TRI cons

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Contents

1. **Radiation exposure**

2. Learning curve

3. Anatomical consideration

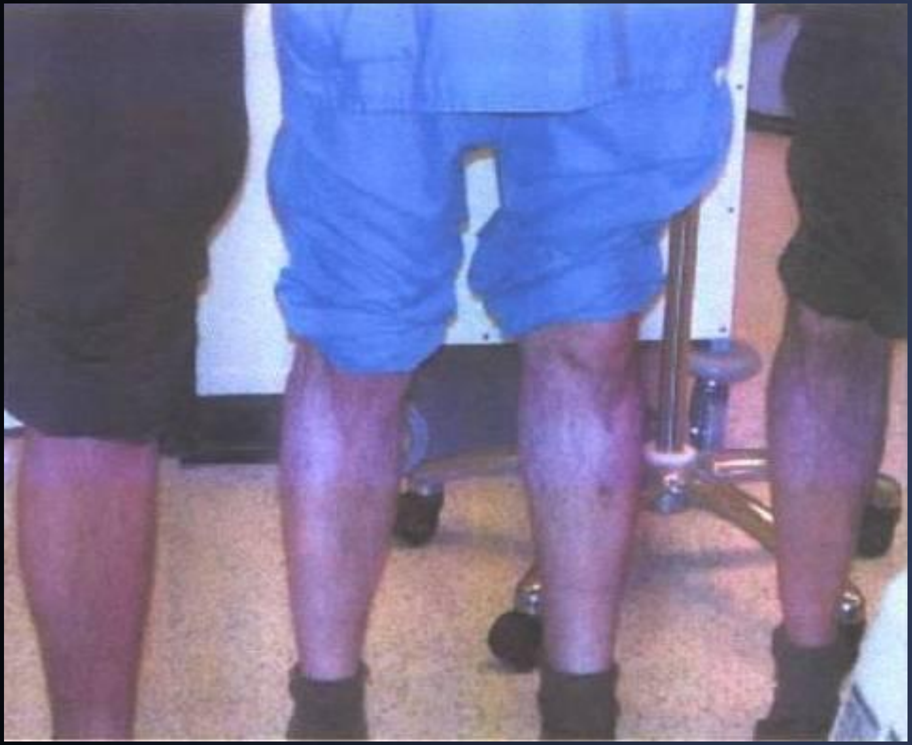
4. Procedural complexity

Mihran Kassabian (1870-1910)
(X-Ray dermatitis hands)

Radiation Exposure is Important
Skin injury due to cardiac intervention




Operators also Radiation Induced Skin Injury



Radiation is Important

If radial access is associated with a significant increase in radiation exposure,

this will offset some of its other proven benefits and could limit its applicability

Review of recent literature comparing radiation exposure in transfemoral and transradial cardiac catheterisation

	FA				RA			
	No	DAP (Gycm^2)	FT (min)	Rad Exp (uSv)	No	DAP (Gycm^2)	FT (min)	Rad Exp (uSv)
Mann et al 1996 -PCI	126			8.8	138			13.5
Sandborg et al 2003 -CA	40	38±22	4.6±4		36	51±25	7.5±4	
Sandborg et al 2003 –CA+PCI	42	47±34	12.5±9		24	75±47	18.4±9	
Sandborg et al 2003 -All	82	43±29	8.6±8		60	61±37	11.9±9	
Larrazet et al 2003 –ad hoc PCI	184	138	12		218	175	17	
Geijer et al 2004 - PCI	114	69.8	16.4		55	70.5	18.1	
Lange et al 2006 –CA	103	13.1±8.5	1.7±1.4	32±39	92	15.1±8.4	2.8±2.1	64±55
Lange et al 2006 -PCI	48	51±29.4	10.4±6.8	110±115	54	46.3±28.7	11.4±8.4	166±188

Radiation exposure

- Operator experience
- Fluoroscopy time
- Patient radiation dose (dose-area product)
- Operator exposure (mSv)

Operator radiation exposure during elective diagnostic coronary angiogram & Intervention by TFA or TRA (single operator, RCT)

- **Radiation Protection and catheter length**

  TFA:
  side shield and upper protective shield
  85 cm diagnostic catheters

  TRA:
  side shield only -for uninhibited hand movement of the operator
  125 cm diagnostic catheters

- **Detection of radiation:**

  dosimeter at the breast pocket on the outside of the lead apron
  operator exposure (mSv)
  fluoroscopy time (min)
  dose-area product (Gy·cm^2)

Lange HW Catheter Cardiovasc Interv. 2006 Jan;67(1):12-6

Fluoroscopy Time and Radiation Measurements (TFA vs. TRA, single operator)

	Femoral	Radial	P
Coronary angiography (n)	103	92	
Fluoroscopy time (min)	1.7 ± 1.4	2.8 ± 2.1	< 0.001
Dose-area product (Gy cm2)	13.1 ± 8.5	15.1 ± 8.4	< 0.05
Radiation exposure (mSv)a	32 ± 39	64 ± 55	< 0.001
Percutaneous intervention (n)	48	54	
Fluoroscopy time (min)	10.4 ± 6.8	11.4 ± 8.4	NS
Dose-area product (Gy cm2)	51.0 ± 29.4	46.3 ± 28.7	NS
Radiation exposure (mSv)	110 ± 115	166 ± 188	< 0.05

Lange HW Catheter Cardiovasc Interv. 2006 Jan;67(1):12-6

- Rt. radial access increases radiation exposure for patients and operators

Left vs. Right Radial approach and Procedural times

1540 Patients randomized

770 Right
Radial Approach

770 Left
Radial Approach

1467 coronary angiography
(Diagnostic group)

688 PCI
(PCI Group)

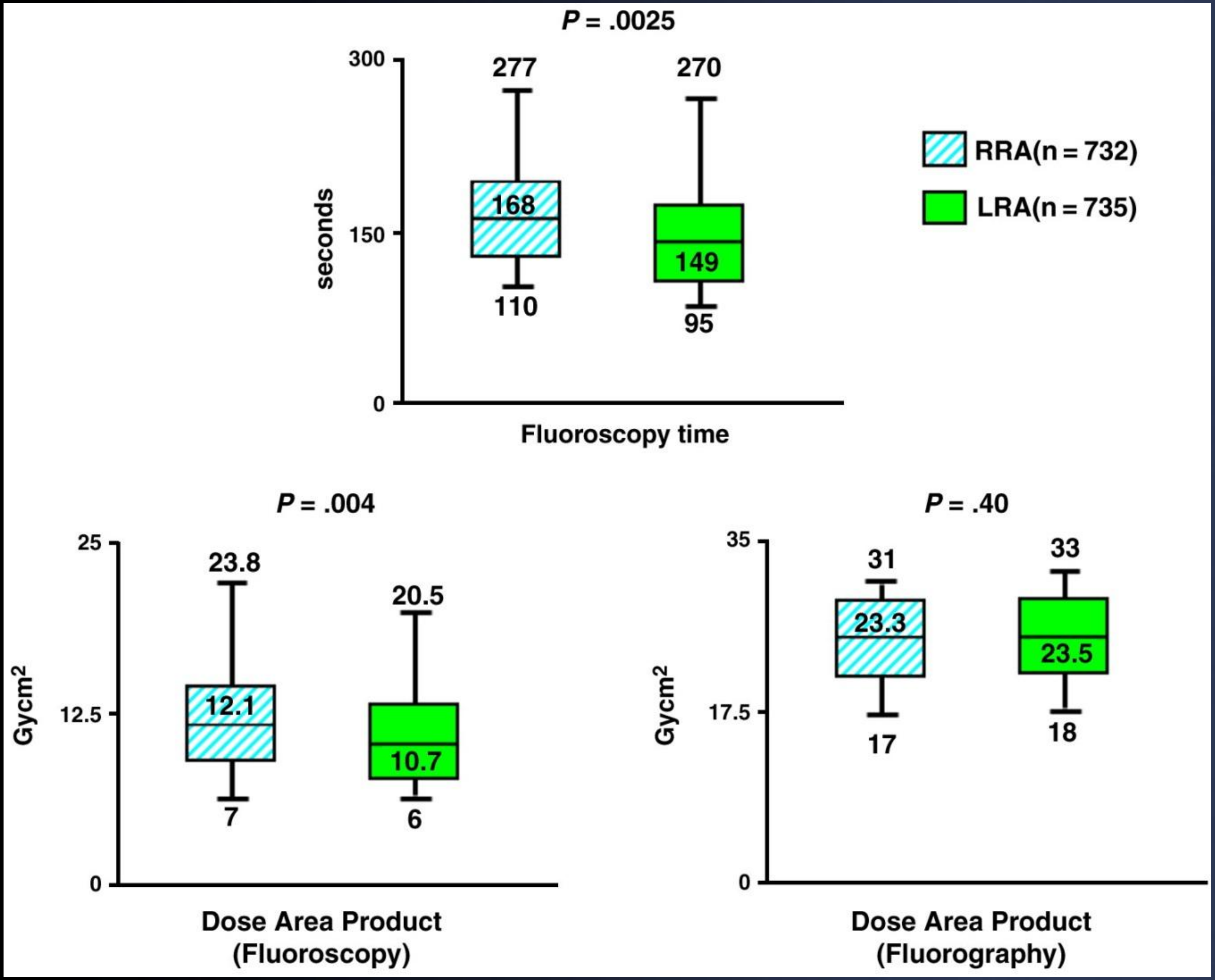
732 Right
Radial Approach

735 Left
Radial Approach

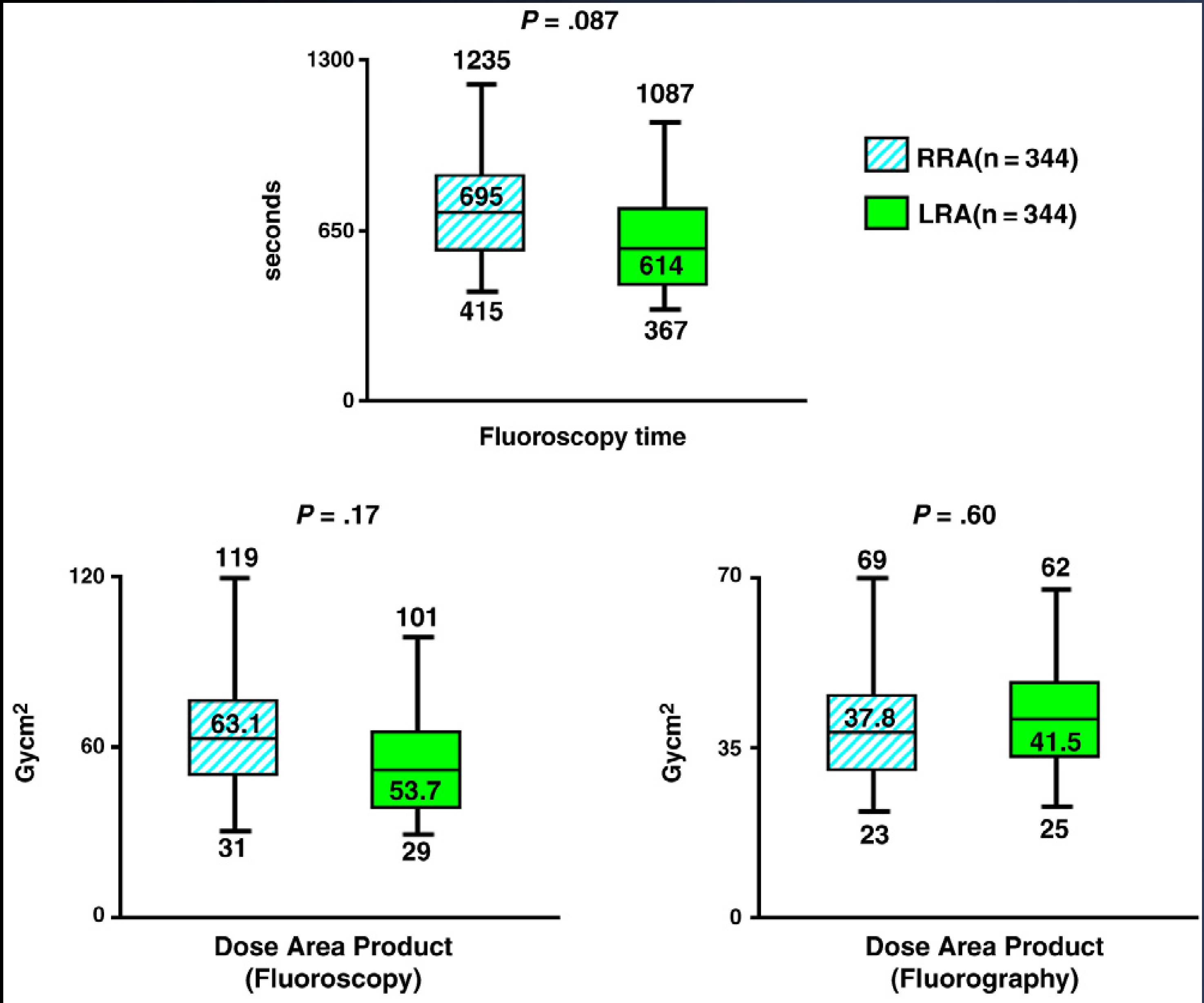
344 Right
Radial Approach

344 Left
Radial Approach

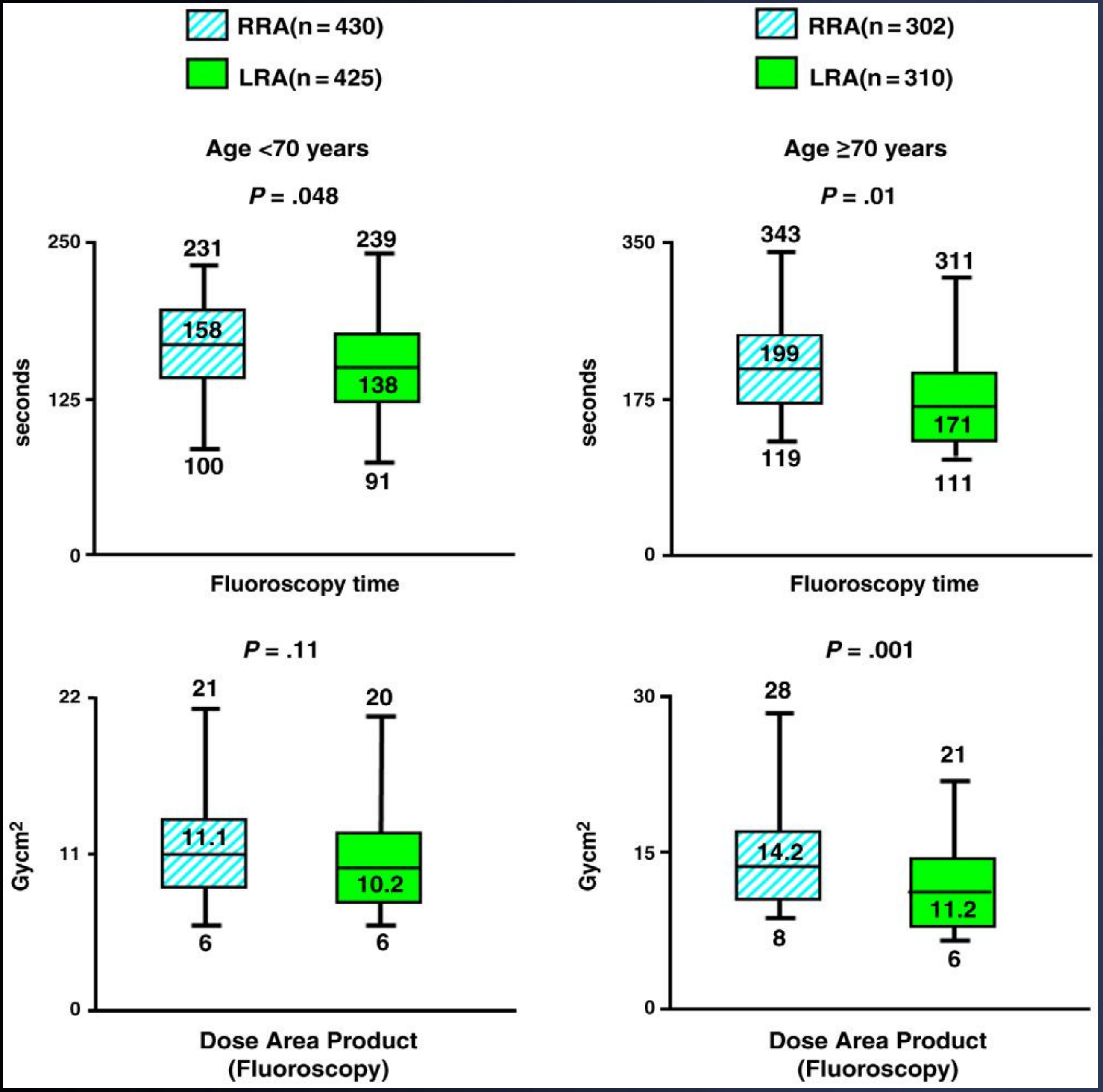
Sciahbasi A, TALENT study. Am Heart J. 2011 Jan;161(1):172-9.



Sciahbasi A, TALENT study. Am Heart J. 2011 Jan;161(1):172-9.



Sciahbasi A, TALENT study. Am Heart J. 2011 Jan;161(1):172-9.



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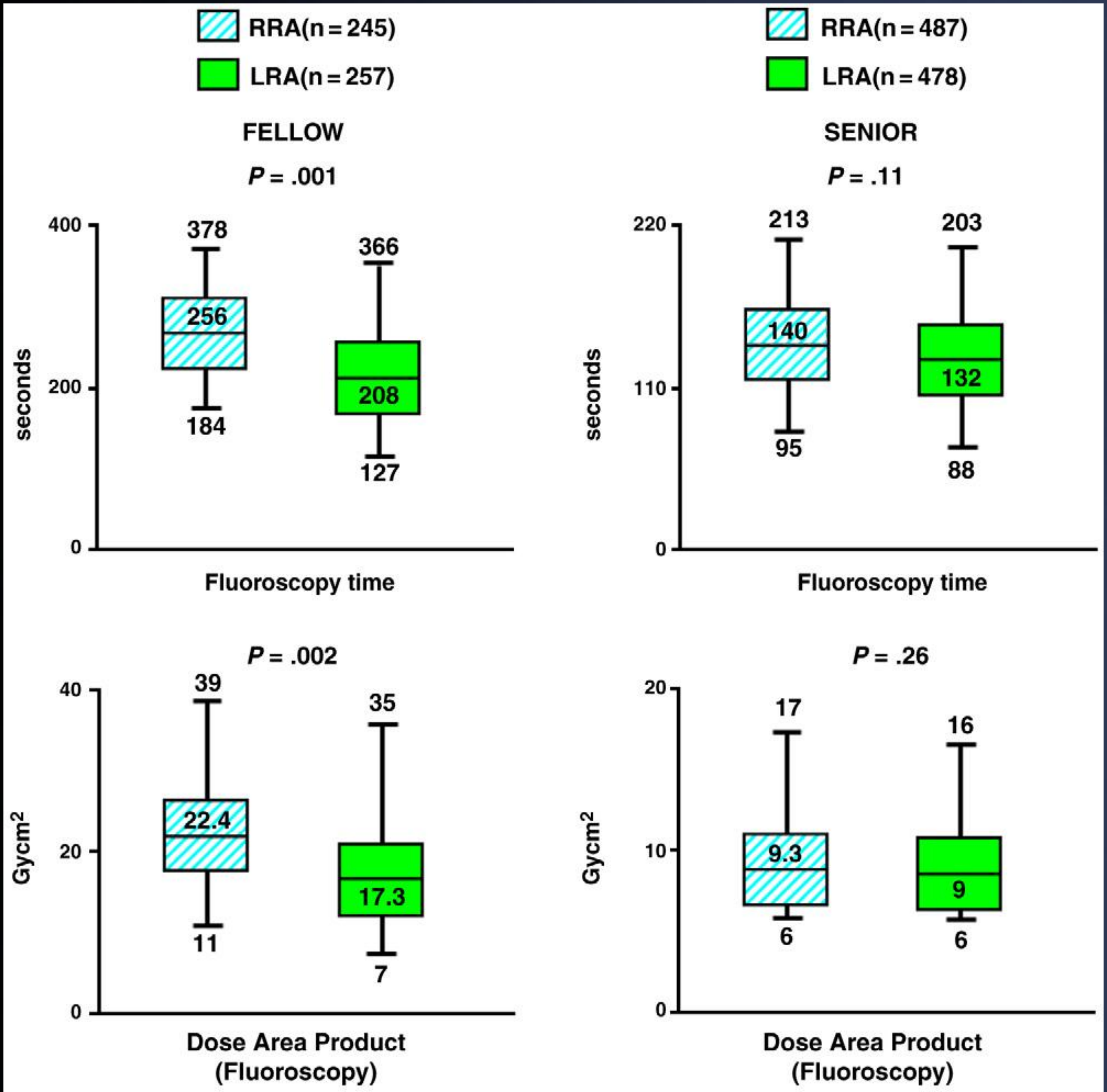
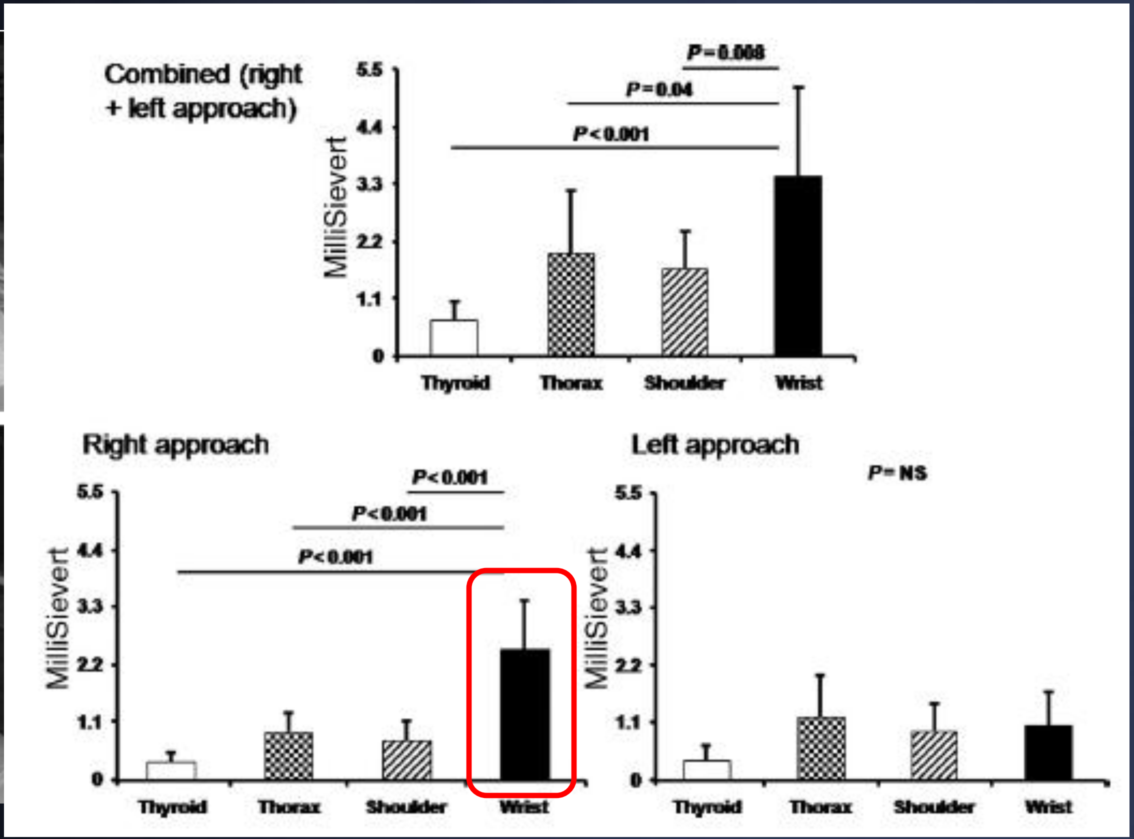


Sciahbasi A, TALENT study. Am Heart J. 2011 Jan;161(1):172-9.

Operator radiation exposure (Lt vs. Rt radial a)

Total 390 patients

5 different sites dosimeters were analyzed (left wrist, shoulder, thorax ouside the lead apron, throax under the lead apron, thyroid)



Lt radial approach for coronary procedures is associated with similar radiation dose for operators at the body, shoulder, or thyroid level, with a possible significant advantage at the wrist.

Sciahbasi A, et al. *Am J Cardiol.* 2011;Epub ahead of print.

Contents

1. Radiation exposure

2. Learning curve

3. Anatomical consideration

4. Procedural complexity

Learning curve (Femoral to Radial)

Variable	TF Access (n = 340)	TR Access (n = 661)	p Value
Total procedure duration (minutes)			
Radial experts	24	20.5	NS
Non-radial experts	22	27	<0.001
Total fluoroscopic time (minutes)			
Radial experts	4.4	4.5	NS
Non-radial experts	3.6	6.2	<0.001
Total contrast volume (ml)			
Radial experts	120	108	<0.001
Non-radial experts	140	119	<0.001

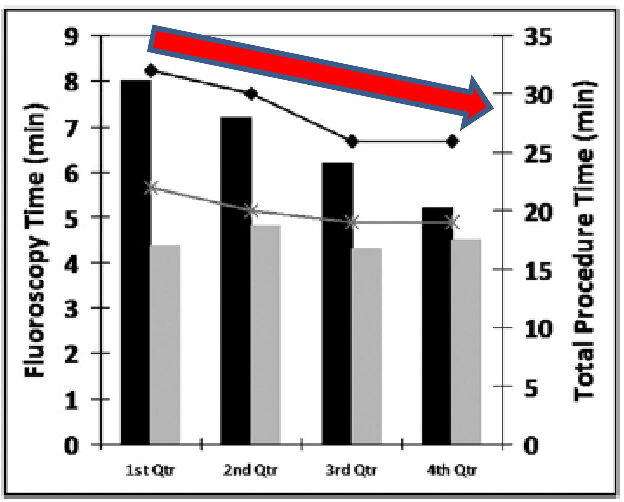


Figure 1. Trends of total procedural *(crosses)* and fluoroscopic *(gray bars)* times for radial experts and total procedural *(diamonds)* and fluoroscopic *(black bars)* times for non-radial experts. Values are medians. Qtr = quarterly interval over 12 months.

Period (quartiles)	Procedure Time (minutes)	Fluoroscopic Time (minutes)	Contrast Volume (ml)
First 3 months			
Non-radial experts (n = 28)	32	8	113
Radial experts (n = 102)	22	4.4	115
p Value	<0.001	0.02	NS
Second 3 months			
Non-radial experts (n = 54)	30	7.2	110
Radial experts (n = 104)	20	4.8	105
p Value	<0.001	<0.001	NS
Third 3 months			
Non-radial experts (n = 101)	26	6.2	121
Radial experts (n = 78)	19	4.3	108
p Value	NS	0.02	NS
Fourth 3 months			
Non-radial experts (n = 135)	26	5.2	120
Radial experts (n = 59)	19	4.5	104
p Value	NS	NS	NS

Technical learning curve is needed

Looi JL et al. *Am J Cardiol.* 2011;Epub ahead of print.

Experience and outcomes

	TR-PCI Operator Experience				
	1–50 (n=655)	51–100 (n=344)	101–150 (n=213)	151–300 (n=141)	Control (n=319)
TR-PCI failure*	43 (7)	10 (3)	5 (2)	5 (3)	6 (2)
No. guides†	1.4±1	1.4±1	1.3±1	1.3±1	1.3±1
Contrast volume, mL‡	180±79	174±79	170±79	157±75	168±79
Fluoroscopy time, min§	15±10	14±10	13±10	11±8	12±9

All values are mean±SD or n (%). Abbreviation as in Table 1.

*Analyzed by repeated-measures logistic regression model (*P*=0.007 [1–50 vs 51–100], *P*=0.01 [1–50 vs control]).

†Analyzed by Poisson regression model (*P*=0.90).

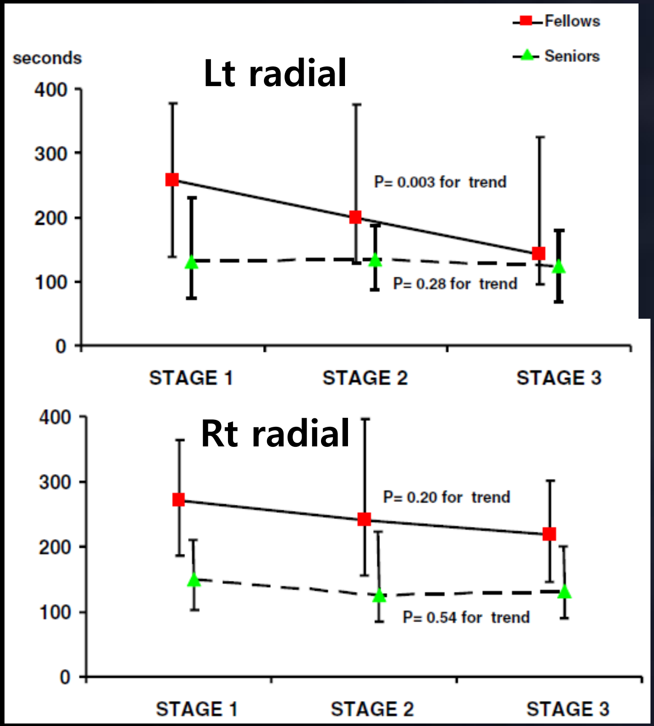
‡Analyzed by repeated-measures linear regression model on log-transformed contrast volume with Tukey adjustment for multiple comparisons (*P*=0.007 [overall], *P*=0.02 [1–50 vs 151–300], *P*=0.05 [1–50 vs control]).

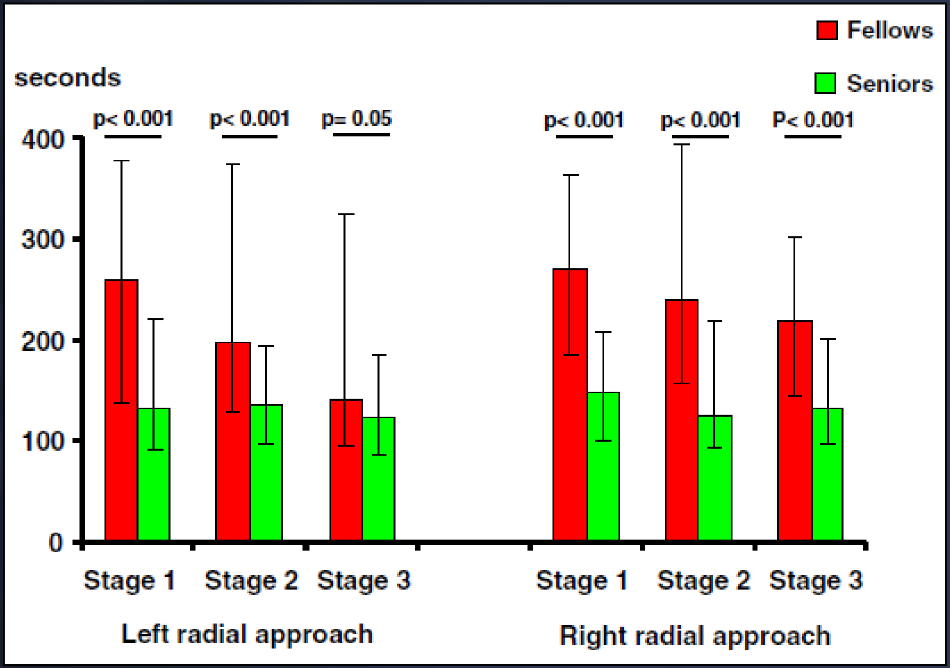
§Analyzed by repeated-measures linear regression model on log-transformed fluoroscopy time with Tukey adjustment for multiple comparisons (*P*=0.003 [overall], *P*=0.04 [1–50 vs 101–150], *P*=0.02 [1–50 vs control]).

Ball WT et al. *Circ Cardiovasc Interv.* 2011;4:336-41.

Left vs. Right Radial a. (TALENT study)

Total 1,467 patients randomized to Lt or Rt radial artery
3 Stages : **0-100 procedures (Stage 1), 101-200 (Stage 2), >200 (Stage 3)**
Primary endpoint : fluoroscopic time during the 3 stages





The left radial approach is associated with a shorter learning curve compared with the right radial approach.

Sciahbasi A, et al. *Am J Cardiol.* 2011;Epub ahead of print.

Contents

1. Radiation exposure

2. Learning curve

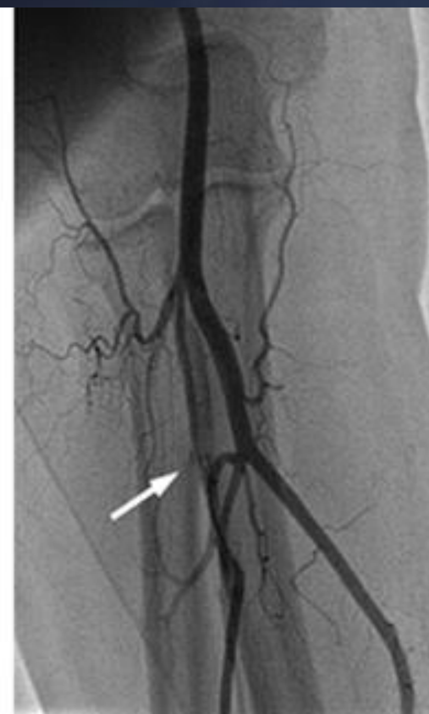
3. Anatomical consideration

4. Procedural complexity

Causes of Transradial Approach PCI Failure

Radial Artery Loop

Guidewire-induced Dissection



Severe Spasm

Severe Subclavian Tortuosity

Dehghani, P. et al. J Am Coll Cardiol Intv 2009;2:1057-1064

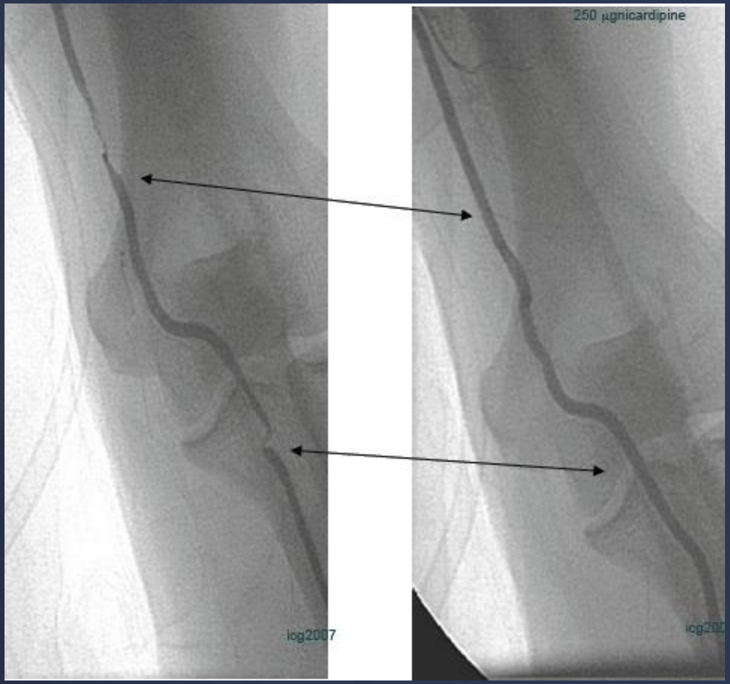
TRA Failure in Low (8%) to Intermediate (42%) Volume Operators

Overall Failure rate: 4.7% (N=2,100)

Table 4. Mechanism and Causes of Transradial PCI Failure (n = 98)

Failure of arterial access	
Inadequate arterial puncture	13 (13)
Failure to advance catheter to ascending aorta	
Radial artery spasm	33 (34)
Radial artery dissection	10 (10)
Radial artery loop/tortuosity	6 (6)
Radial artery stenosis	1 (1)
Failure to complete PCI due to lack of guide support	
Subclavian tortuosity	18 (18)
Inadequate guide backup support	17 (17)

Values are n (%).
PCI = percutaneous coronary intervention.



Dehghani, P. et al. J Am Coll Cardiol Intv 2009;2:1057-1

Causes of TRI failure

Cause	Total (n=69)	TR-PCI Operator Experience 1–50 (n=43)	51–100 (n=10)	101–150 (n=5)	151–300 (n=5)	Control (n=6)
Radial artery spasm	26 (38)	15 (35)	5 (50)	1 (20)	1 (20)	4 (66)
Subclavian tortuosity	11 (16)	7 (16)	…	2 (40)	1 (20)	1 (17)
Inadequate guide support	11 (16)	8 (18)	1 (10)	2 (40)	…	…
Inadequate arterial puncture	7 (10)	6 (14)	1 (10)	…	…	…
Radial artery loop	5 (7)	4 (9)	1 (10)	…	…	…
Need for contralateral injection	2 (3)	…	1 (10)	…	1 (20)	…
Inadequate guide engagement	2 (3)	1 (2)	1 (10)	…	…	…
Radial artery dissection	1 (1)	1 (2)	…	…	…	…
Radial artery perforation	1 (1)	…	…	…	1 (20)	…
Radial artery thrombus	1 (1)	…	…	…	1 (20)	…
Radial artery stenosis	1 (1)	1 (2)	…	…	…	…
Unknown	1 (1)	…	…	…	…	1 (17)

Ball WT et al. *Circ Cardiovasc Interv.* 2011;4:336-41.

Influences of Radial a. tortuosity

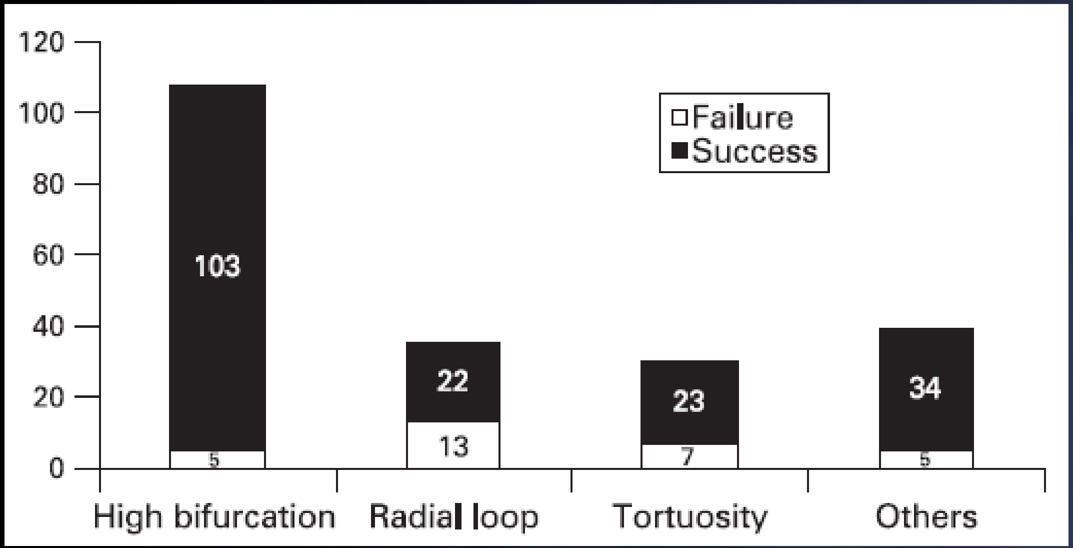
	RA tortuosity	
	No (n=1141)	Yes (n=50)
Age (years)	59.7±10.2	66.9±7.8*
BSA (m^2)	1.65±0.17	1.67±0.15
T PT (min)	21.8±11.2	26.0±9.92*
VAT (min)	2.95±3.11	3.34±3.58
FT (min)	5.82±4.12	7.14±3.6**

Radial artery tortuosity was associated with old age and prolonged procedure time

TPT : total procedure time
VT : vascular access time
FT : fluoroscopy time

Yoo BS et al. Int J Cardiol. 2005;101:421-7.

Radial a. anomaly & procedural outcome

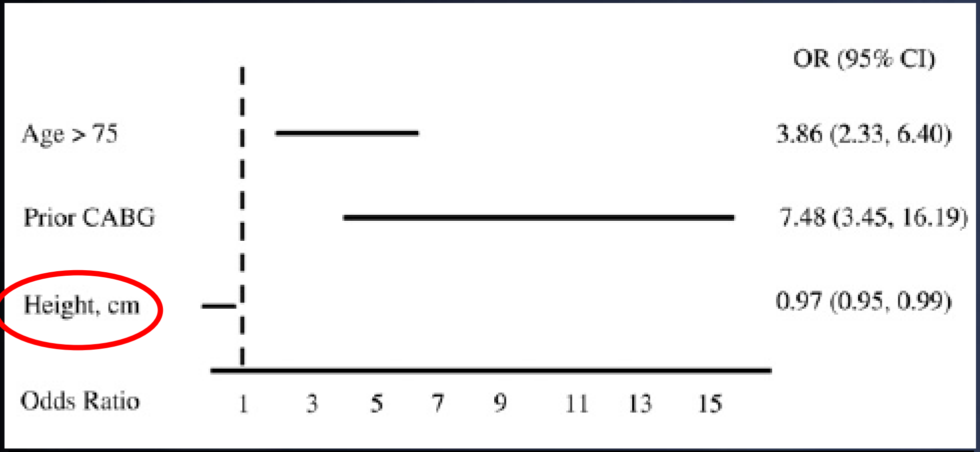


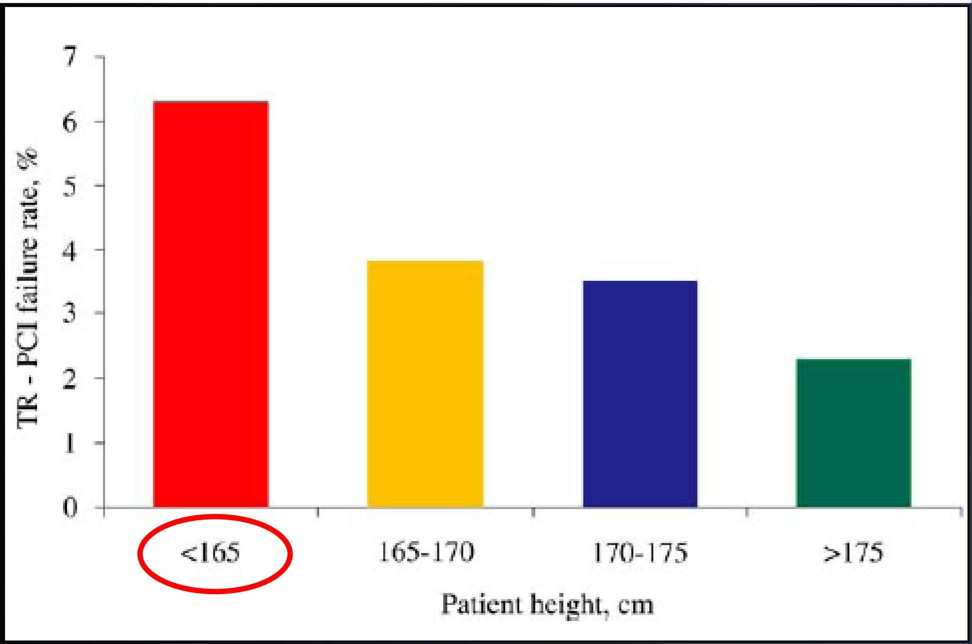
	Normal anatomy	High bifurcations*	RA loops*	Tortuous RA*	Other anomalies*
Patients (n)	1321	108	35	30	39
Women (%)	28	29†	49‡	50‡	33†
Age (years), mean (SD)	63.0 (11.0)	65.5 (10.8)†	69.8 (10.4)§	72.2 (7.7)§	65.1 (11.8)†
Procedure duration (min), mean (SD)	41.3 (21.5)	45.2 (23.2)†	49.4 (17.1)†	41.0 (12.7)†	42.1 (19.2)†
Fluoroscopy time (min), mean (SD)	9.7 (8.0)	9.3 (6.5)†	10.0 (6.6)†	10.7 (6.5)†	9.6 (7.1)†
Failures (%)**	0.9	4.6†	37.1§	23.3¶	12.9%†

*p Value comparing radial anomaly with normal anatomy provided when relevant; †p = NS; ‡$p<0.05$; §$p<0.001$; ¶$p<0.005$.
**Percentage of failure to radial artery anatomical finding.

Lo TS et al. Heart. 2009;95:410-5.

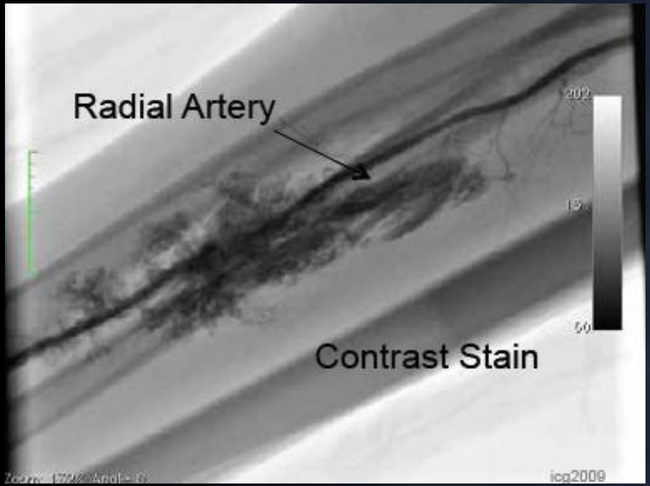
Predictors of TRI failure





Lo TS et al. Heart. 2009;95:410-5.

If occurs, fatal complications

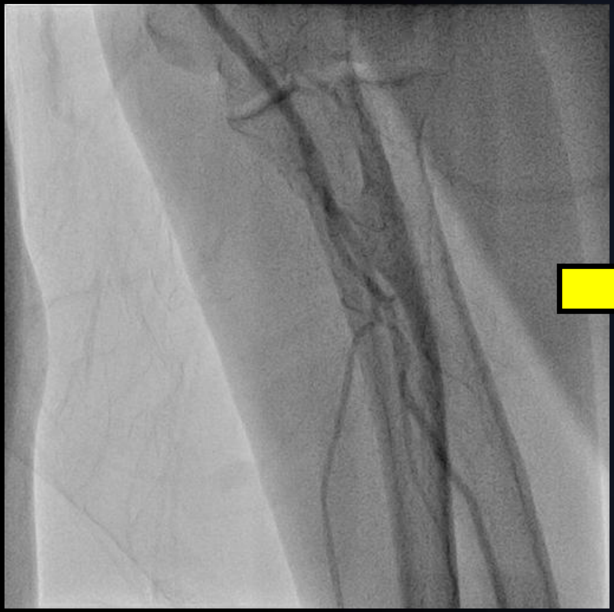


Perforation

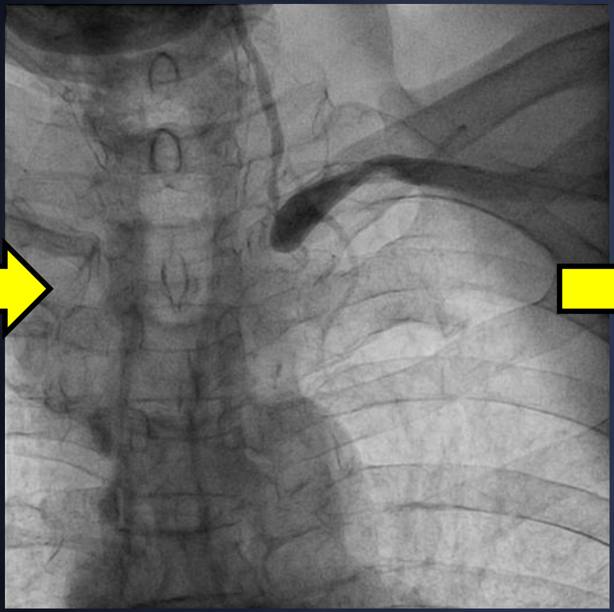
Compartment syndrome

Necrosis

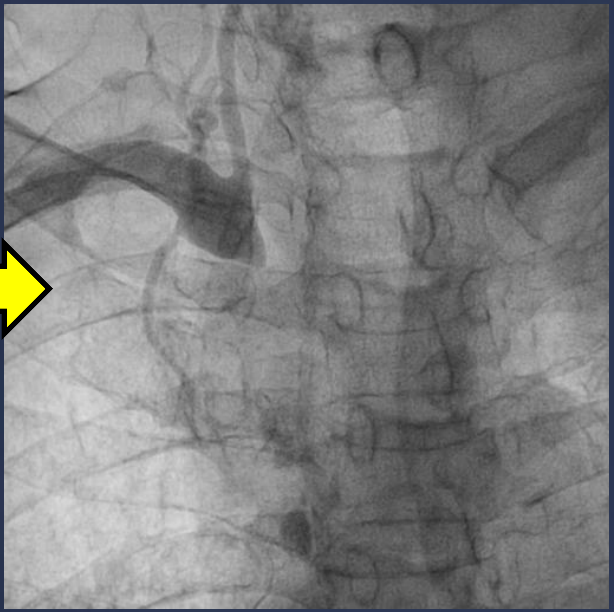
Impossible TRI case



Weak radial pulsation
But patent radial artery

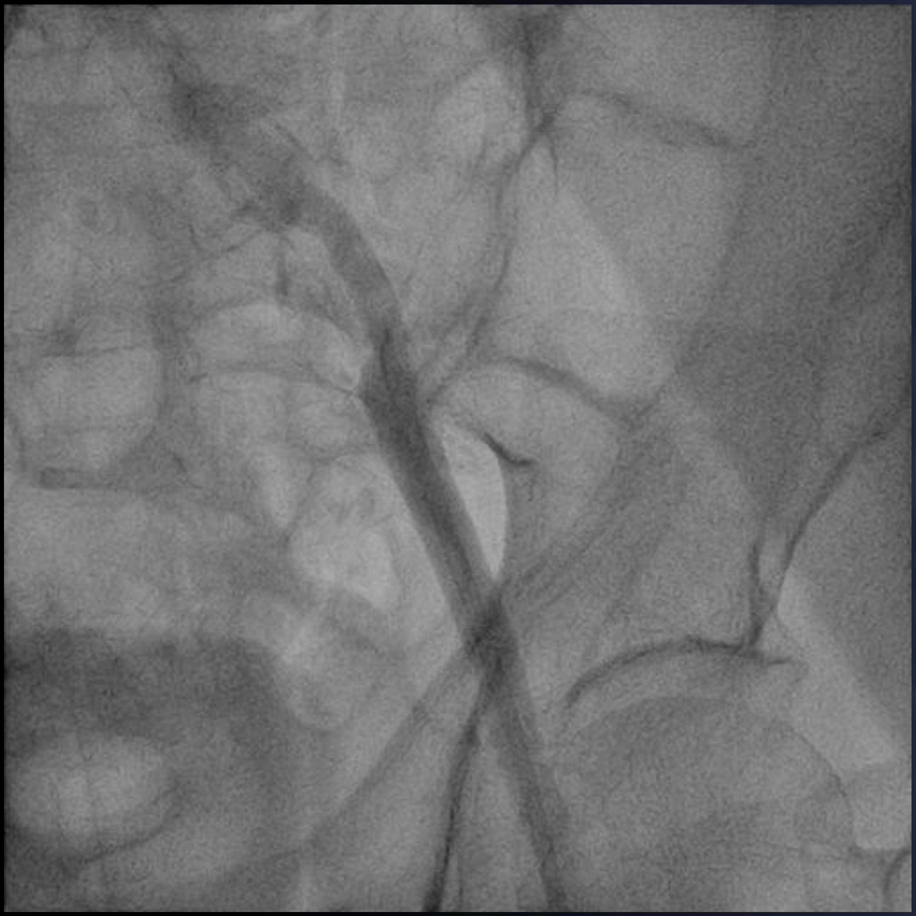


Lt subclavian artery
total occlusion

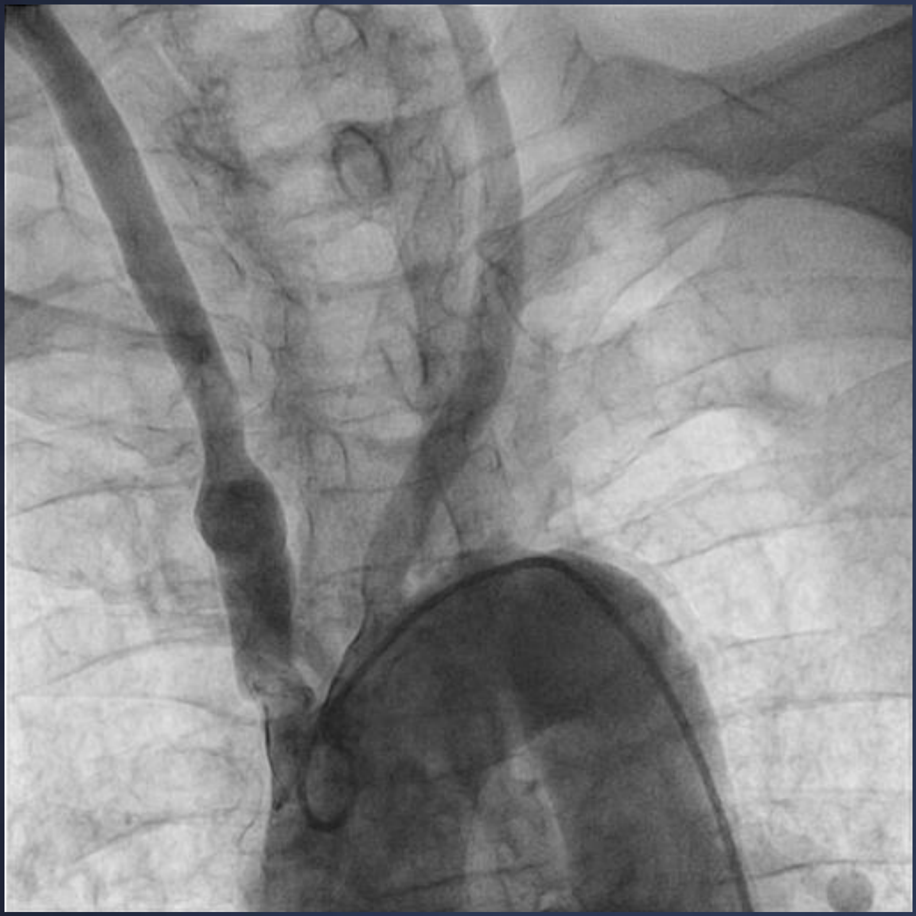


Rt subclavian artery
total occlusion

Impossible TRI case



Crossover to femoral a.



Intact Rt innominate a.
& Lt common carotid a.

Contents

1. Radiation exposure

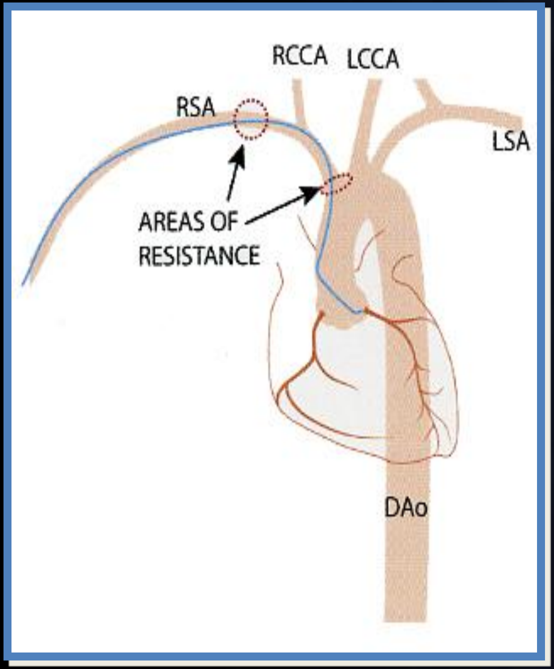
2. Learning curve

3. Anatomical consideration

4.Procedural complexity

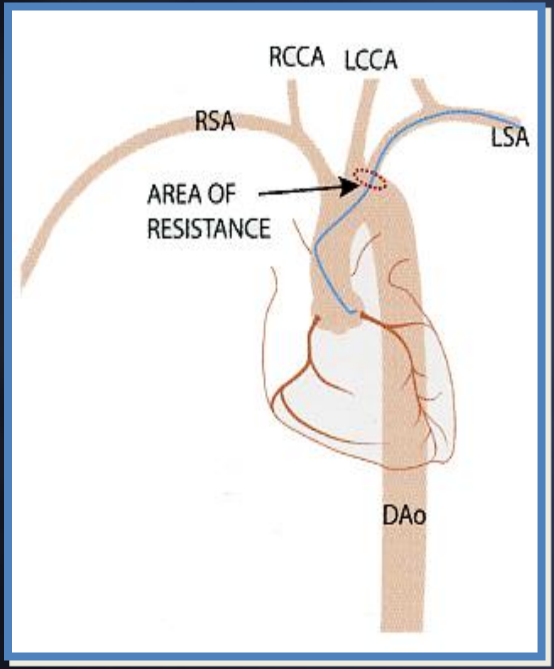
Understanding the Catheter's Course

Right Radial



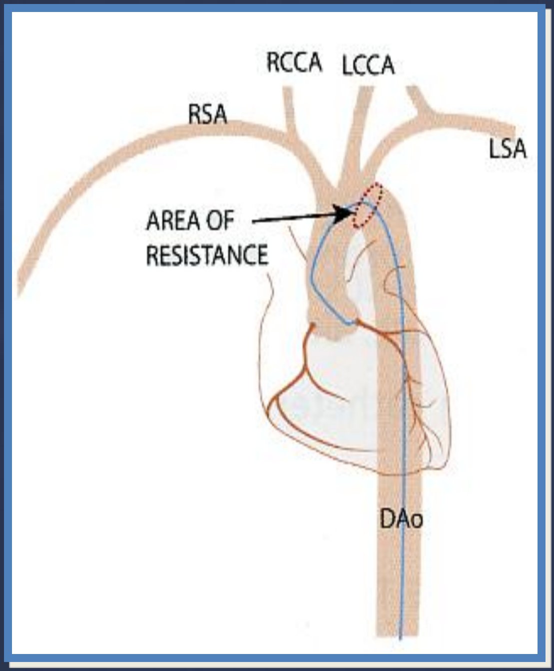
2 points of resistance

Left Radial



1 point of resistance

Femoral



1 point of resistance

TFI preferable situations

- Cardiogenic shock
- Need for hemodynamic support (IABP, EBS)

- CTO lesion
- Left main lesion
- Bifurcation lesion
- Heavily calcified lession → rotational atherectomy
- Tortuous upper extremity vessels

Contraindications for radial access

- Abnormal Allen's test
- Prev. radial procedures with subsequent known radial occlusion
- Pts had CABG with radial grafts
- Pts with Raynaud's phenomenon
- Dialysis pts (may require new conduit in the future)

- **Lesions that requires large >2.0mm Rota burr, CTO with support catheter & simultaneous IVUS guidance**

  ➔ recent advances are overcoming the limit of TRI

Future of femoral artery

- Methods and devices for TRI are evolving…
  - Sheathless guiding catheter, Slender system
  - CTO intervention using both transradial approach
  - Left main, Bifurcation PCI through radial artery

- TFI is also evolving for great vessel and valves
  - Endovascular stent graft (Thoracic and Abdominal aorta)
  - TAVI
  - Peripheral intervention
  - Carotid intervention

Thank You for Your Attention