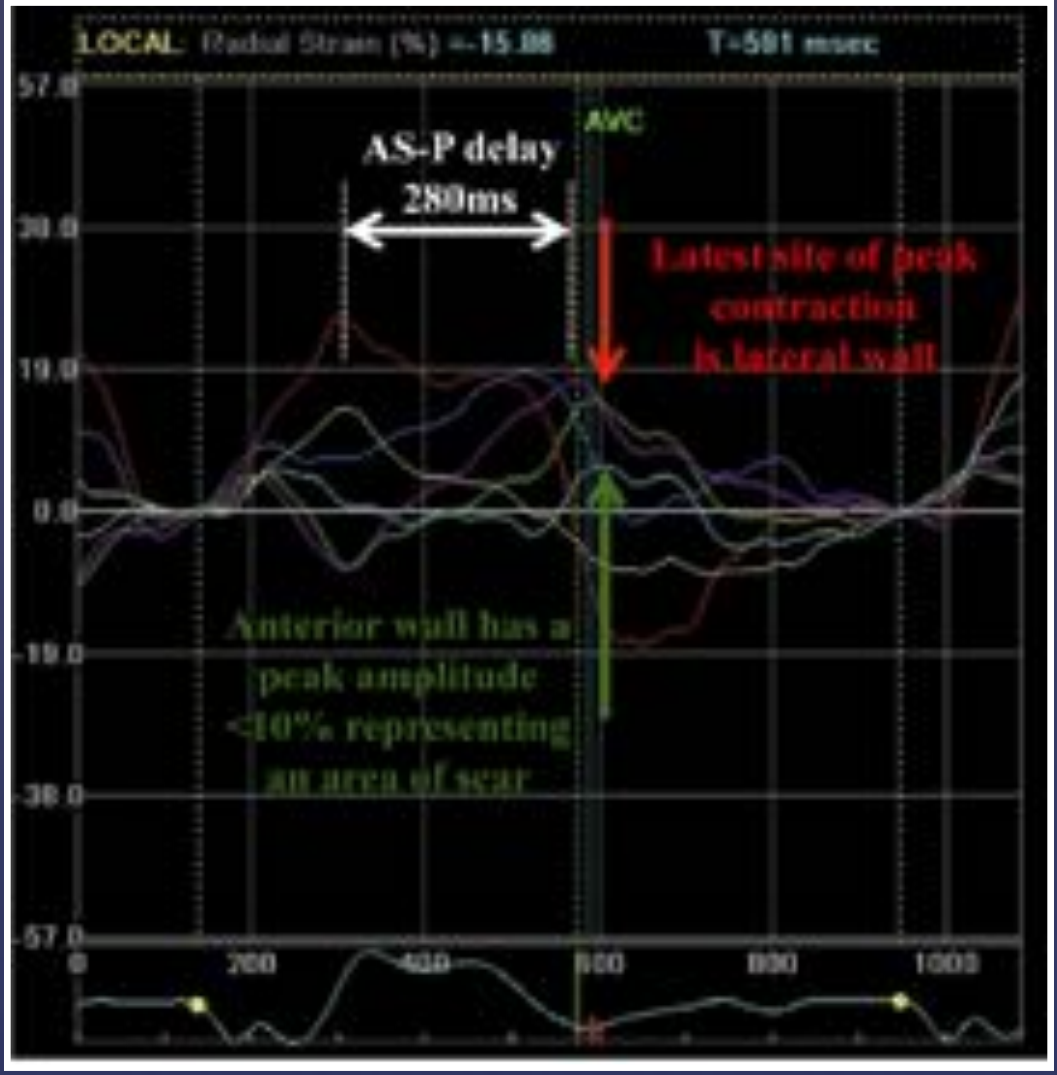
A total of 220 patients scheduled for CRT underwent baseline echocardiographic speckle-tracking 2-dimensional radial strain imaging and were randomized 1:1 into 2 groups:

GROUP 1 (TARGET [Targeted Left Ventricular Lead Placement to Guide Cardiac Resynchronization Theraphy]). LV lead was positioned at the latest site of peak contraction with an amplitude of >10% to signify freedom from scar.

GROUP 2 (control) patients underwent standard unguided CRT.

Khan et al. J Am Coll Cardiol 2012

Speckle-Tracking Echocardiography to Determine Optimal Sites



Khan et al. J Am Coll Cardiol 2012

Targeted Left Ventricular Lead Placement to Guide Cardiac Resynchronization Therapy

The TARGET Study: A Randomized, Controlled Trial

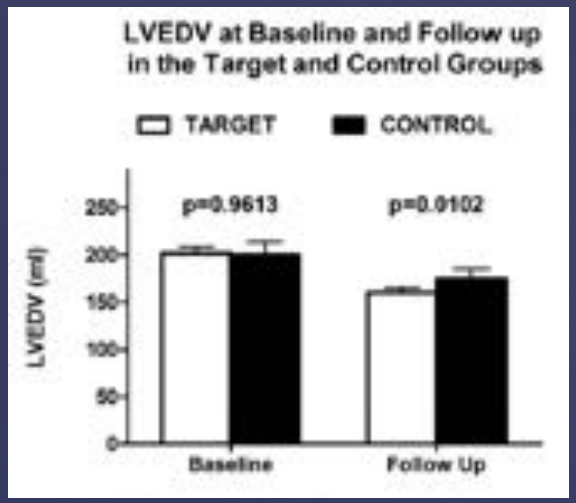
Table 2 Distribution of Latest Site of Activation, LV Lead Position, Implant-Related Complications, and Procedural Characteristics Between Both Treated Groups

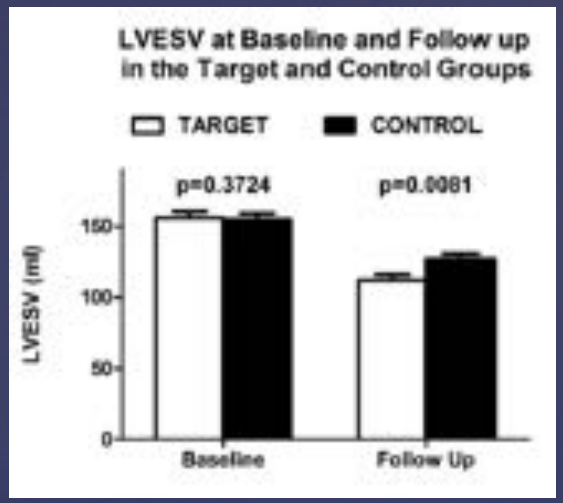
	Target Group (n = 103)	Control Group (n = 104)	p Value
Latest site of activation, % (% basal/mid)			0.962
Inferior	13 (13) [4/9]	14 (15) [5/9]	
Posterior	38 (39) [14/24]	41 (43) [15/26]	
Lateral	32 (33) [13/19]	31 (32) [11/20]	
Anterior	9 (9) [3/6]	7 (7) [3/4]	
Anteroseptal	4 (4) [1/3]	4 (4) [1/3]	
Inferoseptal	4 (4) [1/3]	3 (3) [0/3]	

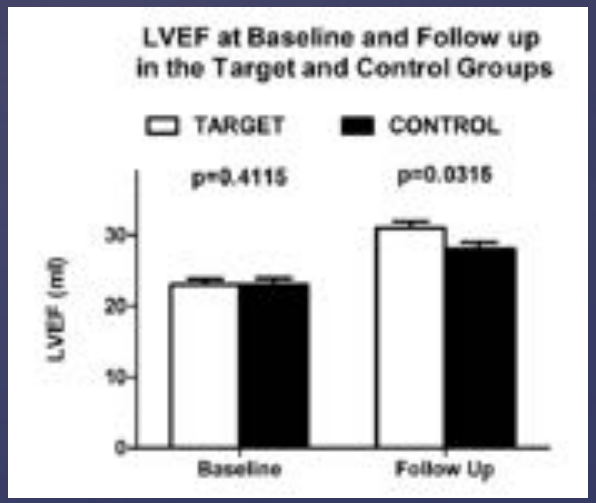
Khan et al. J Am Coll Cardiol 2012

Targeted Left Ventricular Lead Placement to Guide Cardiac Resynchronization Therapy

The TARGET Study: A Randomized, Controlled Trial





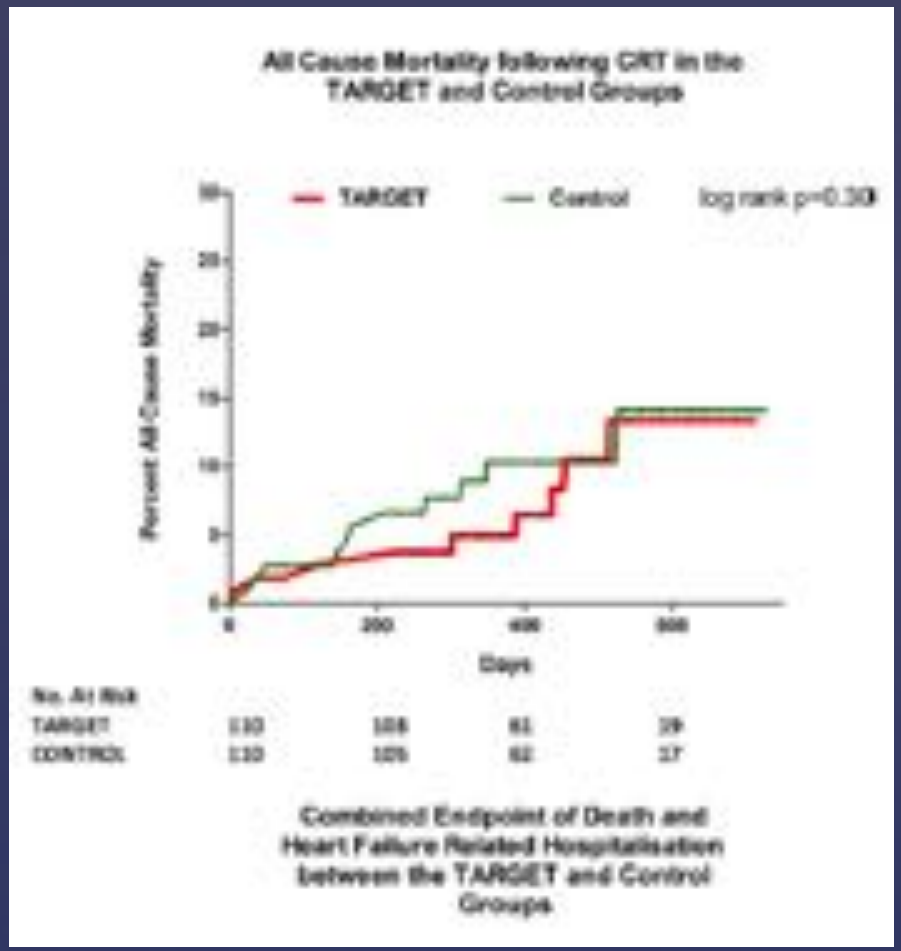


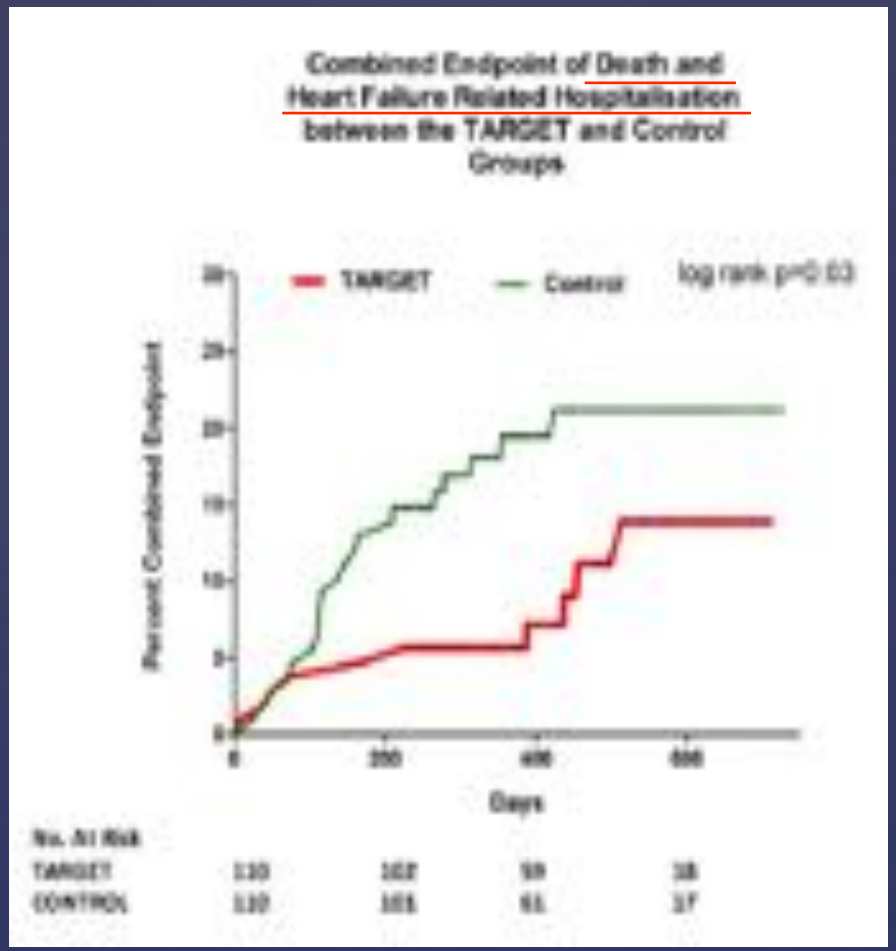
Comparison of changes in left ventricular (LV) volumes and LV function betweenboth study groups at baseline and at 6-month follow-up showing greater improvementin LV reverse remodeling and improvements in ejection fraction in the TARGET population.

Khan et al. J Am Coll Cardiol 2012

Targeted Left Ventricular Lead Placement to Guide Cardiac Resynchronization Therapy

The TARGET Study: A Randomized, Controlled Trial

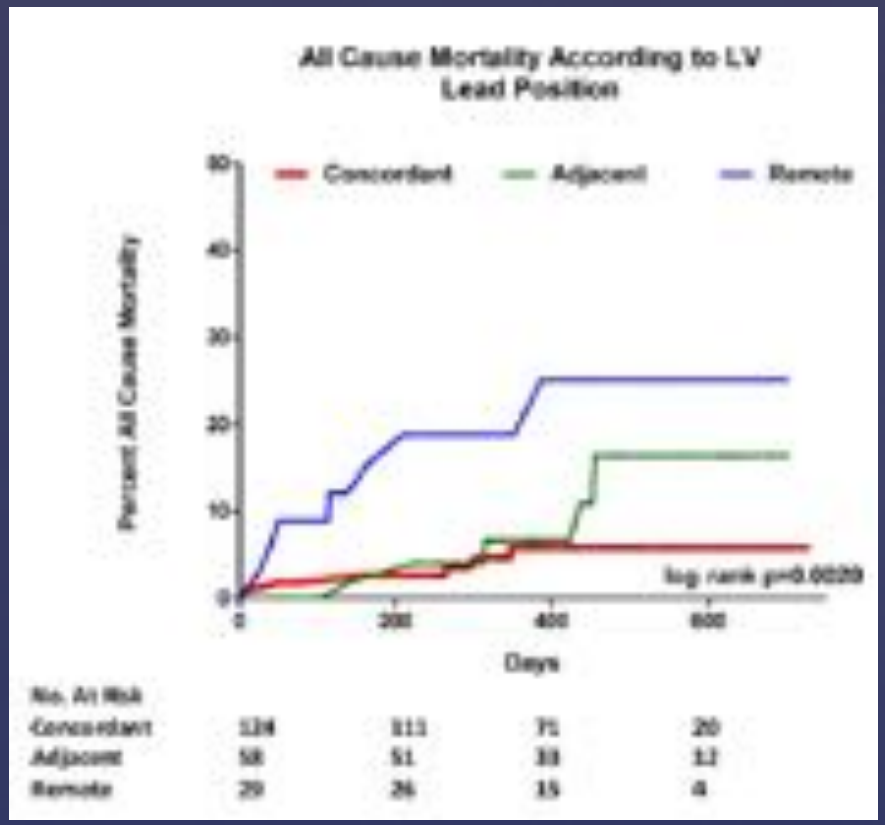


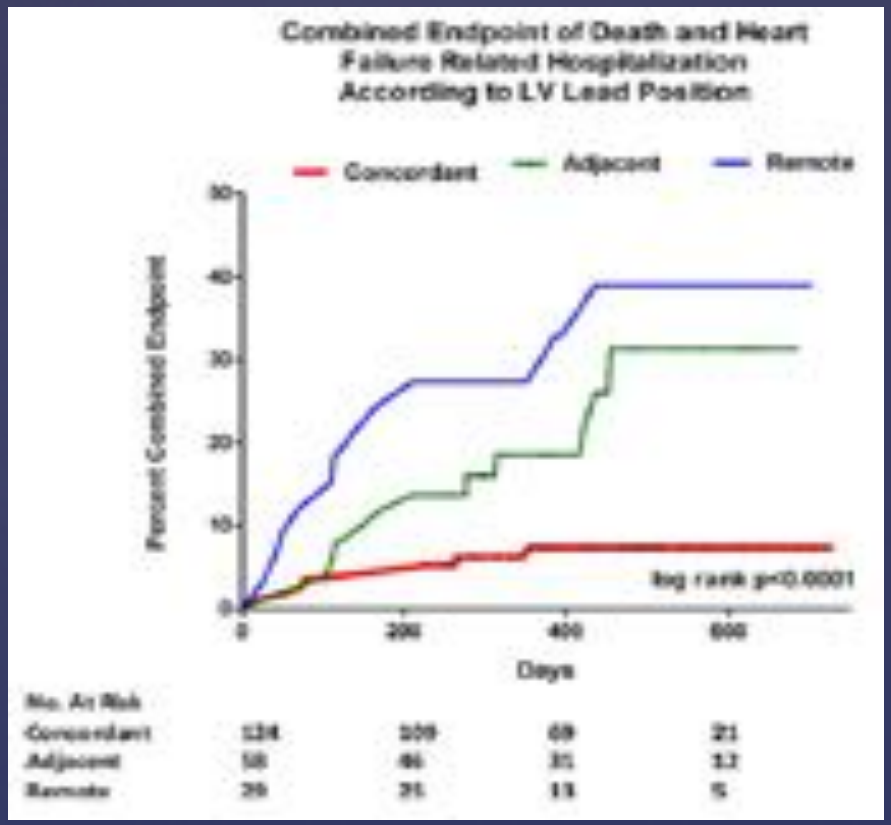


Khan et al. J Am Coll Cardiol 2012

Targeted Left Ventricular Lead Placement to Guide Cardiac Resynchronization Therapy

The TARGET Study: A Randomized, Controlled Trial

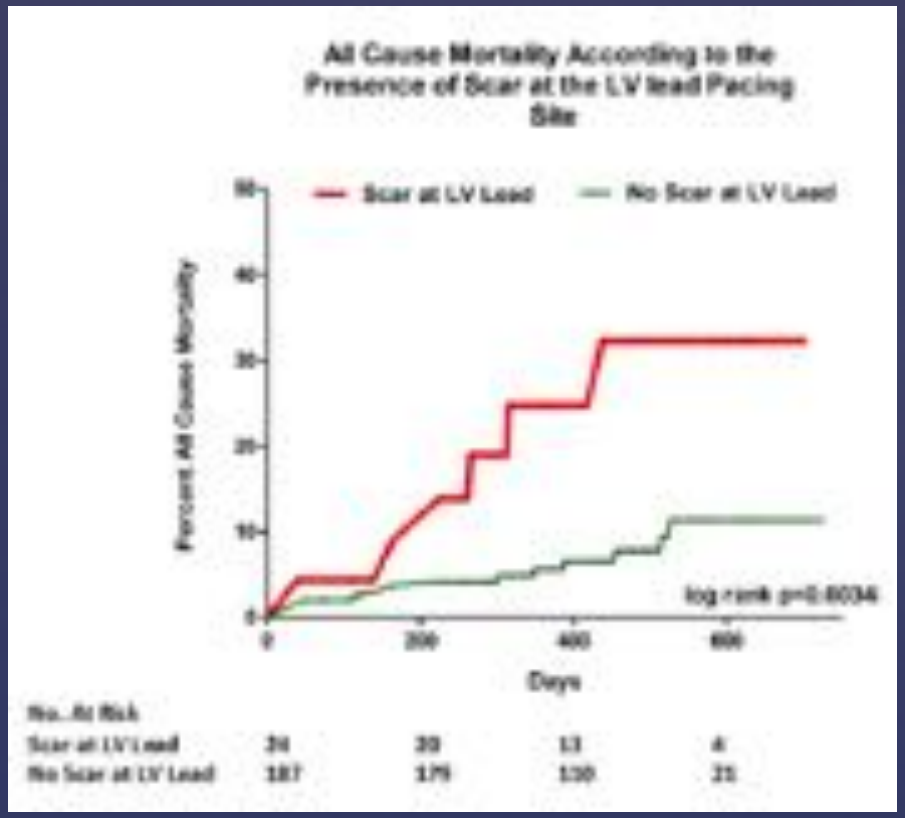


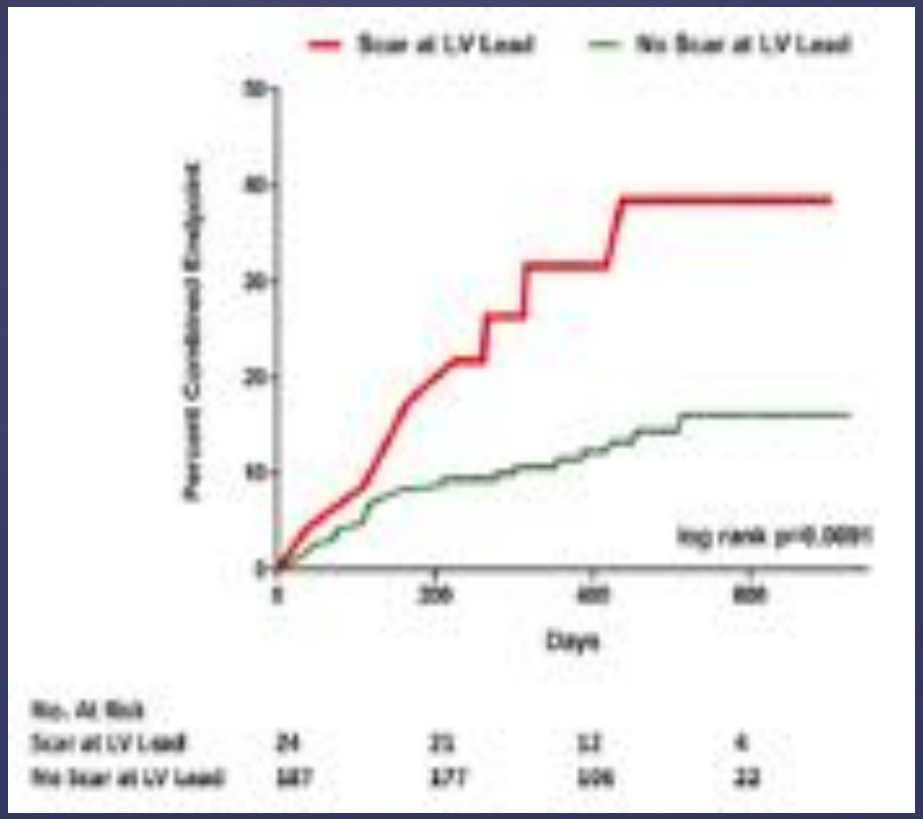


Khan et al. J Am Coll Cardiol 2012

Targeted Left Ventricular Lead Placement to Guide Cardiac Resynchronization Therapy

The TARGET Study: A Randomized, Controlled Trial

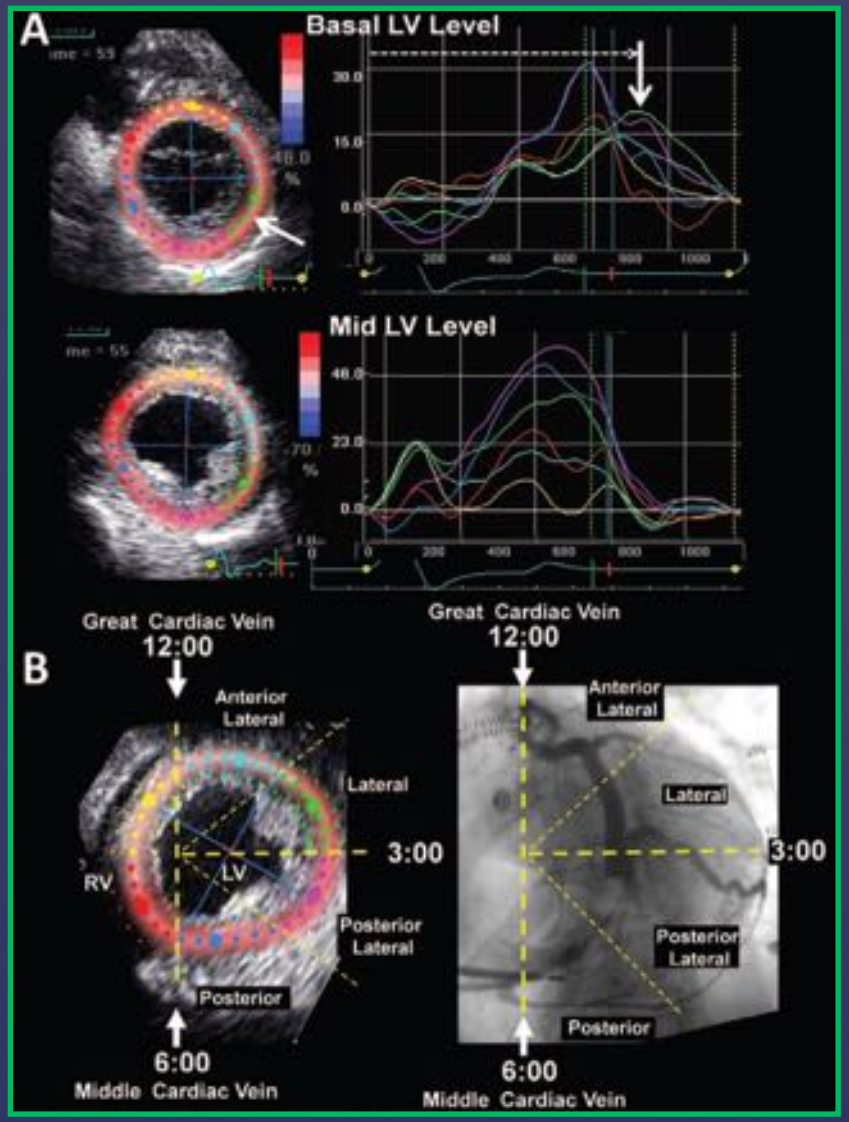




Khan et al. J Am Coll Cardiol 2012

Echocardiography-Guided Left Ventricular Lead Placement for Cardiac Resynchronization Therapy

Results of the Speckle Tracking Assisted Resynchronization Therapy for Electrode Region Trial



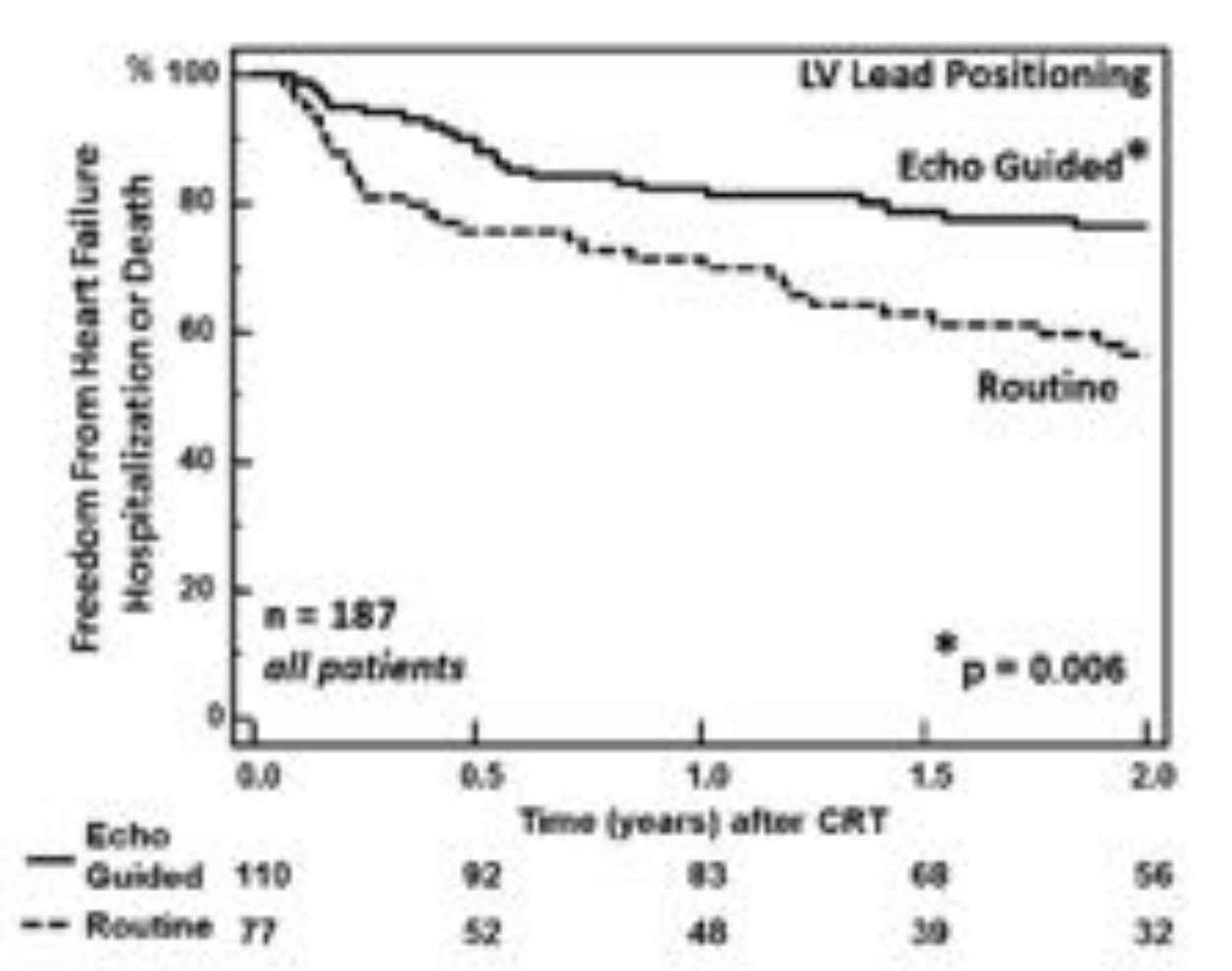
A: Short-axis echocardiography speckle tracking images (RADIAL STRAIN) at basal and mid-left ventricular (LV) levels. Site of latest mechanical activation (arrows riht top) was determined to be basal lateral (left top).

CONCORDANT LV SITE:

- echo-guided group 85%
- control group (by chance) 66% (P 0.01)

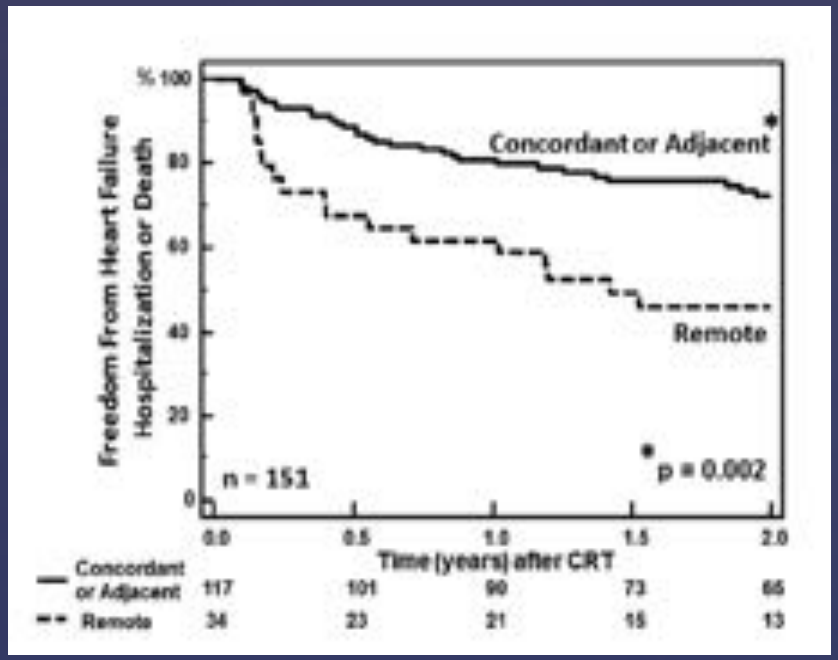
Saba et al Circ Heart Fail 2013

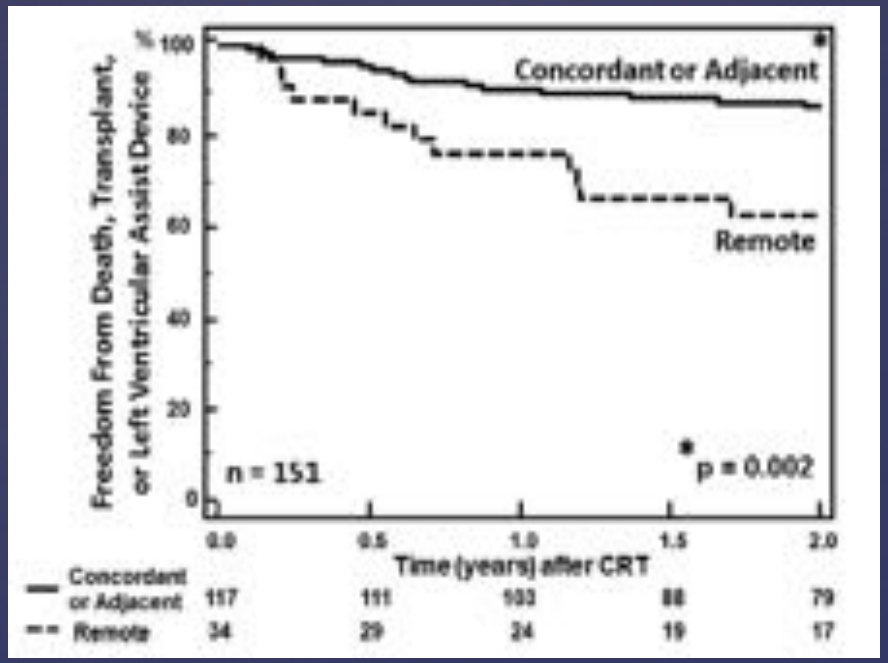
THE STARTER TRIAL



Saba et al. Circ Heart Fail 2013

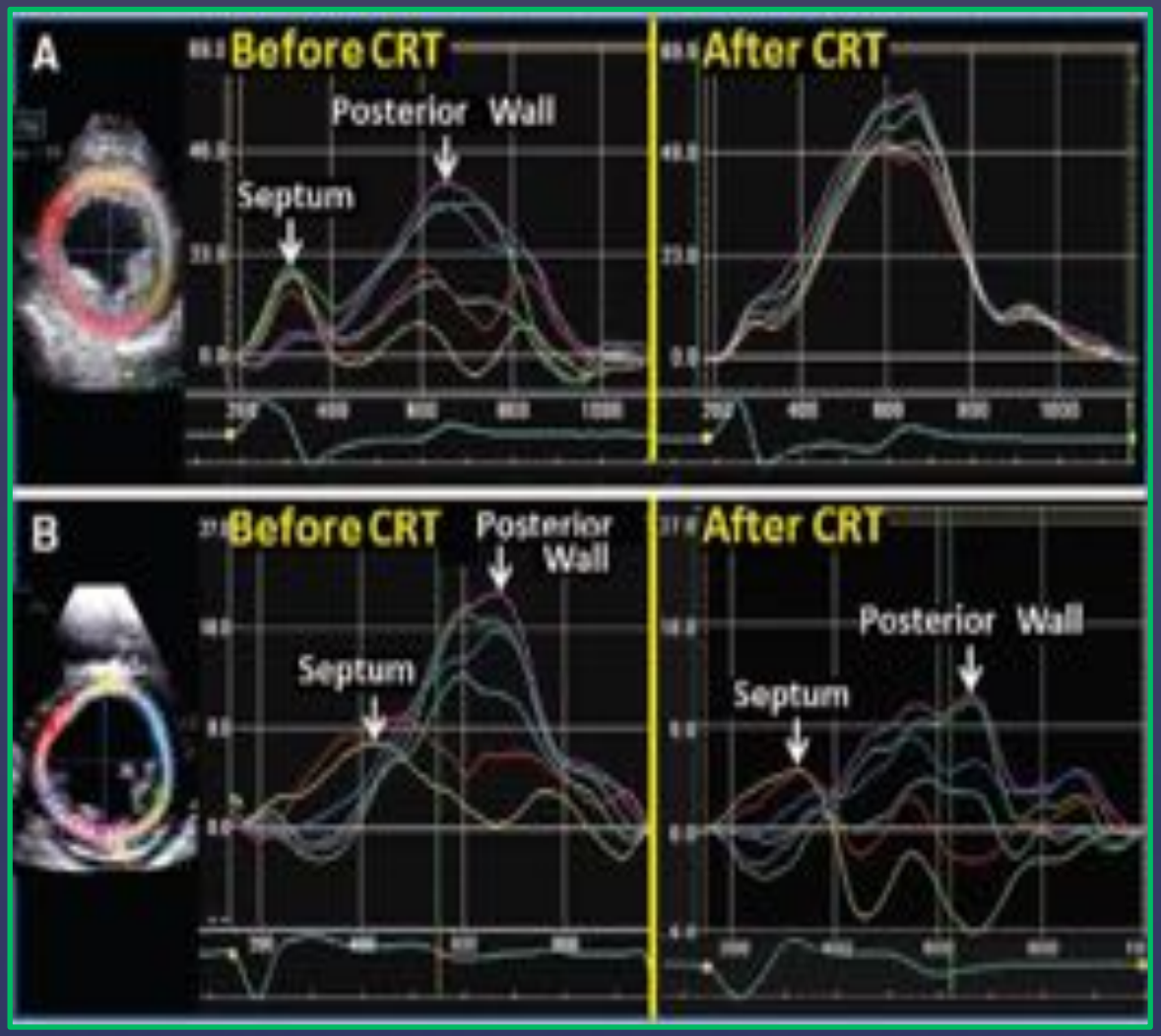
THE STARTER TRIAL





Saba et al Circ Heart Fail 2013

THE STARTER TRIAL

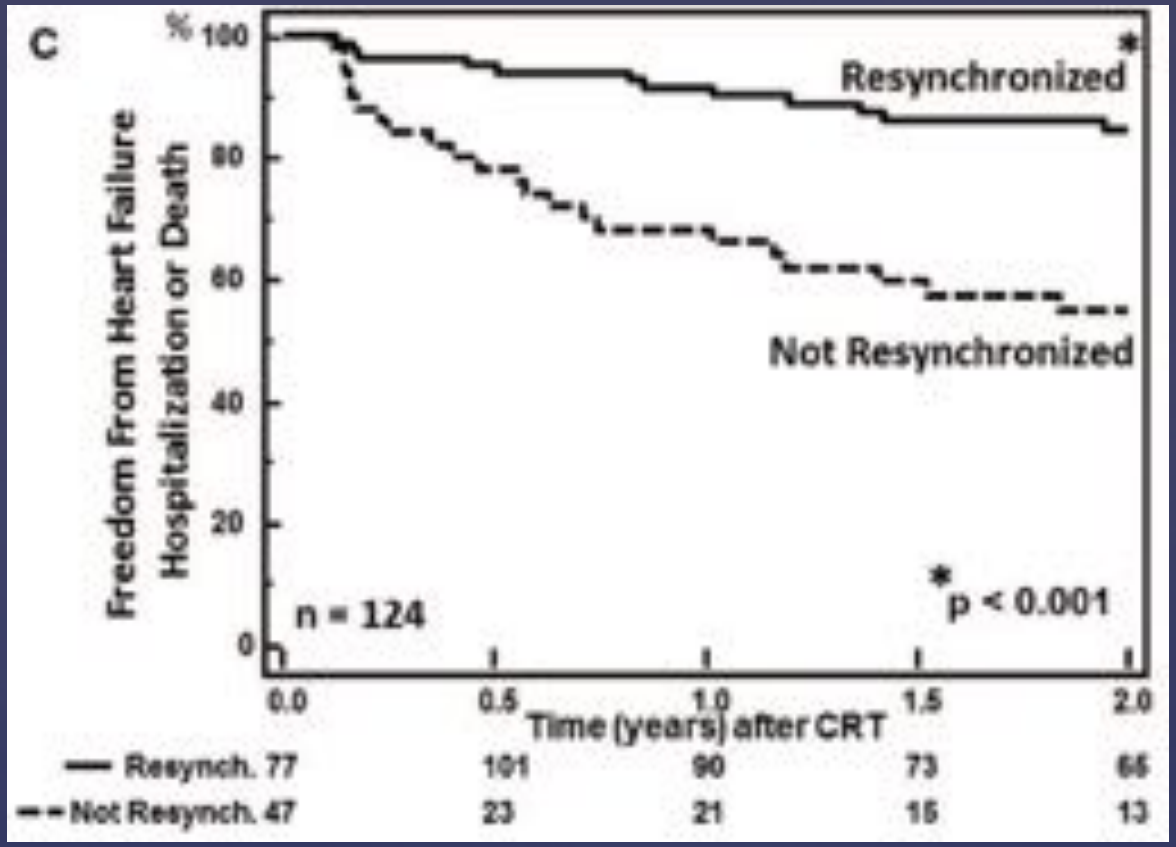


Patient A had a significant septal to posterior wall strain delay by speckle tracking echocardiography that resynchronized after CRT with a concordant left ventricular (LV) lead position

Patient B had significant dyssynchrony that failed to resynchronize after CRT with a remote LV lead position

Saba et al Circ Heart Fail 2013

THE STARTER TRIAL



Resynchronization was defined as having dyssynchrony at baseline (> 95 ms anterior to septal radial strain delay) and a > 50% reduction in dyssynchrony after CRT.

Saba et al Circ Heart Fail 2013

Limitations of speckle tracking echocardiography

- ✓ need of optimal short axis alignment
- ✓ need of good acoustic window, high frame-rate images and high quality ECG trace
- ✓ requirement of a dedicated software
- ✓ requirement of off-line imaging processing
- ✓ lack of absolute consensus on best parameter (radial vs longitudinal vs circumferential strain) and cut-offs
- ✓ LV lead implantation at the most delayed site is not always possible because of technical issues (not suitable anathomy, high threshold, high likelihood of dislodgment, phrenic nerve stimulation, etc…)

Conclusions

- ✓ Tailored LV-lead position impacts patients reponse to CRT.
- ✓ Although significant LV reverse remodeling and favourable clinical outcome was demonstrated after CRT regardless of LV lead site, the preponderance of available data support the hypotesis of the importance of proper LV lead position to optimize clinical outcomes.
- ✓ Speckle tracking echocardiography allows detection of myocardial viability as well as assessment of the site of latest mechanical activation.
- ✓ In 2 RCTs the strategy of echocardiographic guidance to LV lead placement was proved superior to a routine approach in CRT device implantation in terms of major clinical outcomes as well as degree of LV reverse remodeling.

Thank you for your attention