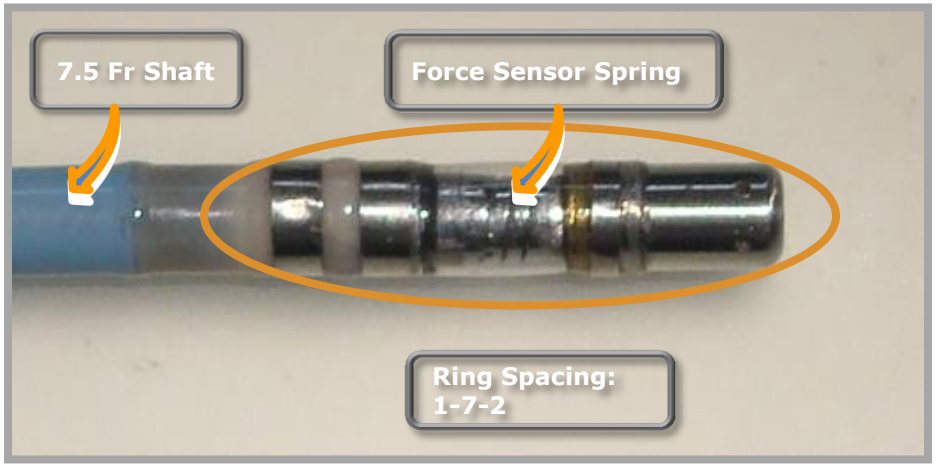
Contact force sensing- do the numbers matter?

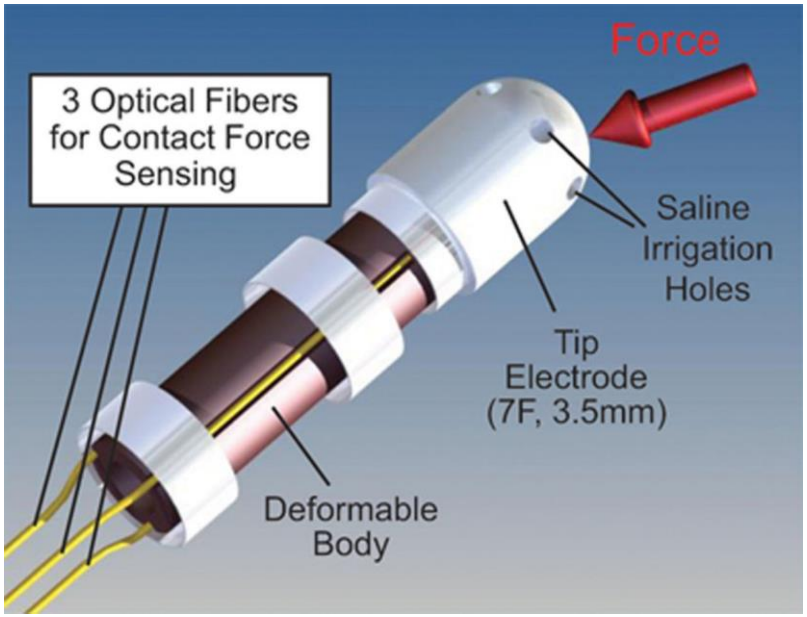
Mark Hall

Liverpool Heart and Chest Hospital



Smart Touch (Biosense Webster)

Tacticath (St Jude Medical)



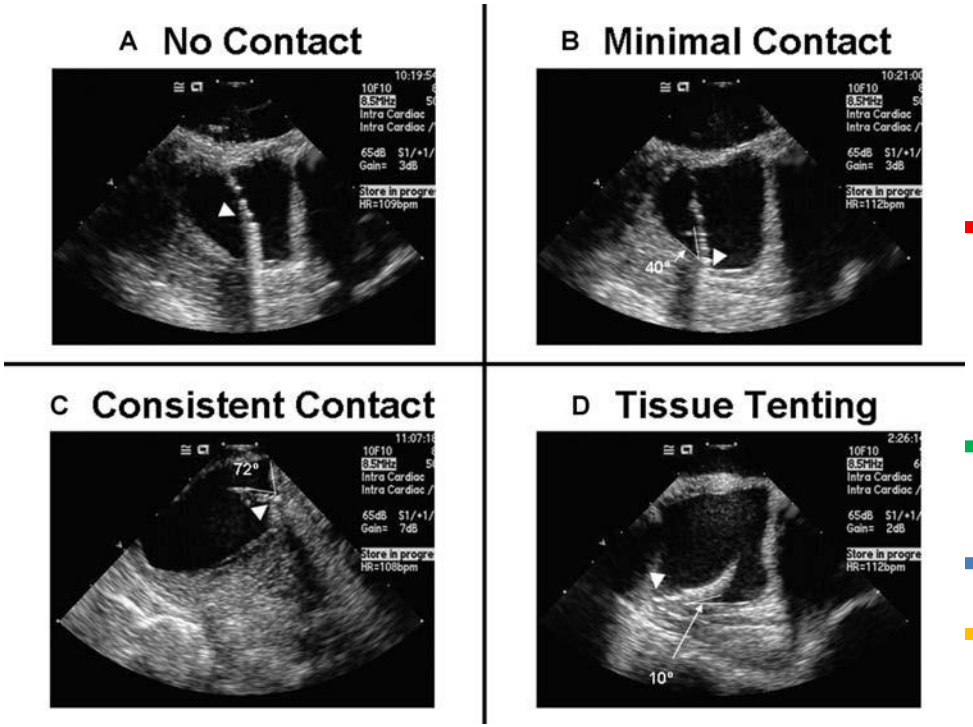
Why is contact force so important in VT ablation?

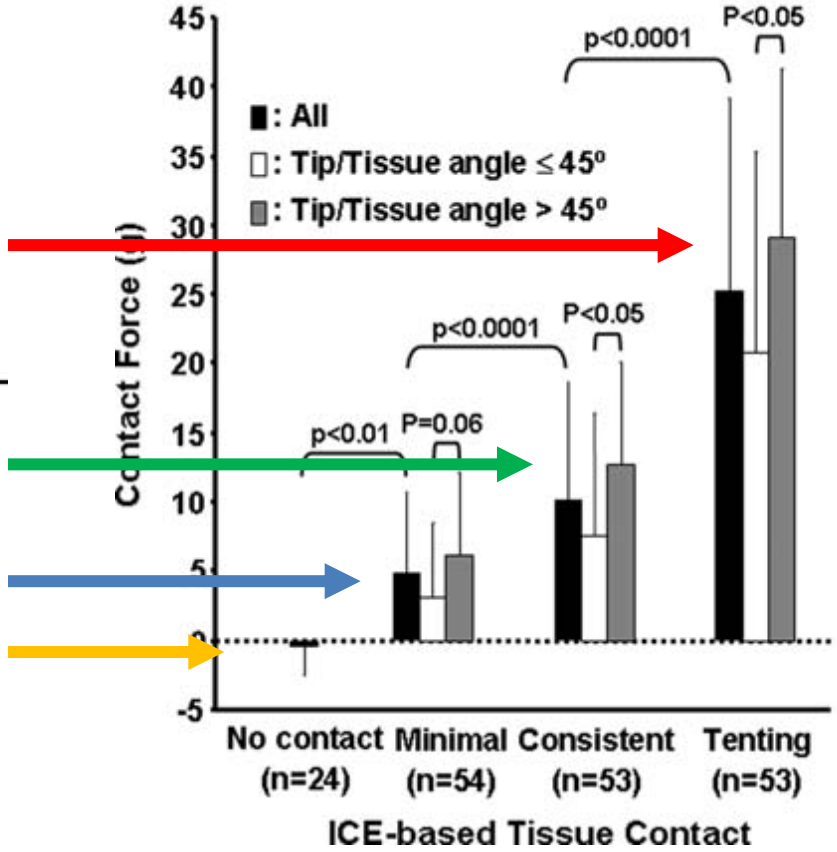
- Differentiation between scar and poor contact in large ventricles

- Good contact is needed to create ablation lesions which are
  - Deep
  - Transmural
  - Contiguous

How much contact force do I need to make a good map?

Using ICE to validate tissue contact in canine ventricle





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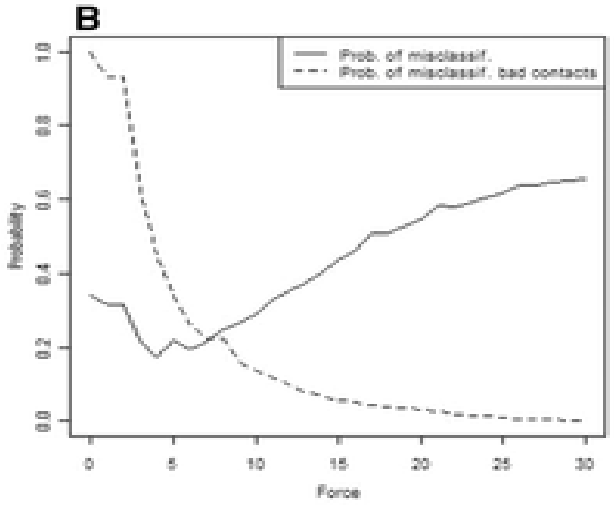
Okumura et al Journal of Cardiovascular Electrophysiology
Volume 19, Issue 6, pages 632-640, 28 JUN 2008 DOI: 10.1111/j.1540-8167.2008.01135.x

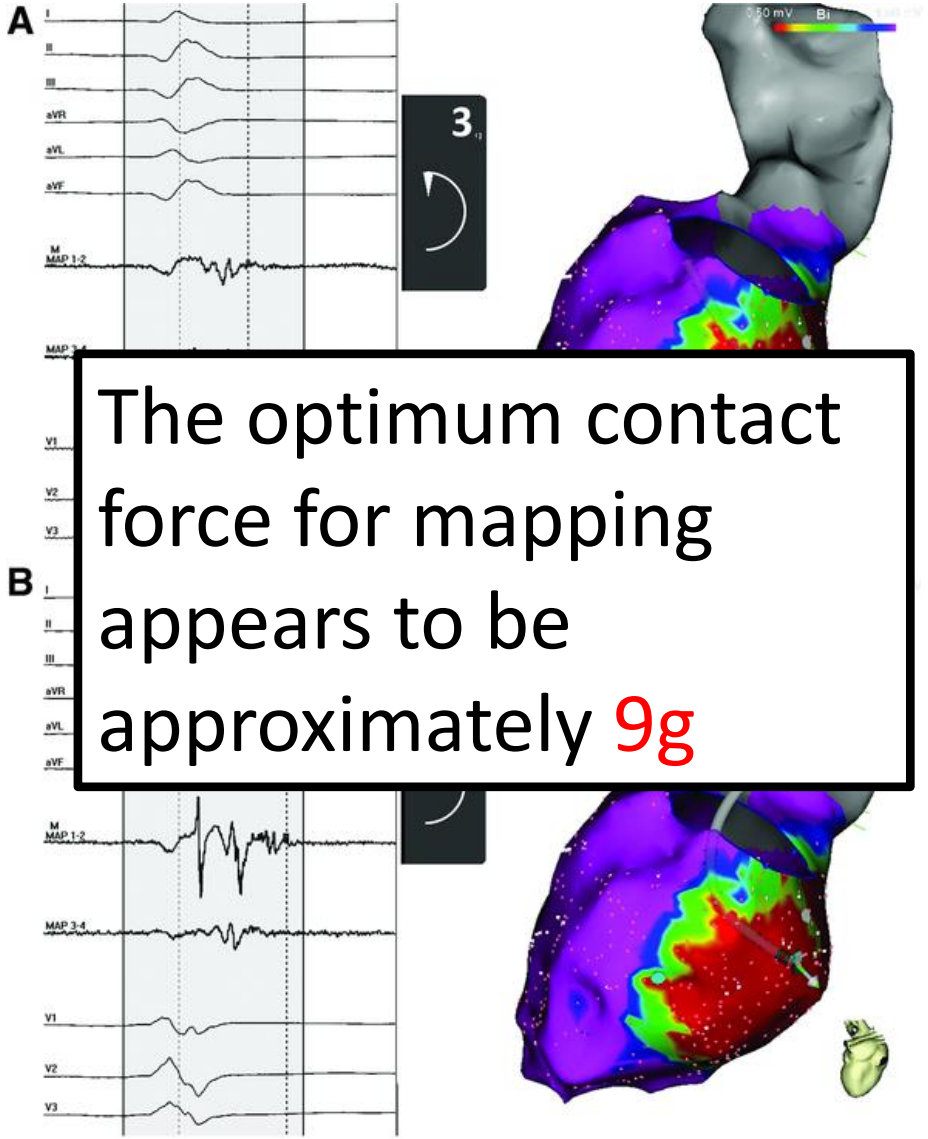
Poor contact force equates to

- Overestimation of scar size
- Missed complex electrograms

Too much contact force leads to distortion of the map



Left Ventricle			
CF cut-off	sensitivity	specificity	AUC
8 grams	0,74	0,82	0.8289



The optimum contact force for mapping appears to be approximately 9g

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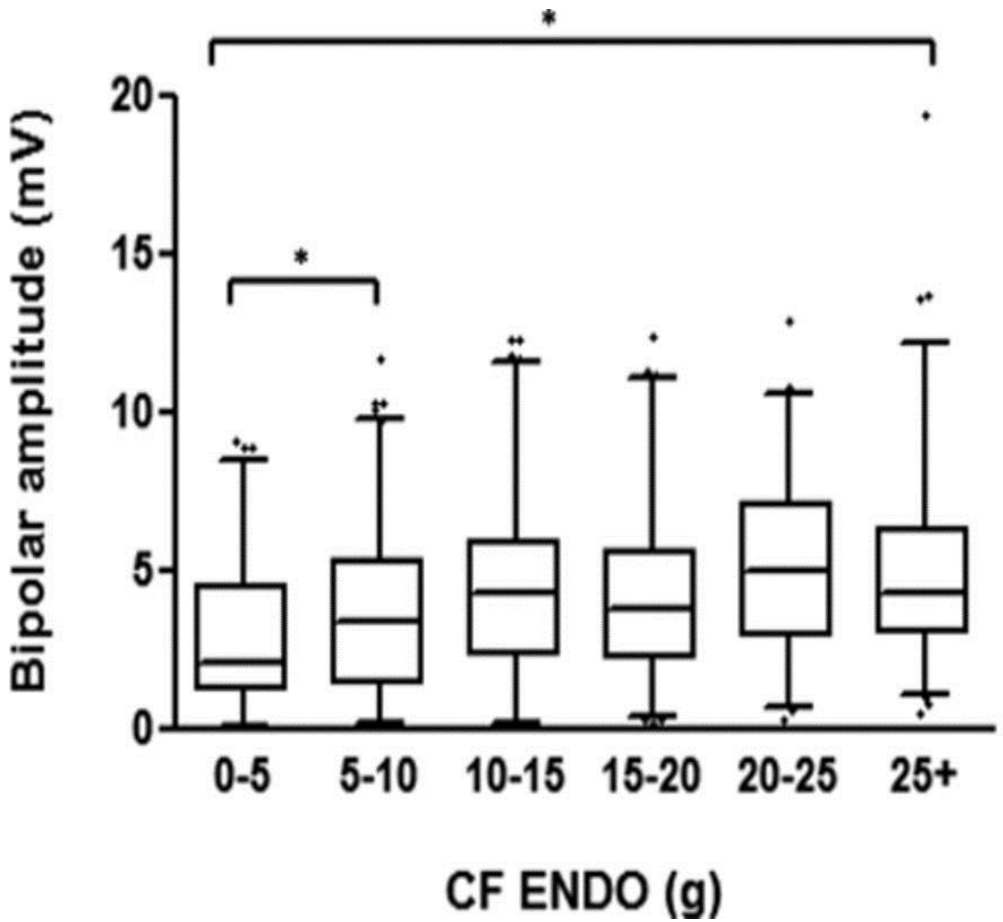
Mizuno et al Journal of Cardiovascular Electrophysiology
Volume 24, Issue 5, pages 519-524, 1 FEB 2013 DOI: 10.1111/jce.12080

Corroborating data

- Haisaguerre's group using Smart Touch system
- In force range 0-10g the bipolar signal amplitude gets bigger with better contact force
- The best CF value for detecting a signal over 1.5mV is
  - 7g in LV
  - 9g in RV
  - 4g in epicardium



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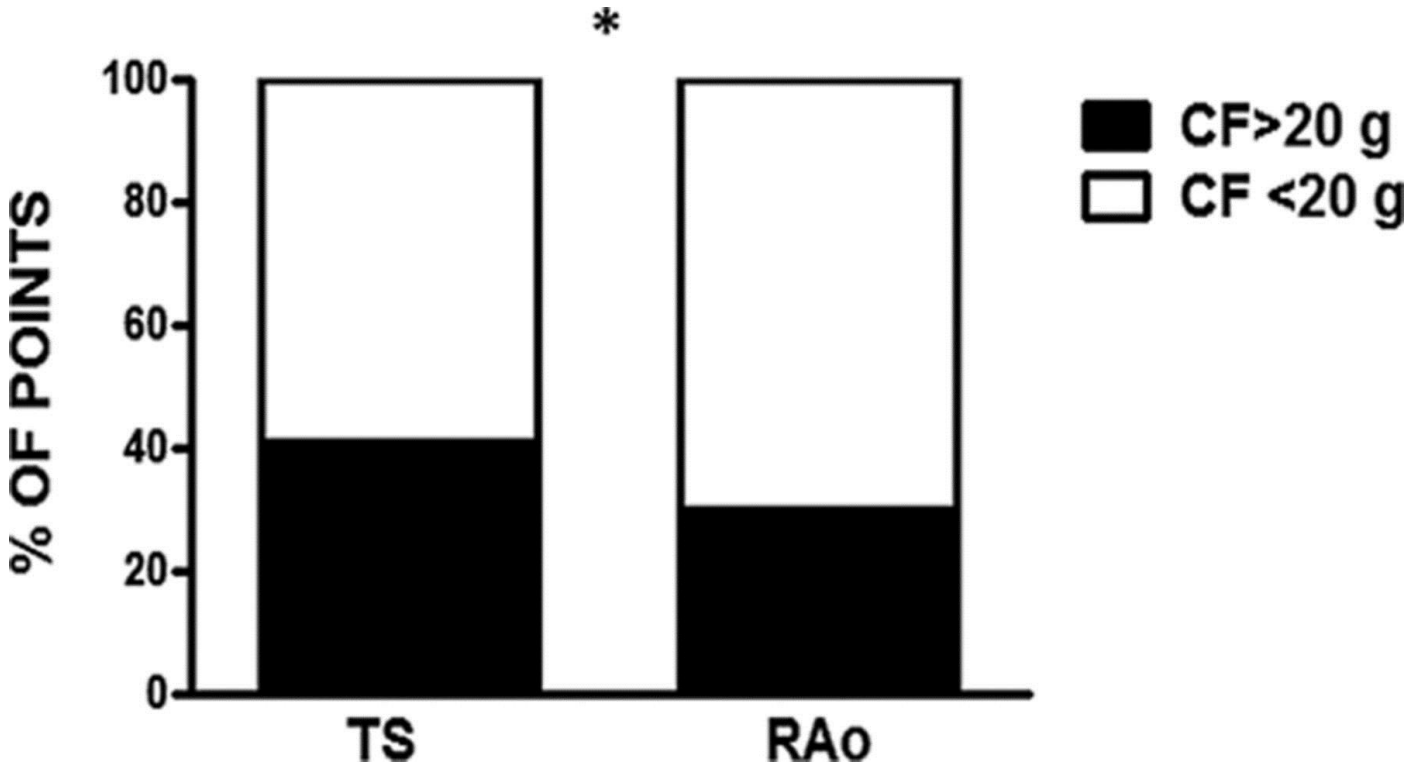
It’s a little harder to get good contact force from a retrograde aortic approach



Percentage (%) of endocardial left ventricular points with contact force (CF) >20 g according to the left ventricular approach, *P<0.01.

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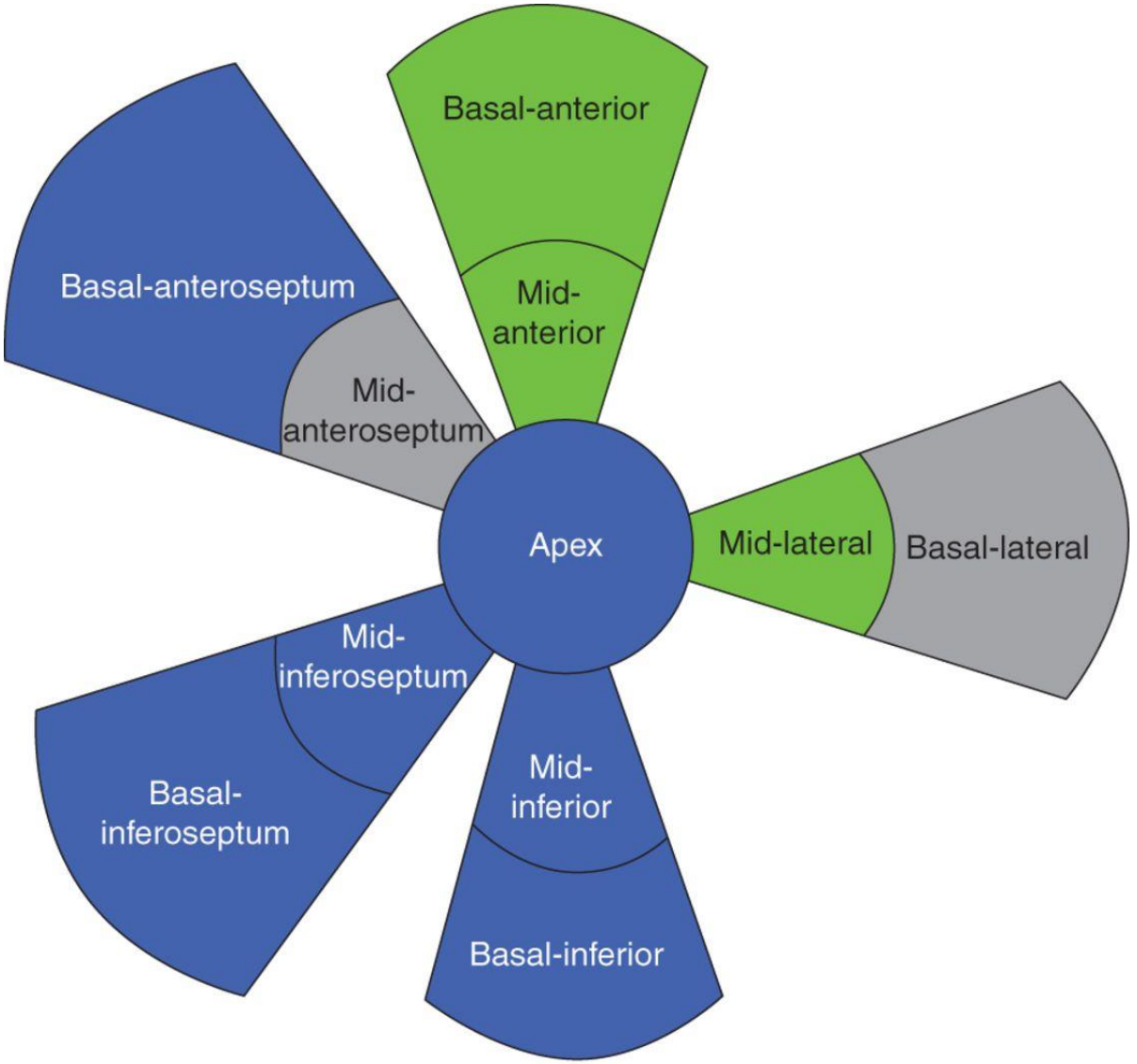

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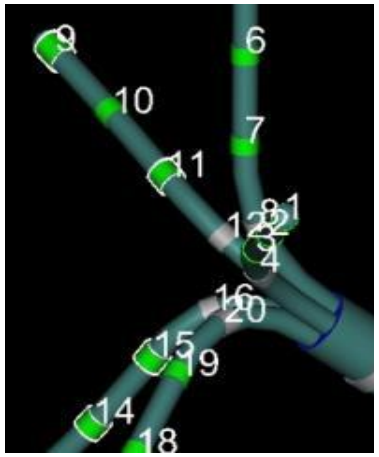
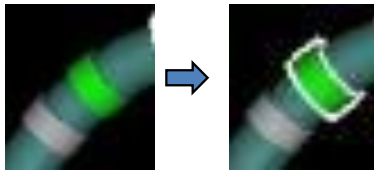
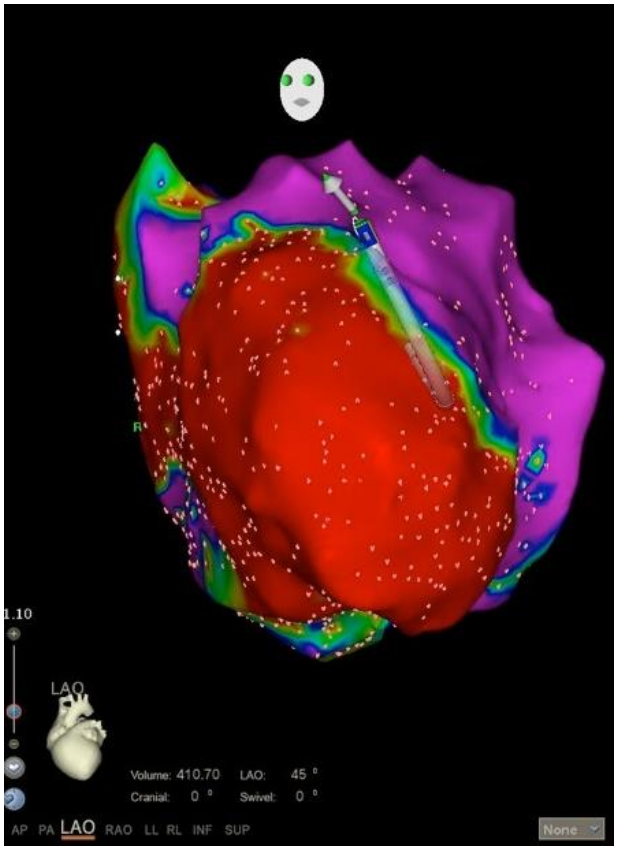
Roland Richard Tilz et al. Europace 2014;16:1387-1395

How do we reconcile the need to map with good contact force with the use of multi-electrode mapping catheters?

Is impedance enough?



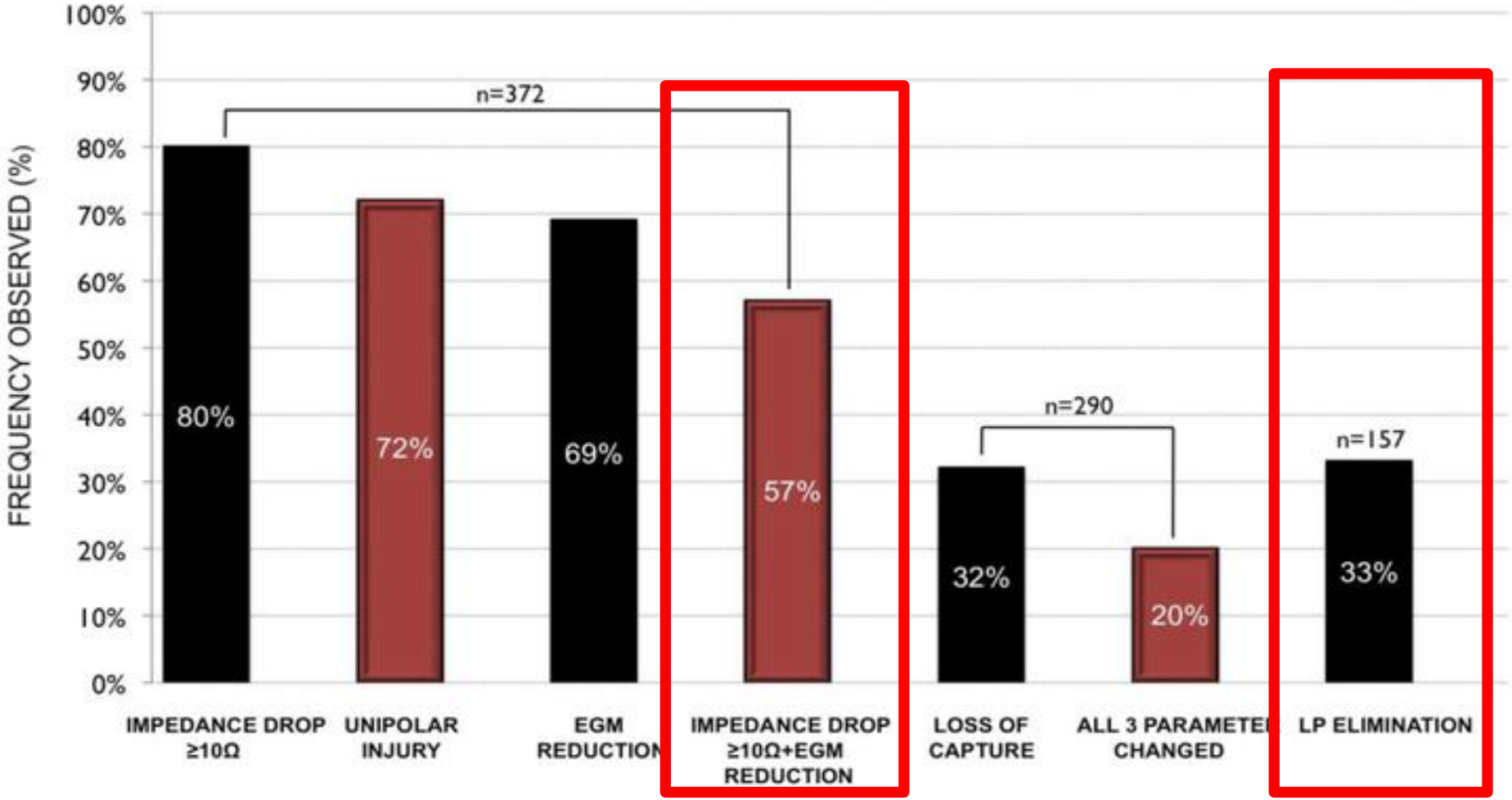




Is this scar as homogenous at it looks?

How much contact force do I need to make a good lesion?

How good are we at ablating in the ventricle?



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Bourke et al Journal of Cardiovascular Electrophysiology
Volume 25, Issue 11, pages 1165-1173, 24 JUL 2014 DOI: 10.1111/jce.12477

Is it because ablating scar is difficult?

Canine infarct model
Needle electrode ablation

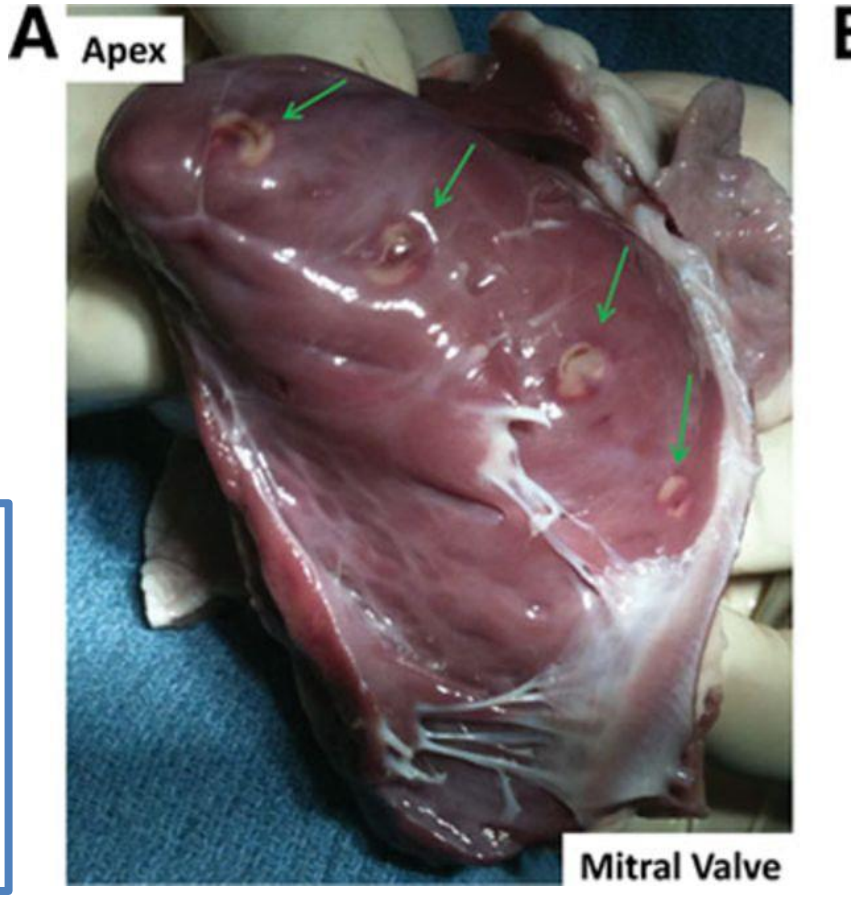
	Normal	Patchy Scar	Scar
Lesion Width	6.3 ± 1	6.4 ± 1 (ns)	6.4 ± 1 (ns)
Lesion Depth	7.0 ± 1	6.5 ± 1 (ns)	6.5 ± 1 (ns)

Scar itself does not affect lesion size as long as catheter position is stable

KOVOOR, P et al (2006), Comparison of Radiofrequency Ablation in Normal Versus Scarred Myocardium. Journal of Cardiovascular Electrophysiology, 17: 80–86.

Does operator experience help?

- Tacticath system, canine model
- Experienced operators
- Lesions with and without contact force



22% of RF applications without CF led to no lesion formation at all

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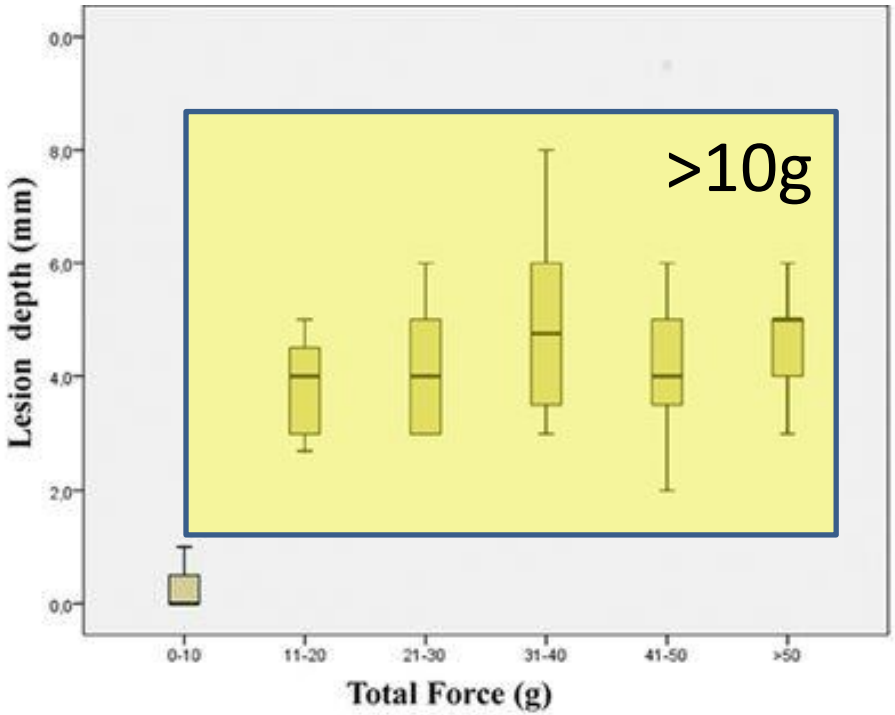
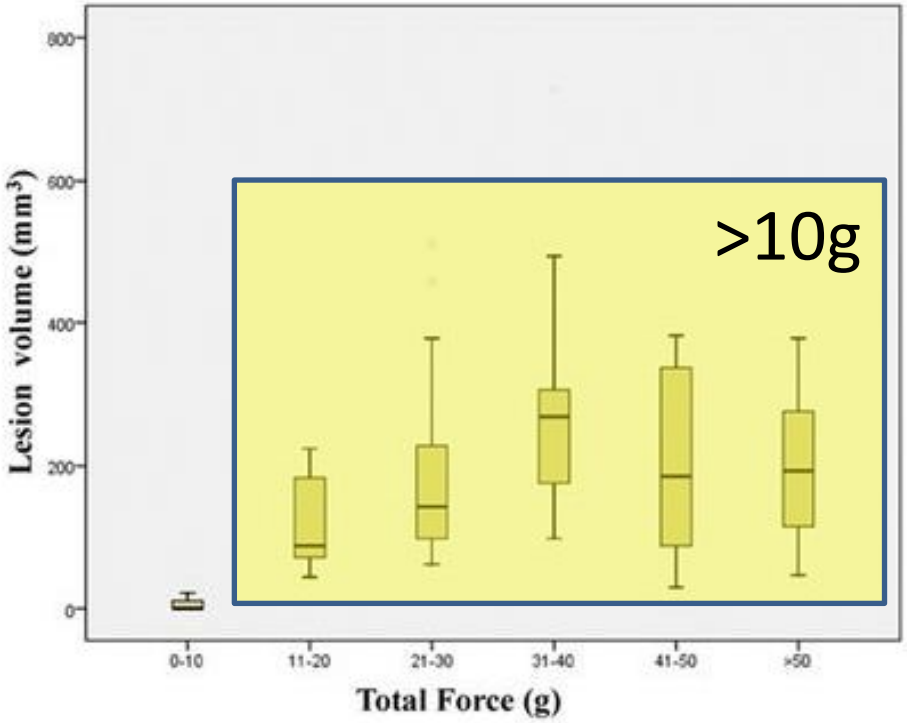
How much contact force is needed to make a good ablation?





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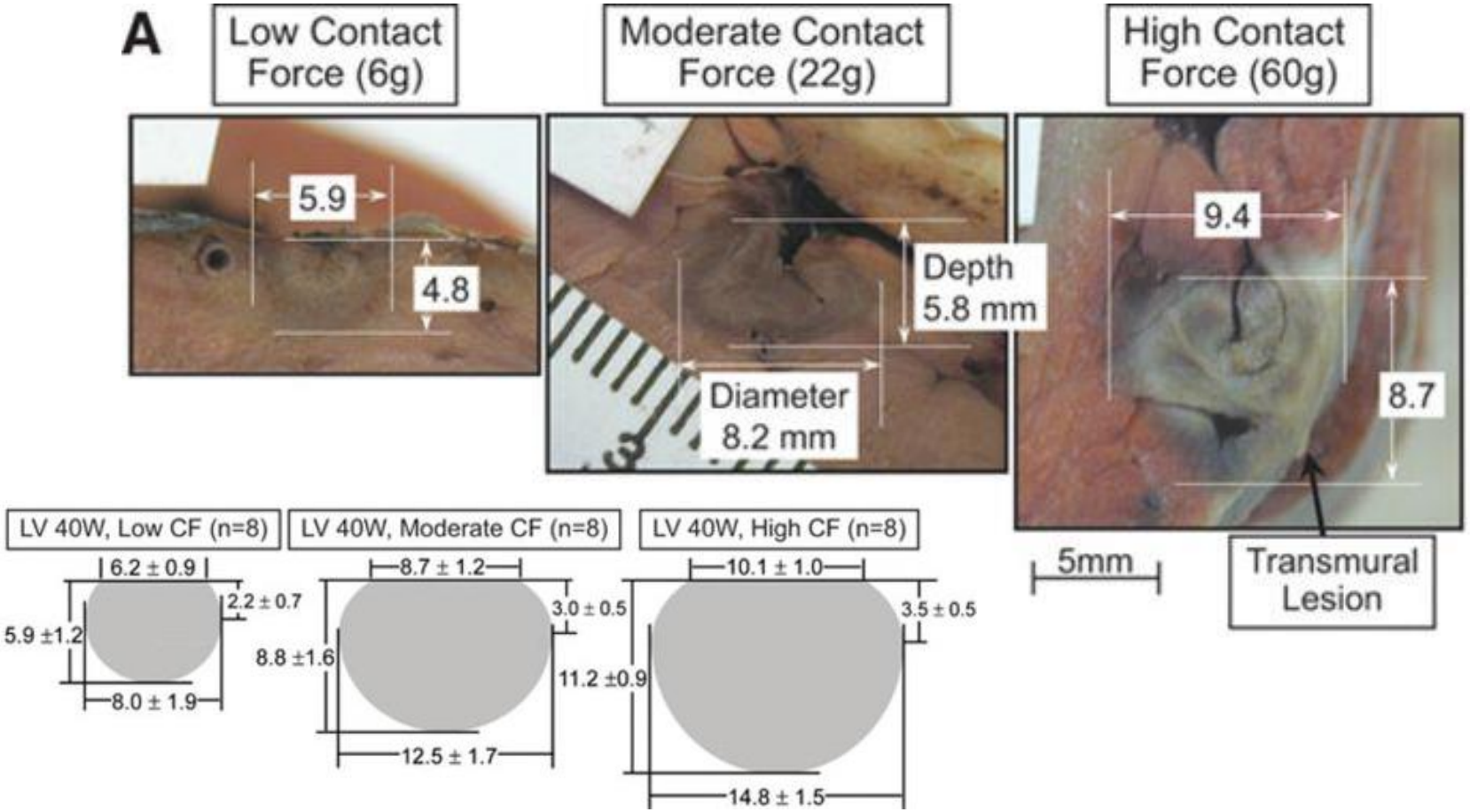
Less than 10g seems to be bad

	<10g	10-20g	>20g
Lesion width (mm)	3.5 ± 1.9	4.7 ± 4.6*	4.6 ± 2.3
Lesion depth (mm)	4.4 ±2.6	6.1 ± 2.2*	5.9 ± 2.9
% Transmurality	64 ± 38	92 ± 23*	85 ± 35*
Volume (mm^3)	40 ± 42	98 ± 69*	89 ± 70*

Okumura et al Journal of Cardiovascular Electrophysiology
Volume 19, Issue 6, pages 632-640, 28 JUN 2008 DOI: 10.1111/j.1540-8

Is there an upper limit?



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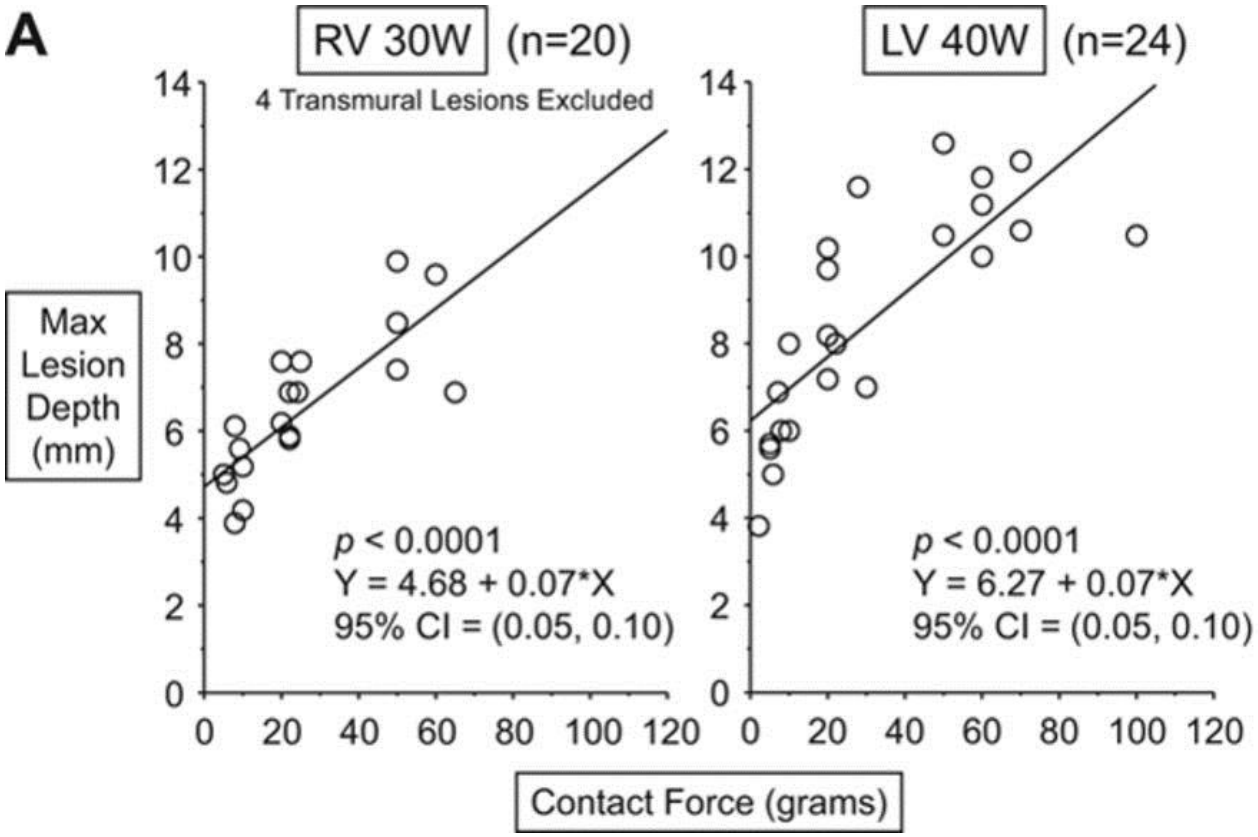
Is there an upper limit?



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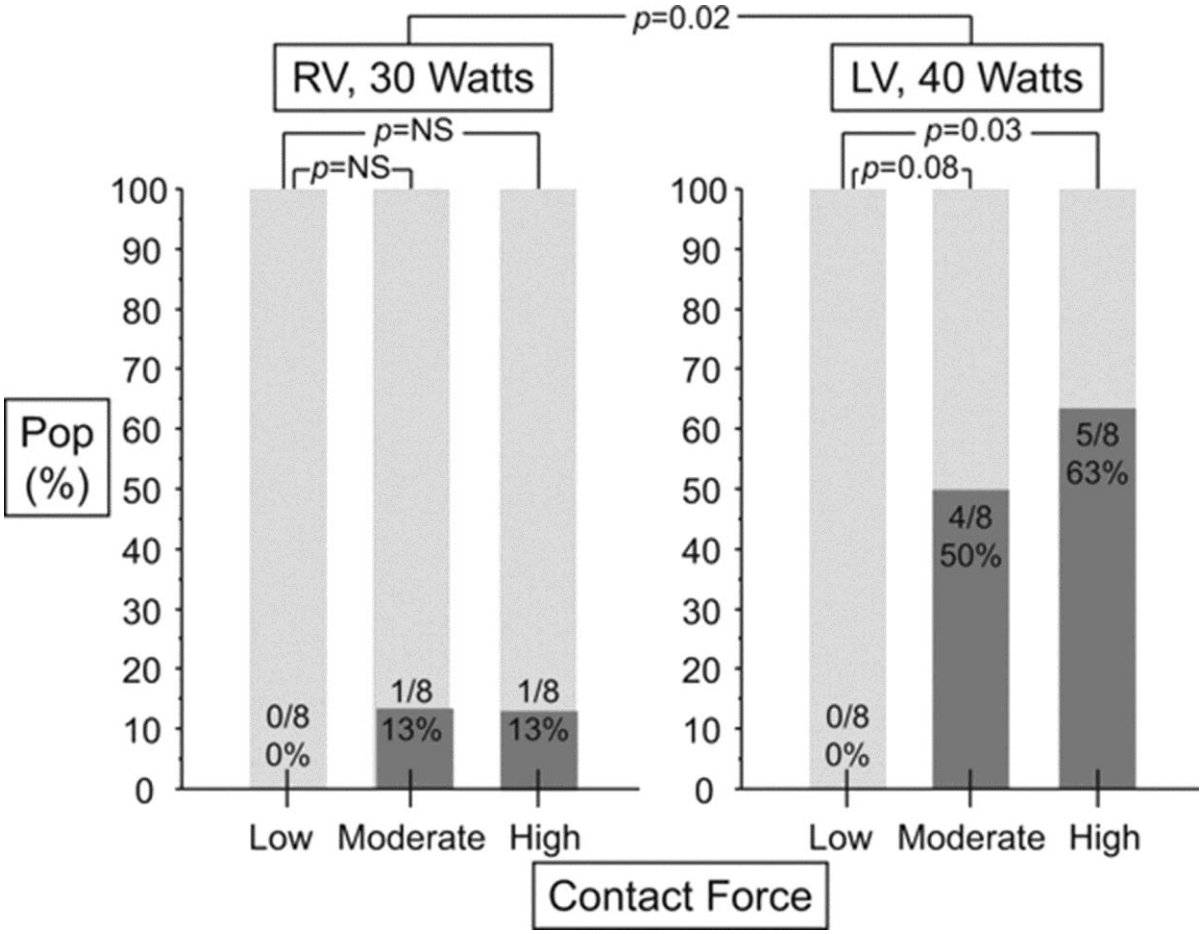
Steam pops with high contact force



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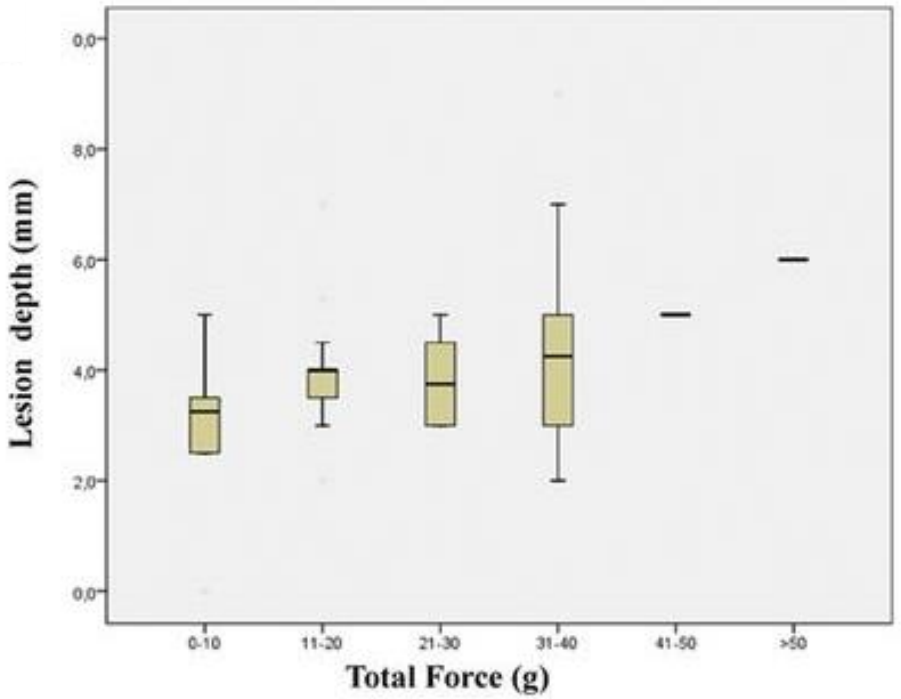
What about epicardial mapping and ablation?

Optimal epicardial contact force

- For mapping
  - Mizuno 8g
  - Jesel 4g
- For ablation
  - CF values don't seem to matter as much



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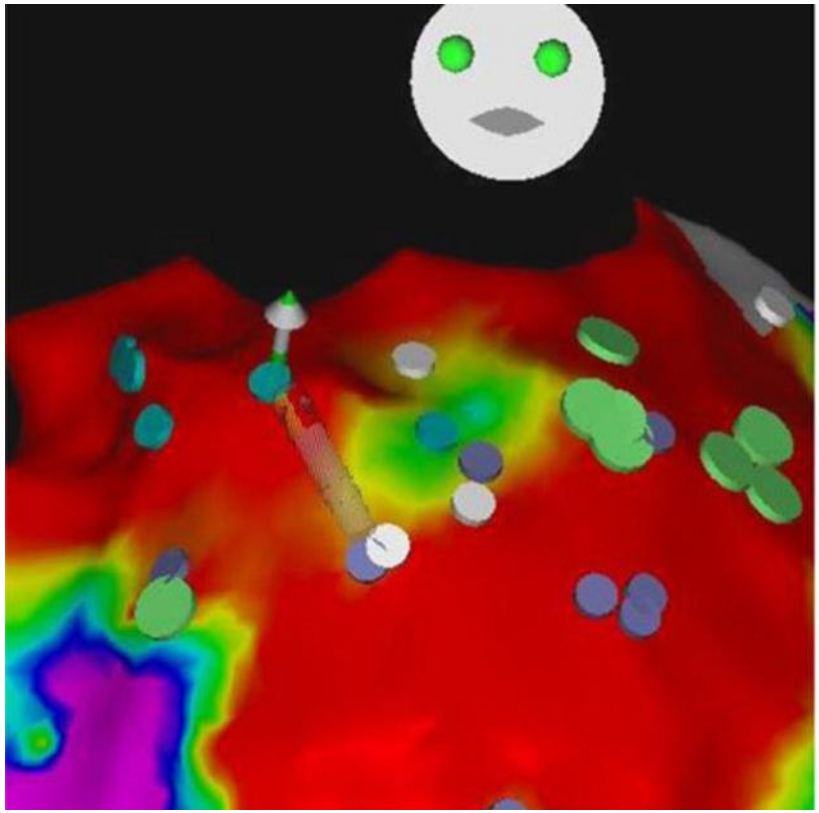
Laurence Jesel et al. Circ Arrhythm Electrophysiol. 2014;7:1168-1173
Frederic Sacher et al. Circ Arrhythm Electrophysiol. 2013;6:144-150

Epicardial mapping and ablation-orientation is more important than force



EPICARDIAL REGIONS	CF when VO is adequate (g)	Percentage of adequate vectors (%)	CF when VO is inadequate (g)
AA	6 (4-12)	43	13 (10-21)
BA	9 (5-14)	50	14 (9-22)
ALV	6 (4-16)	20	19 (12-27)
BLV	7 (4-15)	31	20 (14-26)
AI	6 (4-10)	39	17 (11-25)
BI	8 (5-13)	52	17 (11-25)
ARV	5 (3-13)	44	13 (9-19)
BRV	9 (4-12)	69	12 (9-17)

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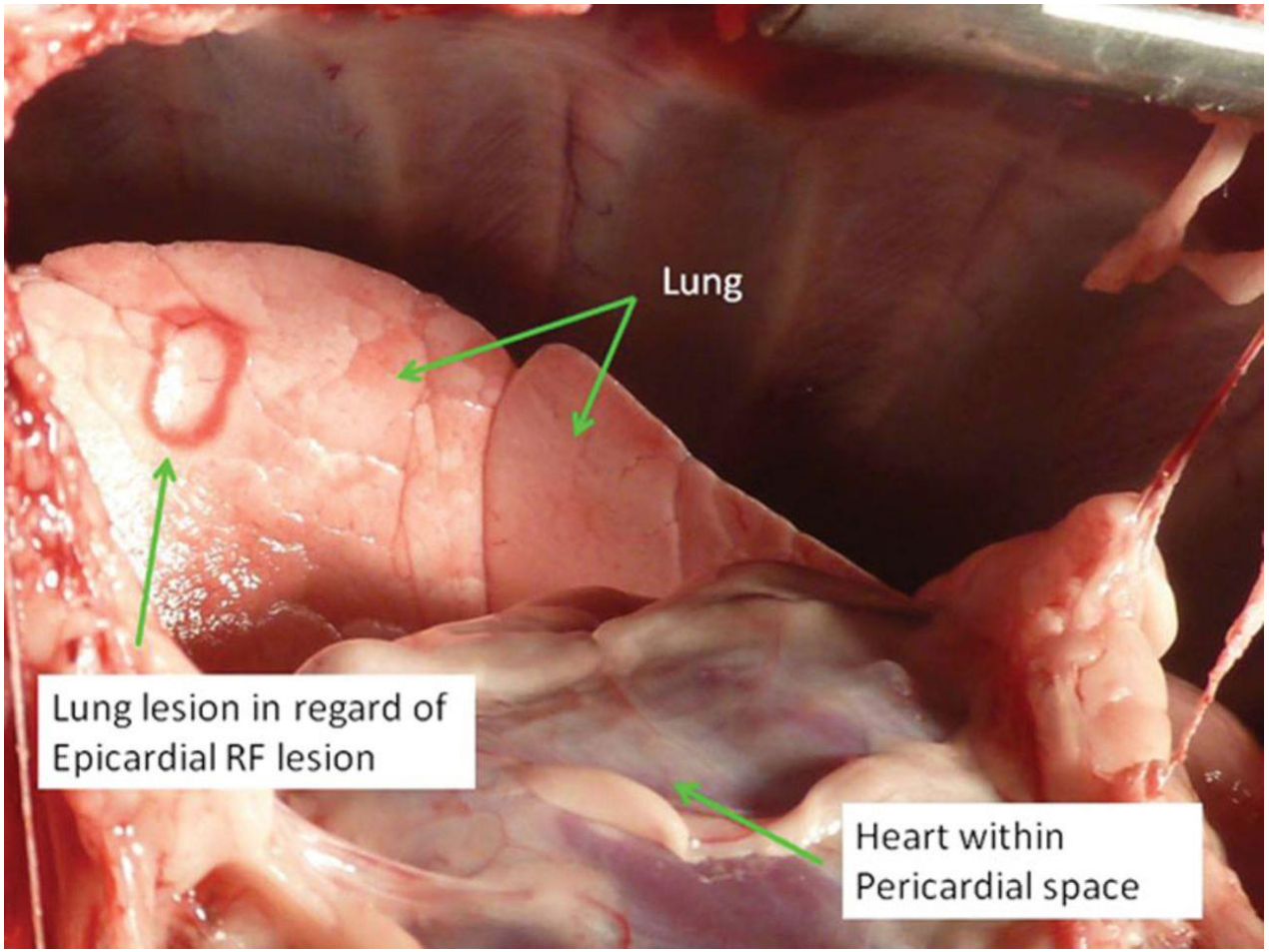
Collateral damage during epicardial ablation



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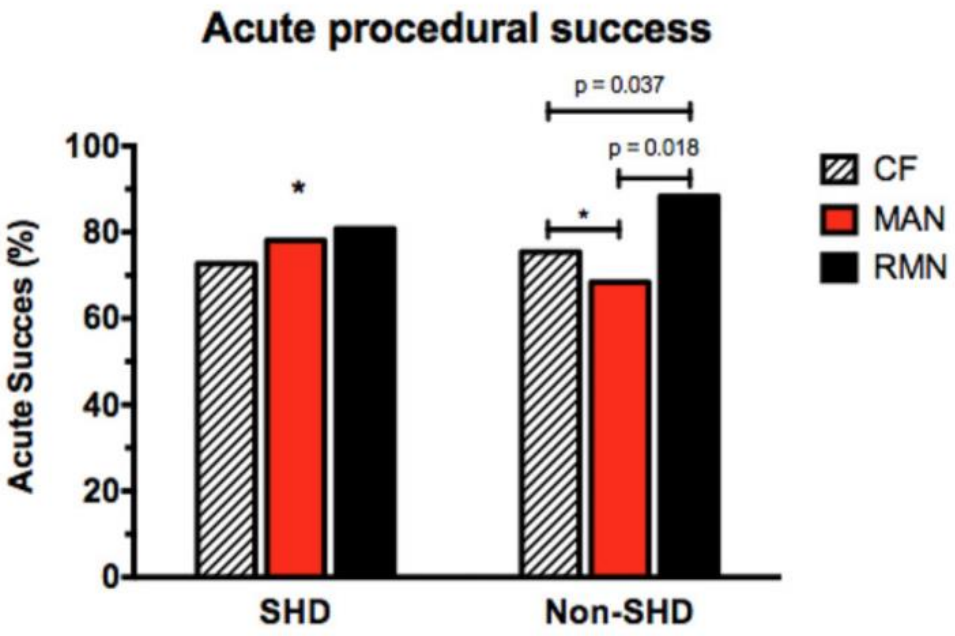
Does using contact force make a difference in terms of clinical outcomes for VT ablation?

- Hendriks *et al*
- 239 patients
- Non-randomised
- Compared
  - Conventional (112)
  - Contact force (41)
  - Remote magnetic navigation (86)



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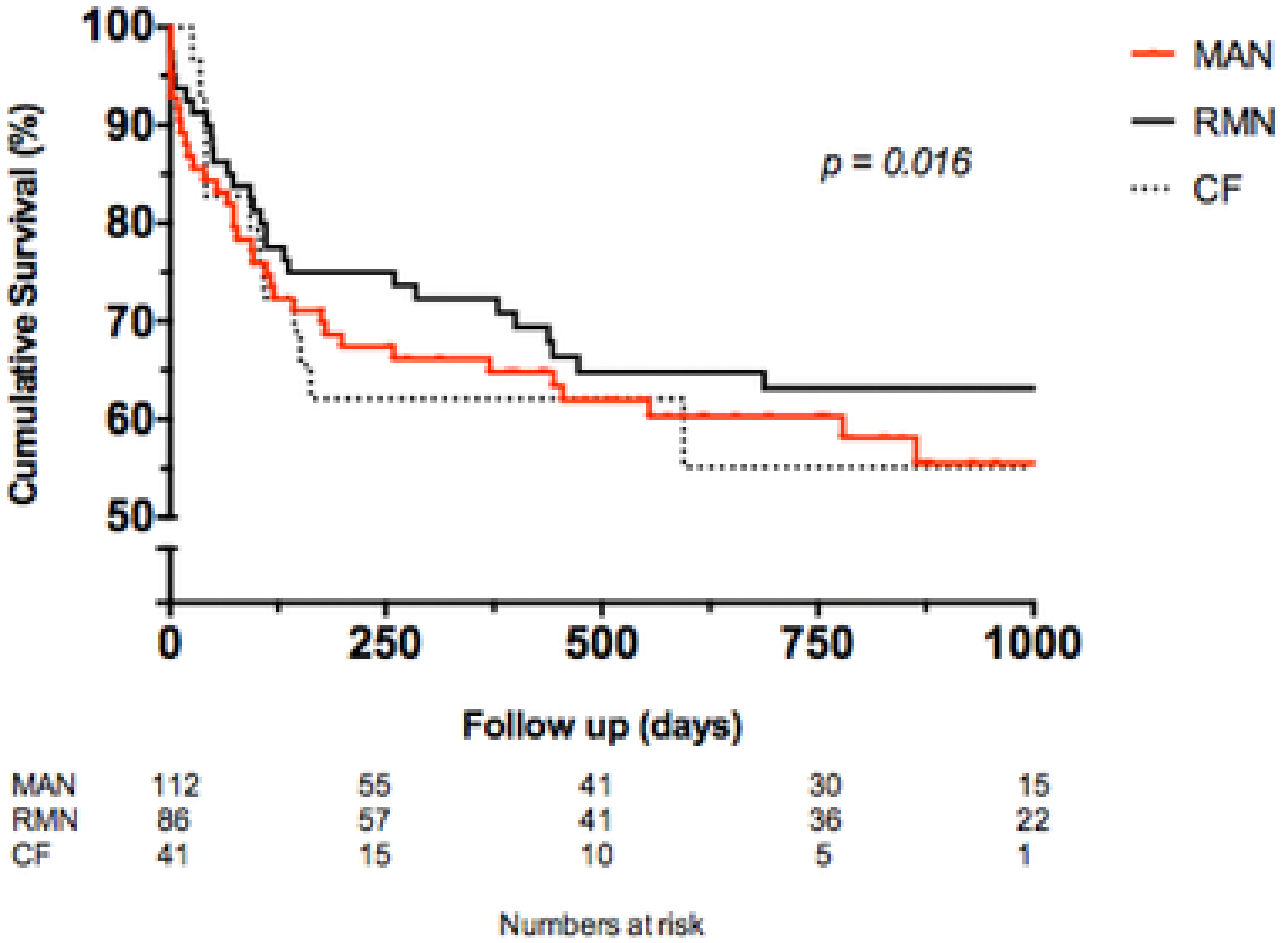
Hendriks et al JCE 2015;26:1224

Recurrence-free survival



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Hendriks et al JCE 2015;26:1224

Conclusion

- For mapping
  - 8-10g CF allows reliable identification of healthy myocardium and late potentials/ LAVAs
- For ablation
  - Less than 10g results in inadequate lesion formation
  - More than 60g results in a lot of steam pops
  - Epicardially orientation is more important than force
  - Contact force has not yet been shown to impact on outcomes