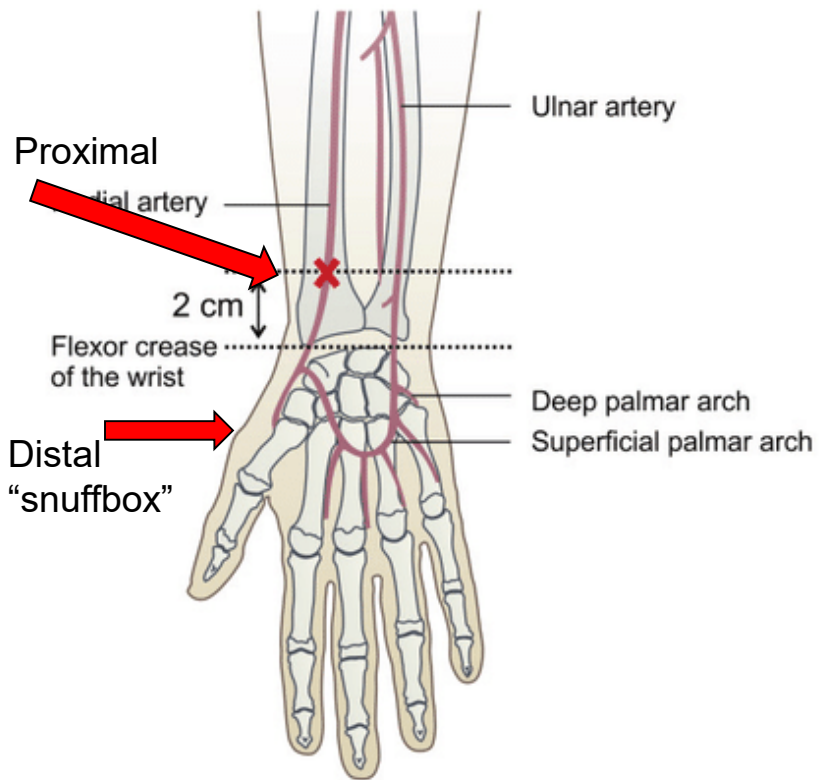


# Adapting Radial Artery Access for Stroke: Challenges and Opportunities

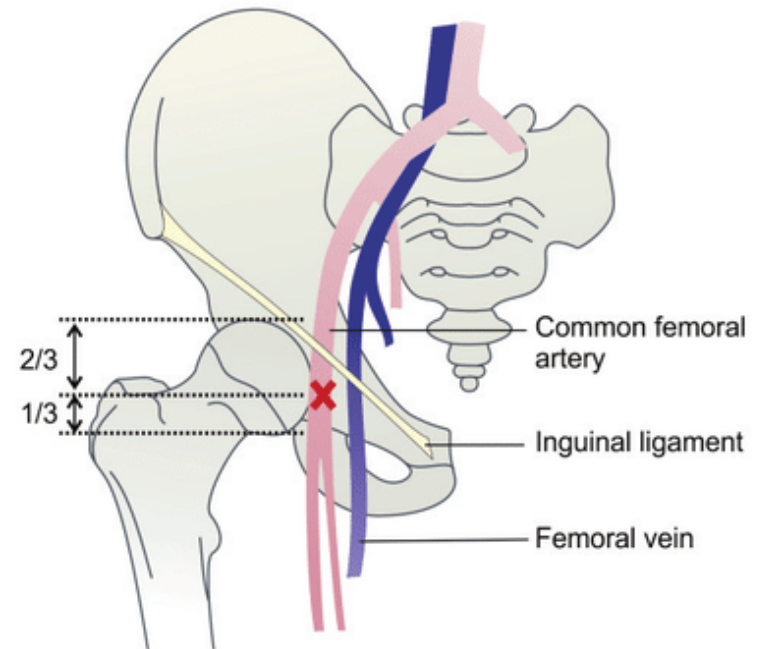
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# Introduction

- Cerebral angiography and neurointerventions have traditionally been performed through the femoral artery (TFA)
- Transradial access (TRA) is an alternative that is gaining popularity



Radial (TRA)



Femoral (TFA)

# History of TRA

- Initially proposed for coronary angiography in 1989<sup>1</sup>
- Numerous small case series published throughout the 90s for angiography/angioplasty
- By 2009, multiple small RCTs. Meta-analysis showed reduced bleeding/LOS and trend towards improved procedural outcomes<sup>2</sup>

1. Campeau L. Percutaneous radial artery approach for coronary angiography. *Cathet Cardiovasc Design*. 1989.

2. Jolly et al. Radial versus femoral access for coronary angiography or intervention and the impact on major bleeding and ischemic events: a systematic review and meta-analysis of randomized trials. *Am Heart J*. 2009.

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## TRANSRADIAL CEREBRAL ANGIOGRAPHY: AN ALTERNATIVE ROUTE

**INTRODUCTION:** The transradial approach has been well described for arteriography of the coronary vessels. To assess the safety and success rate of the transradial approach for three-vessel or four-vessel diagnostic cerebral arteriography, we reviewed the experience at our institution and compared our complication rates with those found in the literature for transfemoral cerebral angiography and transradial coronary angiography.

**METHODS:** We reviewed the electronic medical records of 129 consecutive patients in whom 132 cerebral angiographic studies were performed by use of a transradial approach between December 1999 and June 2001. A total of 54 selective catheterizations were performed, of which 39 were of the vertebral artery, 11 of the internal carotid artery, and 4 of the external carotid artery. Records were reviewed for periprocedural and delayed complications, indications for diagnostic angiography, and requirement of conversion to a femoral approach. Records were reviewed prospectively for the first 55 procedures and retrospectively for the next 77 procedures.

**RESULTS:** The mean time to initial clinical follow-up was 1.5 months (median, 0.5 mo). The combined rate of periprocedural and delayed complications was 9%, and there were no major complications. Minor periprocedural complications included transient radial artery spasm (four patients), failure to access the brachial artery (two patients), severe pain (one patient), skin desquamation (one patient), and hematoma (one patient). There were no major complications. At the time of follow-up evaluation, these patients were without deficits related to cannulation of the radial artery.

**CONCLUSION:** The transradial approach for cerebral angiography is a safe alternative to the transfemoral route. After transradial cerebral angiography, patients require a shorter observation period and are not restricted to bed rest. As technological developments generate smaller, more pliable endovascular surgical devices, future endovascular surgery may be performed transradially.

**KEY WORDS:** Angiography, Cerebral angiography, Radial artery, Transradial

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DOI: 10.1227/01.NEU.0000019768.50025.67

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One of the major limitations after conventional cerebral angiography is the requirement for 4 to 6 hours of leg immobilization at bed rest to prevent bleeding complications or pseudoaneurysm formation at the femoral access site. With the advent of

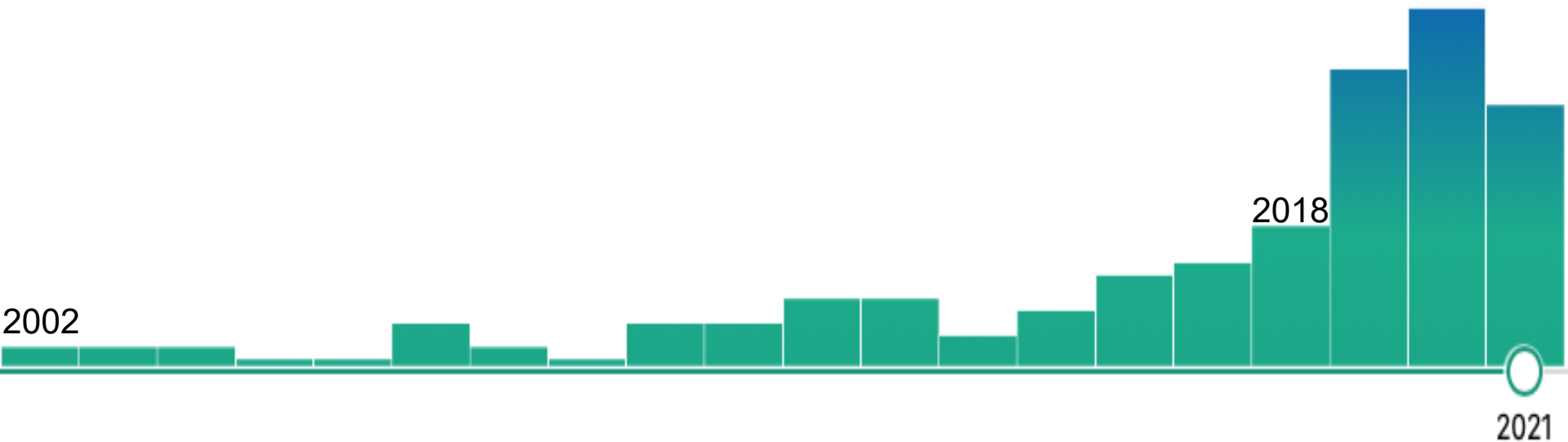
though he had an 88% success rate, he noted a 6% rate of asymptomatic radial artery occlusion determined by delay in return of the radial pulse. Hall et al. (6) studied a series of 21 patients by ultrasound imaging at 1 and 72 days after transradial access for cardiac cath-

# History of TRA (cont.)

- RIVAL (2011): large RCT demonstrating reduced access site complications<sup>1</sup>
- 2018: AHA recommends "radial-first" strategy for patients with ACS<sup>2</sup>
- 2018: First large experience with TRA for cerebral angiography published<sup>3</sup>
- 2020: First large comparison to TFA showing non-inferiority/patient preference for TRA<sup>4</sup>

1. Jolly et al. Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (RIVAL). 2011.
2. Mason et al. An Update on Radial Artery Access and Best Practices for Transradial Coronary Angiography and Intervention in Acute Coronary Syndrome. 2018.
3. Snelling et al. Transradial cerebral angiography: Techniques and outcomes. J Neurointerv Surg. 2018.
4. Stone et al. Transradial versus transfemoral approaches for diagnostic cerebral angiography: a prospective, single-center, non-inferiority comparative effectiveness study. J Neurointerv Surg. 2020.

# Pubmed results: “radial access cerebral angiography”




# Benefits of TRA

- No need for bedrest post-procedure, shorter hemostasis time
- Easier navigation of Bovine/Type III arches
- Lower risk of access complications (hemorrhagic and ischemic)
- Easier access for obese patients
- PAD/prior aorto-iliac interventions



# Transradial versus transfemoral approaches for diagnostic cerebral angiography: a prospective, single-center, non-inferiority comparative effectiveness study

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**Table 3** Patient access site preferences for subsequent angiography

	n	Access site preference for subsequent angiogram			P value*
		Prefer radial	Prefer femoral	No preference	
Transradial group	128	111 (86.7%)	7 (5.5%)	10 (7.8%)	<0.001
Transfemoral group	112	42 (37.5%)	24 (21.4%)	46 (41.1%)	0.008
Total	240	153 (64.8%)	31 (12.9%)	56 (23.3%)	<0.001

\*Analysis between "Prefer radial" and "Prefer femoral" choices.

# Limitations of TRA

- Smaller access site
- Vasospasm
- Arteria lusoria
- Potentially greater difficulty navigating proximal common carotid tortuosity
- Learning curve

# Complication profiles of TRA vs. TFA

Radial	Femoral
Hematoma	Hematoma (femoral vs. retroperitoneal)
Radial artery occlusion	Femoral artery occlusion
Vasospasm	Dissection
	Arteriovenous fistula
	Pseudoaneurysm

# A word on radial artery occlusion

- Asymptomatic: rare (~2-5%)<sup>1,2</sup>
- Symptomatic: extremely rare (1/1,342 in neurointerventions<sup>1</sup>, 0.2% in cardiac<sup>2</sup>)
- “Performing an Allen or Barbeau test to confirm the patency of dual arterial circulation to the hand and intact palmar arch system is only of historical interest”<sup>3</sup>

1. Joshi et al. Transradial approach for neurointerventions: a systematic review of the literature. *J Neurointerv Surg*. 2020.
2. Jolly et al. Radial versus femoral access for coronary angiography or intervention and the impact on major bleeding and ischemic events: a systematic review and meta-analysis of randomized trials. *Am Heart J*. 2009.
3. Mason et al. An Update on Radial Artery Access and Best Practices for Transradial Coronary Angiography and Intervention in Acute Coronary Syndrome. *Circ Card Interv*. 2018.

# Transradial approach for neurointerventions: a systematic review of the literature

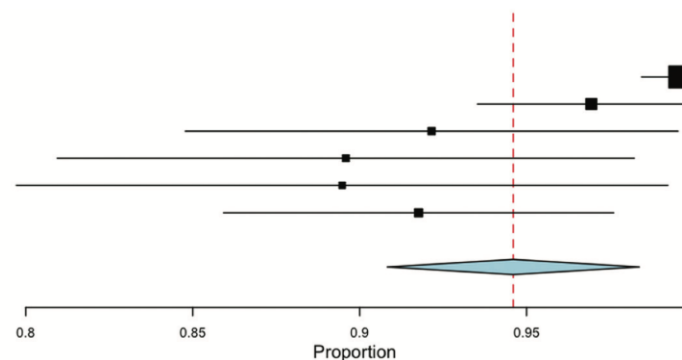
Krishna C Joshi , André Beer-Furlan , R Webster Crowley, Michael Chen, Stephan A Munich

- Systematic review/meta-analysis of 21 studies (n = 1,342, stroke = 127)
- Mostly CAS (46%) and aneurysms (32%)
- 2 (0.15%) major complications
- 37 (2.75%) minor complications
- 64 (5%) crossover to TFA

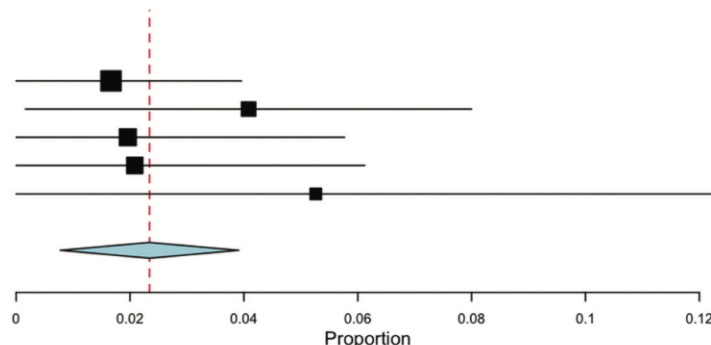
# Distal Transradial Access for Diagnostic Cerebral Angiography and Neurointervention: Systematic Review and Meta-analysis

 H. Hoffman,  M.S. Jalal,  H.E. Masoud,  R.B. Pons,  I. Rodriguez Caamaño,  P. Khandelwal,  T. Prakash, and  G.C. Gould

Studies	Estimate (95% C.I.)
Weinberg et al. 2020	1.00 (0.98, 1.00)
Pons et al. 2020	0.97 (0.94, 1.00)
Saito et al. 2020	0.92 (0.85, 1.00)
Kuhn et al. 2020	0.90 (0.81, 0.98)
Patel et al. 2019	0.89 (0.80, 0.99)
Brunet et al. 2019	0.92 (0.86, 0.98)
<b>Overall (<math>I^2=74.33\%</math>, <math>P&lt;0.01</math>)</b>	<b>0.95 (0.91, 0.98)</b>



Studies	Estimate (95% C.I.)
Weinberg et al. 2020	0.02 (0.00, 0.04)
Pons et al. 2020	0.04 (0.00, 0.08)
Saito et al. 2020	0.02 (0.00, 0.06)
Kuhn et al. 2020	0.02 (0.00, 0.06)
Patel et al. 2019	0.05 (0.00, 0.12)
<b>Overall (<math>I^2=0\%</math>, <math>P=0.77</math>)</b>	<b>0.02 (0.01, 0.04)</b>



1. Hoffman et al. Distal transradial access for diagnostic cerebral angiography and neurointervention: systematic review and meta-analysis. *AJNR*. 2021.

## Transition from Proximal to Distal Radial Access for Diagnostic Cerebral Angiography: Learning Curve Analysis

*Haydn Hoffman<sup>1</sup>, Katherine M. Bunch<sup>1</sup>, Tatiana Mikhailova<sup>1</sup>, John R. Cote<sup>1</sup>, Apeksha Ashok Kumar<sup>1</sup>, Hesham E. Masoud<sup>2</sup>, Grahame C. Gould<sup>1</sup>*

- 75 angiograms performed via distal TRA
- 98.7% success rate
- 4% minor complication rate
- No major complications

1. Hoffman et al. Transition from proximal to distal radial access for diagnostic cerebral angiography: learning curve analysis. *World Neurosurgery*. 2021.

# Access-Site Complications in Transfemoral Neuroendovascular Procedures: A Systematic Review of Incidence Rates and Management Strategies

- 16 RCTs and 17 non-RCTs
- 2.78% - 5.13% access-site complication rate
  - Minor: 2 - 4%
  - Major: 0.2 - 1%



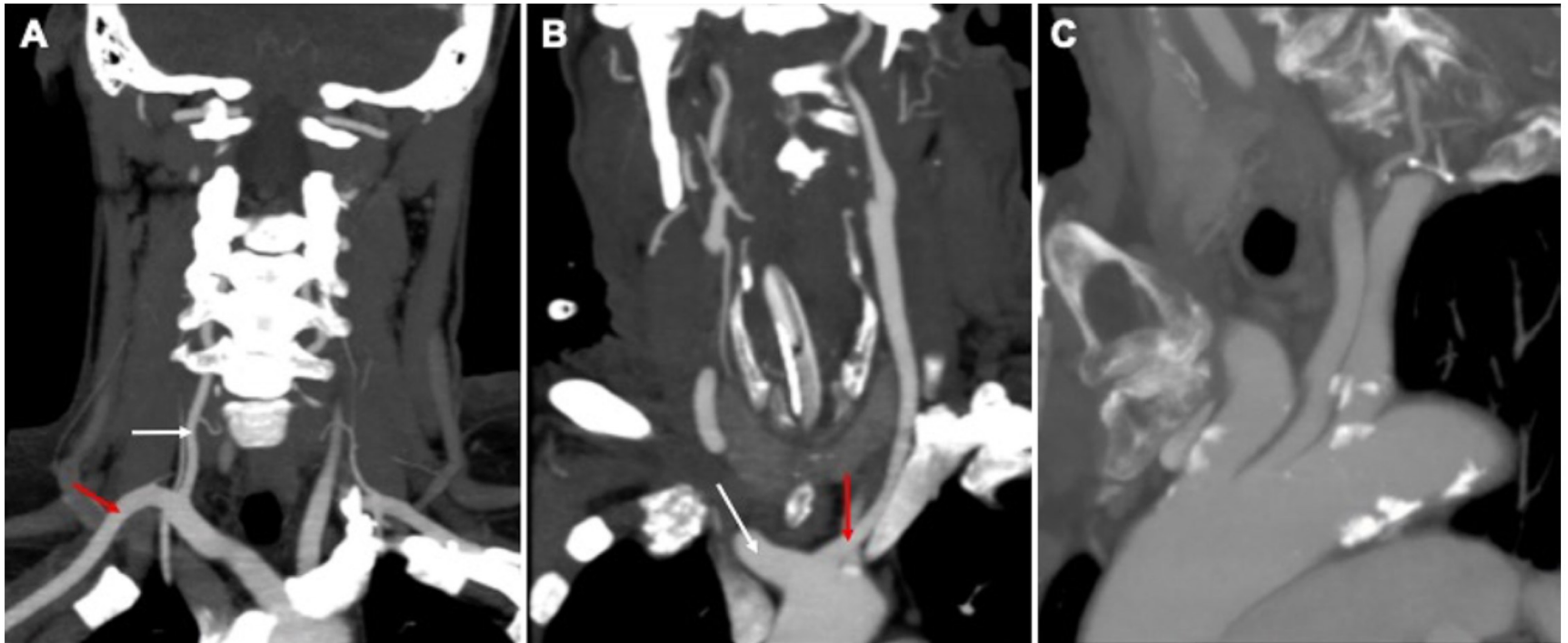
# TRA vs. TFA

- Bhatia et al.<sup>1</sup>
  - 80 patients randomized to TFA or TRA
  - Procedural success in 97.6% TRA vs. 97.3% TFA
  - TRA is not inferior
- Stone et al.<sup>2</sup>
  - 312 patients randomized to TFA or TRA
  - Procedural success in 97% TRA vs. 99% TFA
  - Shorter recovery times for TRA
  - TRA is not inferior

1. Bhatia et al. Radial vs. Femoral Artery Access for Procedural Success in Diagnostic Cerebral Angiography : A Randomized Clinical Trial. *Clin Neuroradiol.* 2020.  
2. Stone et al. Transradial versus transfemoral approaches for diagnostic cerebral angiography: a prospective, single-center, non-inferiority comparative effectiveness study. *J Neurointerv Surg.*

# TRA for mechanical thrombectomy

- Opportunities
  - Potentially fewer access complications
  - Potentially easier navigation of difficult arches
  - Straightforward navigation for posterior circulation strokes
- Challenges
  - Smaller artery limits sheath/aspiration catheter size
  - Existing devices are designed for femoral access
  - Learning curve



From Khanna et al. A comparison of radial versus femoral artery access for acute stroke interventions. *JNS*.

# Transradial versus transfemoral access for anterior circulation mechanical thrombectomy: comparison of technical and clinical outcomes

Stephanie H Chen,<sup>1</sup> Brian M Snelling,<sup>2</sup> Samir Sur,<sup>1</sup> Sumedh Subodh Shah,<sup>1</sup>  
David J McCarthy,<sup>1</sup> Evan Luther,<sup>1</sup> Dileep R Yavagal,<sup>1,3</sup> Eric C Peterson,<sup>1</sup>  
Robert M Starke<sup>1,4</sup>

- 33 patients TFA, 18 patients TRA, all with unfavorable arch anatomy
- No difference in # passes/time to reperfusion
- No difference in rate of successful revascularization (89% for TRA)
- No difference in functional outcome

# A comparison of radial versus femoral artery access for acute stroke interventions

Omaditya Khanna, MD, Lohit Velagapudi, BS, Somnath Das, BS, Ahmad Sweid, MD, Nikolaos Mouchtouris, MD, Fadi Al Saiegh, MD, Michael B. Avery, MD, MSc, Nohra Chalouhi, MD, Richard F. Schmidt, MD, Kalyan Sajja, MD, M. Reid Gooch, MD, Stavropoula Tjoumakaris, MD, Robert H. Rosenwasser, MD, and Pascal M. Jabbour, MD

- 52 patients TFA, 52 patients TRA
- No difference in rate of successful revascularization (92% TRA)
- No difference in # passes
- 5 access site hematomas with TFA, 1 with TRA. 1 patient with TFA developed pseudoaneurysm

## Transradial versus transfemoral access for anterior circulation mechanical thrombectomy: analysis of 375 consecutive cases

Timothy John Phillips <sup>1,2</sup> Matthew Thomas Crockett <sup>1,3</sup>  
Gregory D Selkirk <sup>1,3</sup> Ruchi Kabra <sup>1,2</sup> Albert Ho Yuen Chiu <sup>1,2</sup>  
Tejinder Singh <sup>1,2</sup> Constantine Phatouros <sup>1,3</sup> William McAuliffe <sup>1,3</sup>

- 245 patients TFA, 130 patients TRA
- Similar rates of 90-day mRS 0-2 for TFA (58%) and TRA (67%)
- Similar rates of successful reperfusion
- 6.5% TFA had an access complication requiring a second procedure, 0 for TRA (statistically significant)
- Shorter time from arteriotomy to reperfusion for TRA (25 min) vs. TFA (30 min)

# Transradial Access Results in Faster Skin Puncture to Reperfusion Time than Transfemoral Access in Posterior Circulation Mechanical Thrombectomy

**A. Maud<sup>\*</sup>, R. Khatri, M.R.A. Chaudhry, A. Vellipuram, S. Cruz-Flores, and G.J. Rodriguez**

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- 10 patients TRA, 10 patients TFA
- Shorter puncture to reperfusion time in TRA (29 min) vs. TFA (64 min) – trended towards significance ( $p = 0.08$ )
- Similar # passes, reperfusion, functional outcome

# Summary of evidence

- Limited by retrospective comparisons, small samples, choice of access driven by physician preference
- Reperfusion, functional outcomes appear similar
- Low rates of conversion to TFA
- Trend towards fewer access complications



# Future directions

- Large multi-center prospective studies
- Radial-specific devices

# Conclusion

- TRA yields similar outcomes as TFA for mechanical thrombectomy
- No strong evidence yet to suggest its superiority for neuro (unlike cardiac)
- TRA probably yields faster reperfusion for posterior circulation stroke, though this remains unproven
- Need for radial-specific devices

# Acknowledgments

- Dr. Grahame Gould
- Dr. Hesham Masoud