
بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

Arterial Vascular Access for Coronary Procedures: Femoral approach

By

Gamal F. Gomaa, MD

Professor of cardiology

Faculty of Medicine

Mansoura University

13 October 2014

Introduction

- Vascular access skills are one of the most fundamental and critical competencies for endovascular procedures
- The outcome of a procedure can be affected by the location and technique for obtaining vascular access
- A serious vascular access complication can cloud the success of an intervention

Introduction

- It is important to master the basic principles of access and to
- understand the various approaches that may be considered to optimize care for each patient and to succeed as an ***invasive cardiologist***

Arterial access via the common femoral artery (CFA) still comprises the most frequent strategy in the US and in EGYPT

Whey CFA is commonest access for cardiac cath ?

1. Large in caliber
2. Superficial
3. Predictable location
4. Overlying the femoral head provides solid support against which manual compression

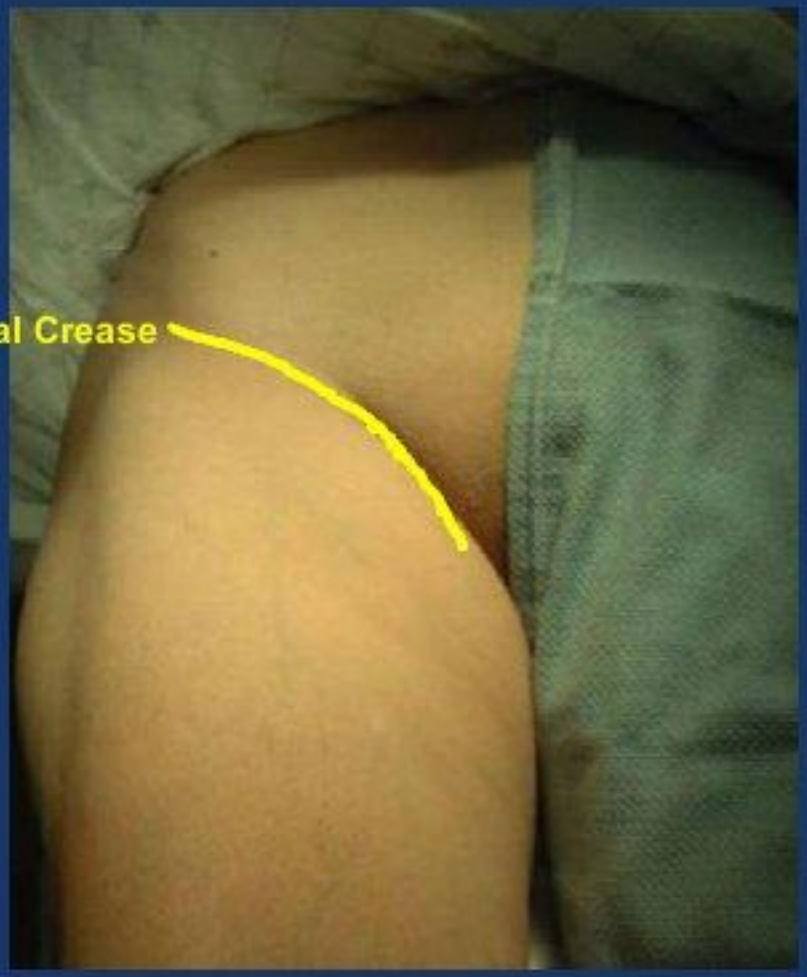
Technique of CFA access and closure

- **Identify and palpate anatomical landmarks**
- **Local anesthesia**
- **Femoral artery puncture**
  a. **Traditional puncture without flourscopy**
  b. **Micropuncture**
  c. **Ultrasound-guided**

Technique of CFA access and closure

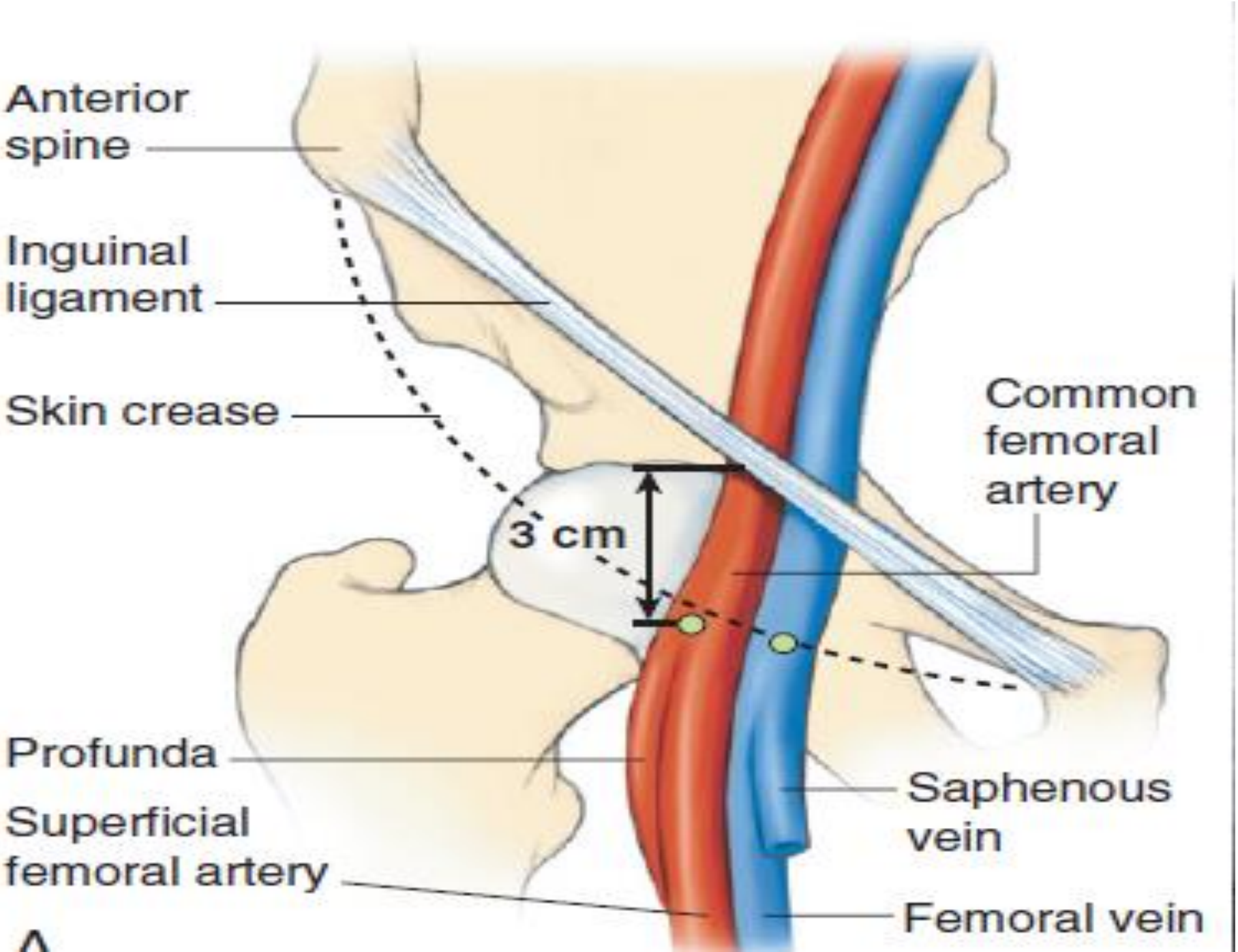
- **Subcutaneous tunnel**
- **Sheath insertion**
- **Study**
- **Sheath removal and hemostasis**
- **Complications**

Transfemoral Access – Basics

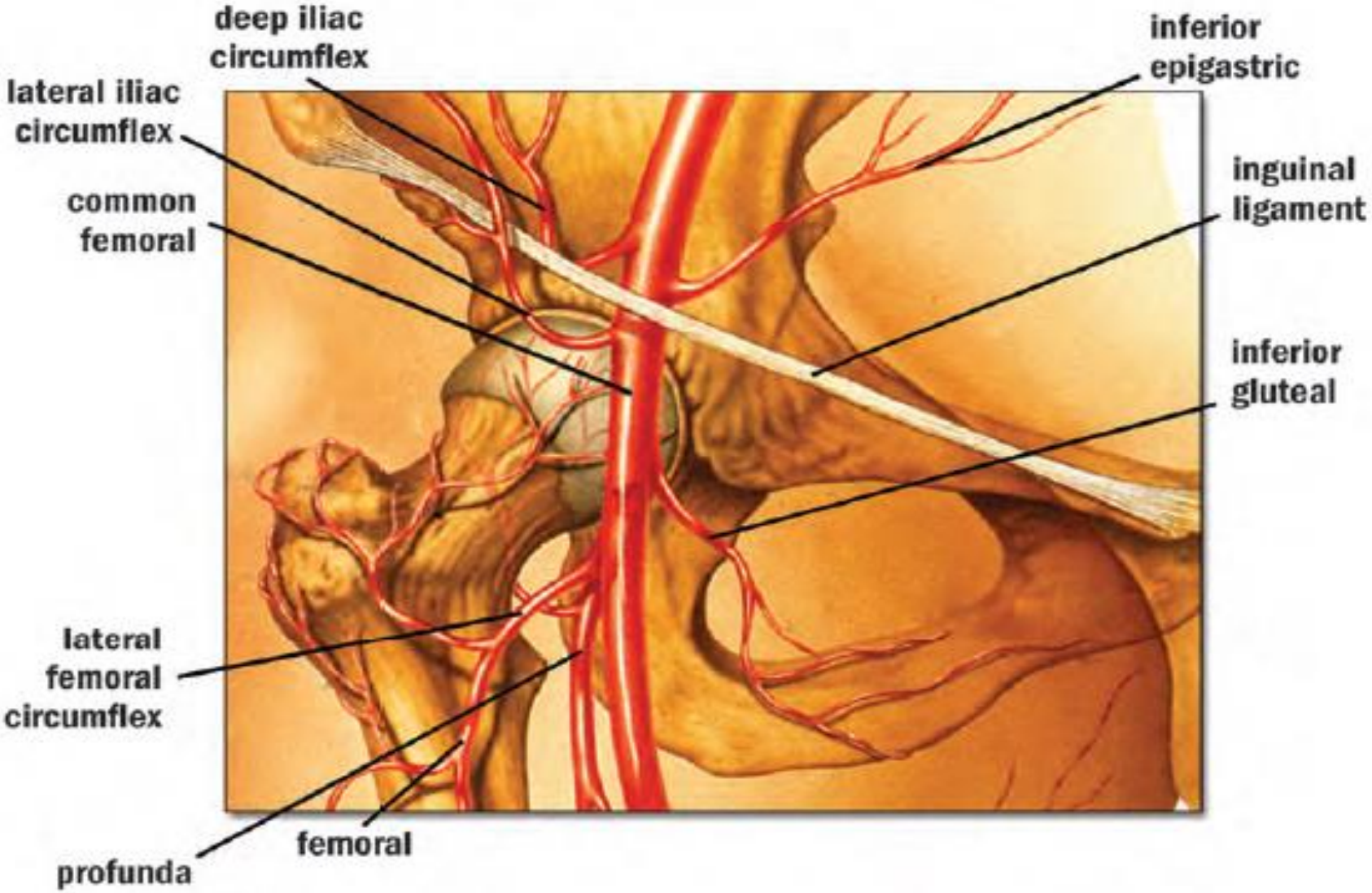


Transfemoral Access – Basics

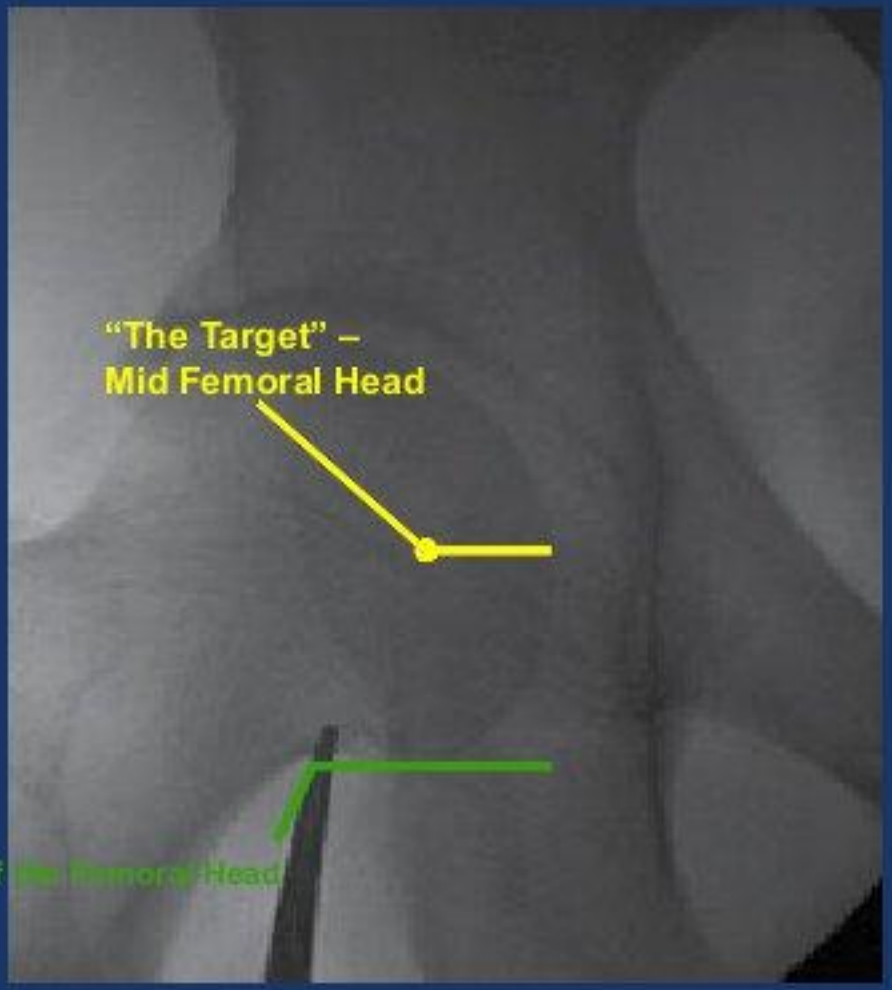
Courtesy
Dr Z Turi


Anterior spine
Inguinal ligament
Skin crease
3 cm
Common femoral artery
Profunda
Superficial femoral artery
Saphenous vein
Femoral vein

Femoral Artery Anatomy



Transfemoral Access – Basics



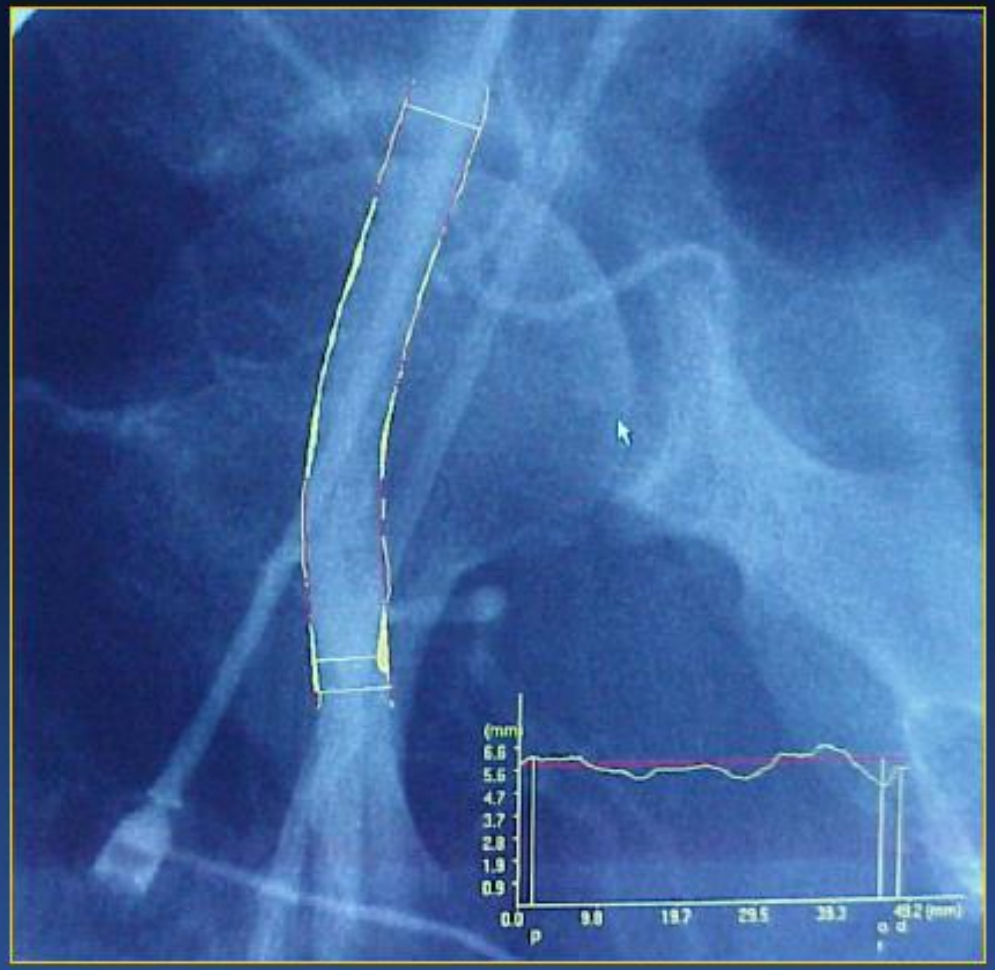
Place a radio-opaque object at the Inferior border of the femoral head

Insert needle at 45 degree angle at the point of intersection with the femoral artery pulse.

Transfemoral Access – Basics

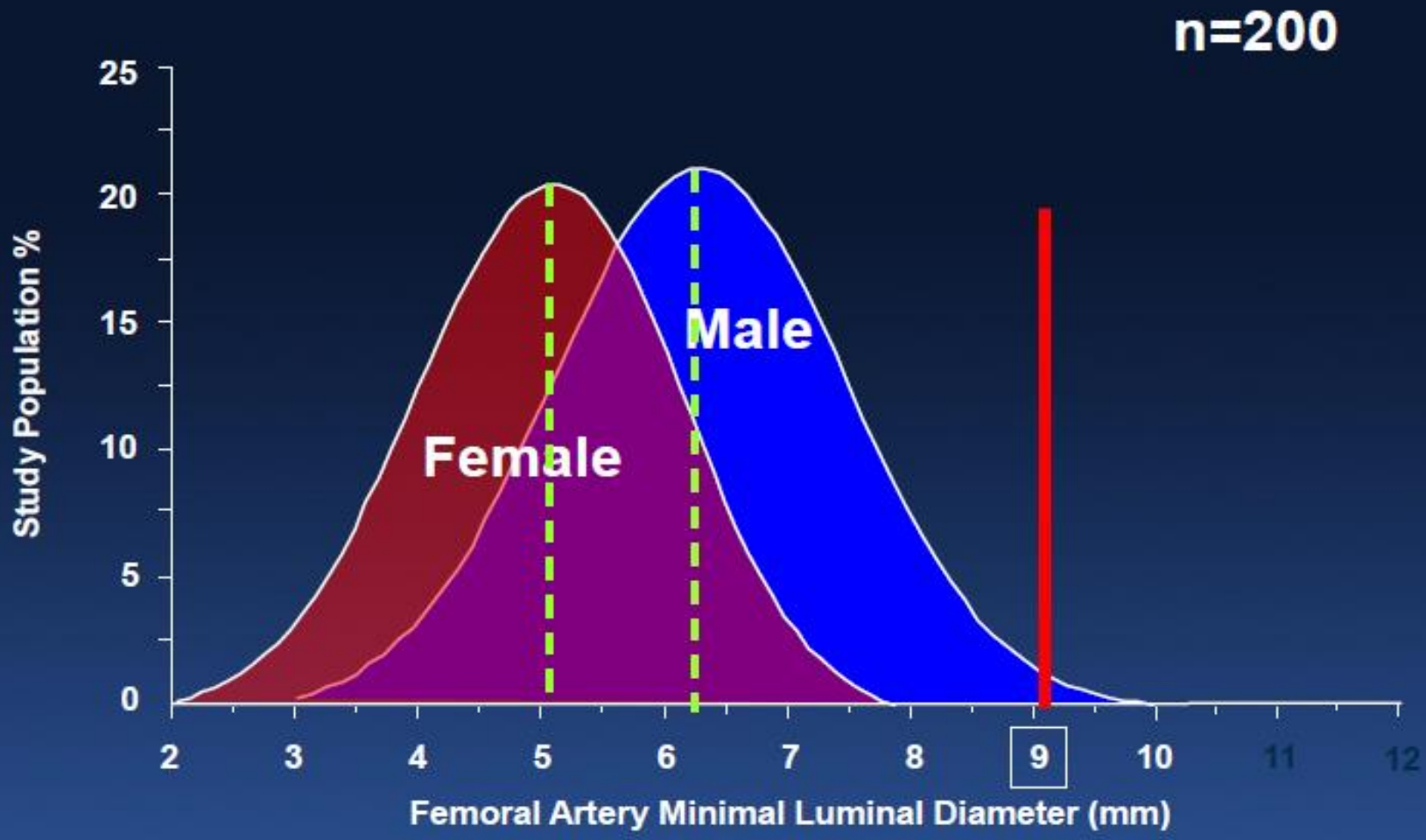
Femoral Artery Anatomy: A Prospective Study

- 200 consecutive patients
- All undergoing coronary angiography
- Femoral angiography at end of procedure
- Quantitative angiography

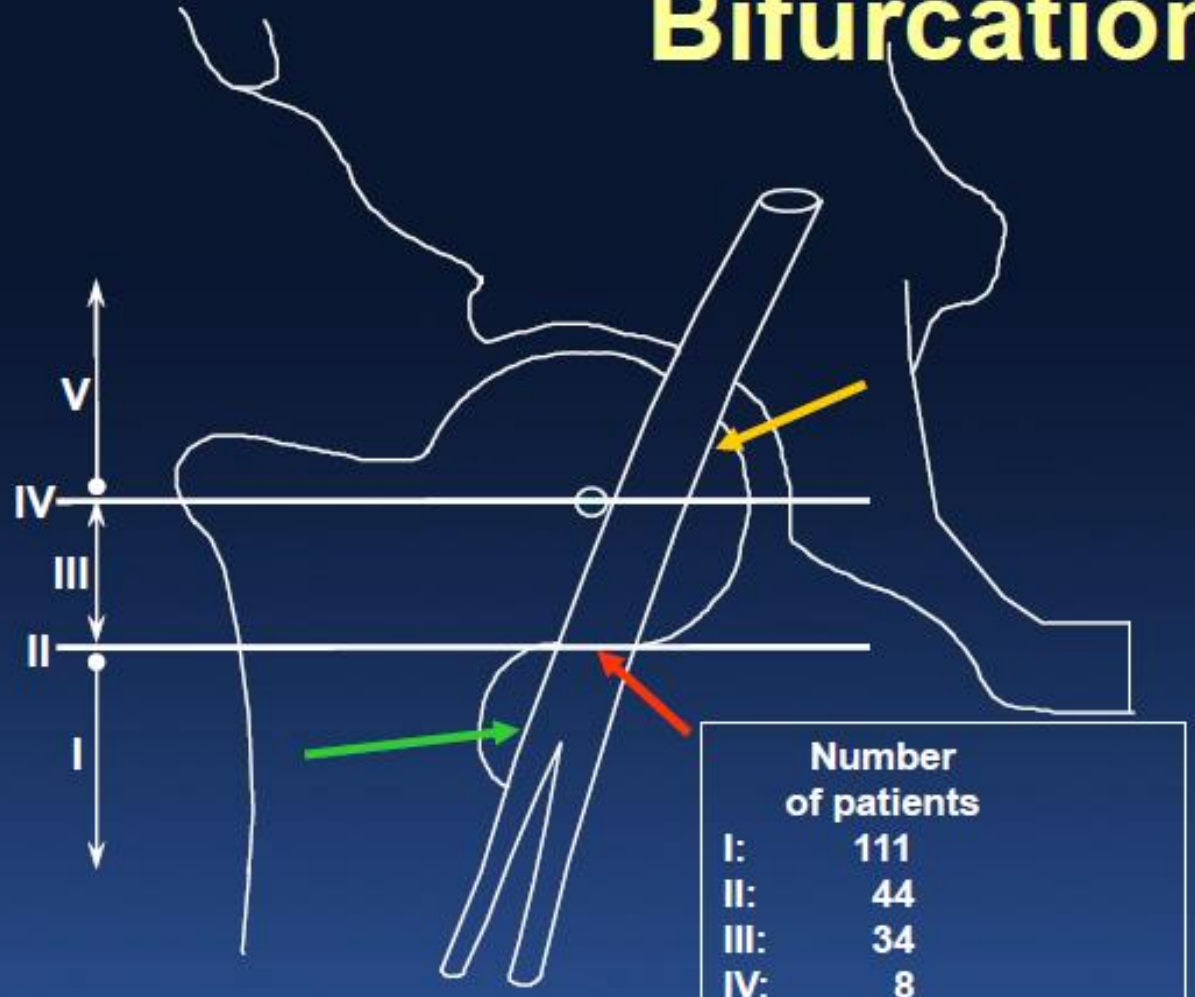


Schnyder et al CCI 2001

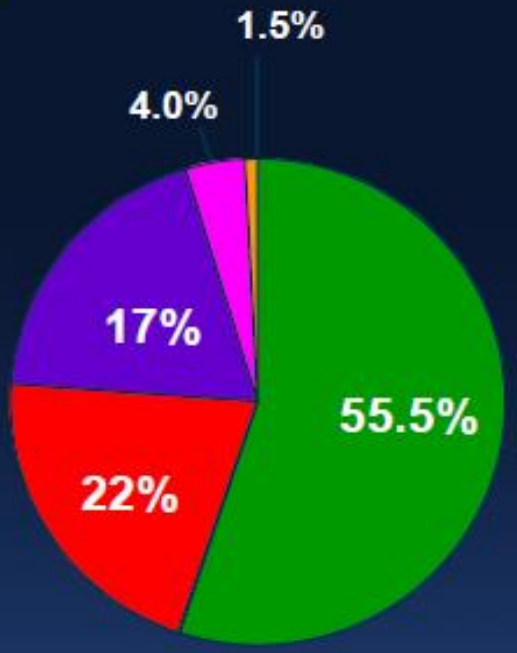
Minimal Luminal Diameter



Femoral Head and the CFA Bifurcation

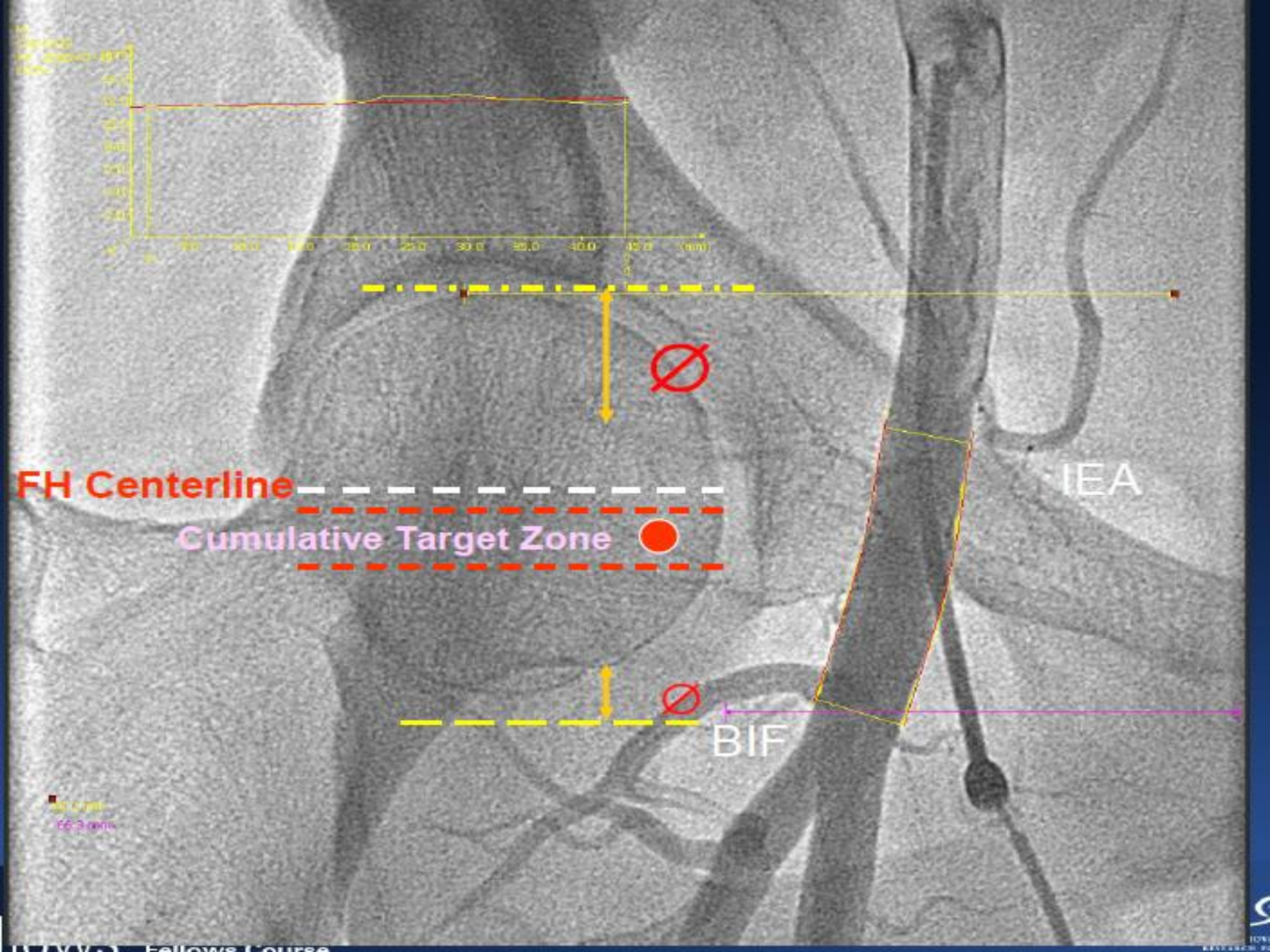


Number of patients	
I:	111
II:	44
III:	34
IV:	8
V:	3



- Below inferior border
- At inferior border
- Below center of head
- At center of head
- Above center of head

n=200


FH Centerline
Cumulative Target Zone
IEA
BIF

Transfemoral Access – Basics

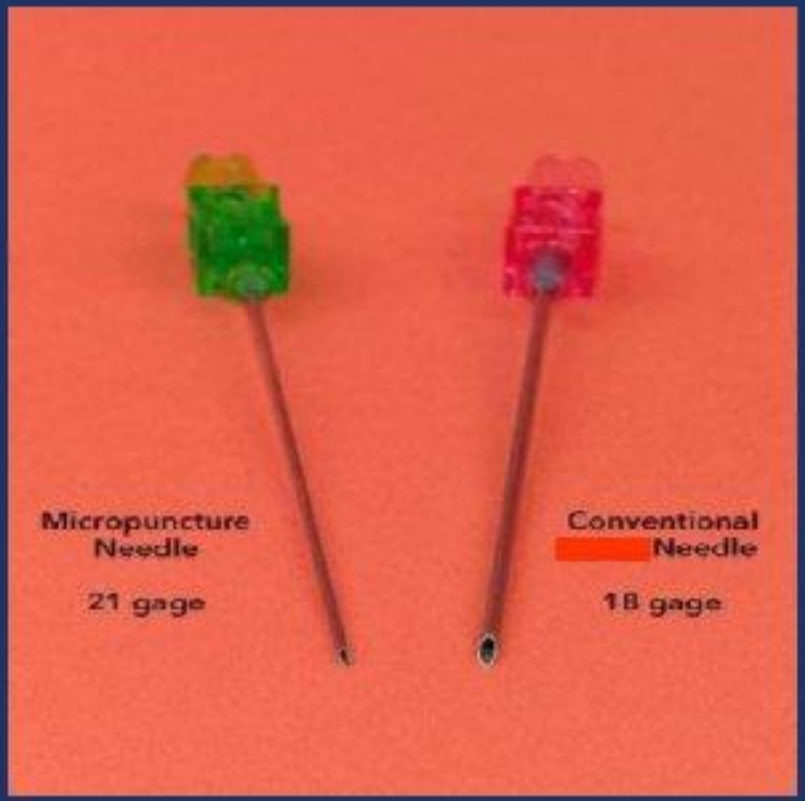
Routine femoral head fluoroscopy to reduce complications in coronary catheterization

Joshua A. Jacobi, MD, Jeffrey M. Schussler, MD, and Kenneth B. Johnson, MD

Variable	Overall (n = 256)	Treatment (n = 130)	Control (n = 126)	*P* value
Complications				
Bleed/hematoma	4%	5%	2%	NS
Correct placement				
Correct overall	60%	65%	54%	NS
Correct in those with BMI <30	59%	62%	57%	NS
Correct in those with BMI ≥30	60%	69%	50%	0.02

Proc (Bayl Univ Med Cent) 2009;22(1):7–8

Transfemoral Access – Micropuncture Assisted



4F Sheath/Dilator

.018" Wire

Transfemoral Access – Micropuncture Assisted

After introduction of micro puncture sheath, an angiogram is performed.

If access is in an ideal location, the micropunture sheath accommodates an .035" wire for exchange to a "working sheath."

If access is NOT in an ideal location, the micropuncture sheath is pulled, and after five minutes of manual compression, vascular access is obtained again with the micropuncture system.

Transfemoral Access – Ultrasound Assisted

Real-Time Ultrasound Guidance Facilitates Femoral Arterial Access and Reduces Vascular Complications

FAUST (Femoral Arterial Access With Ultrasound Trial)

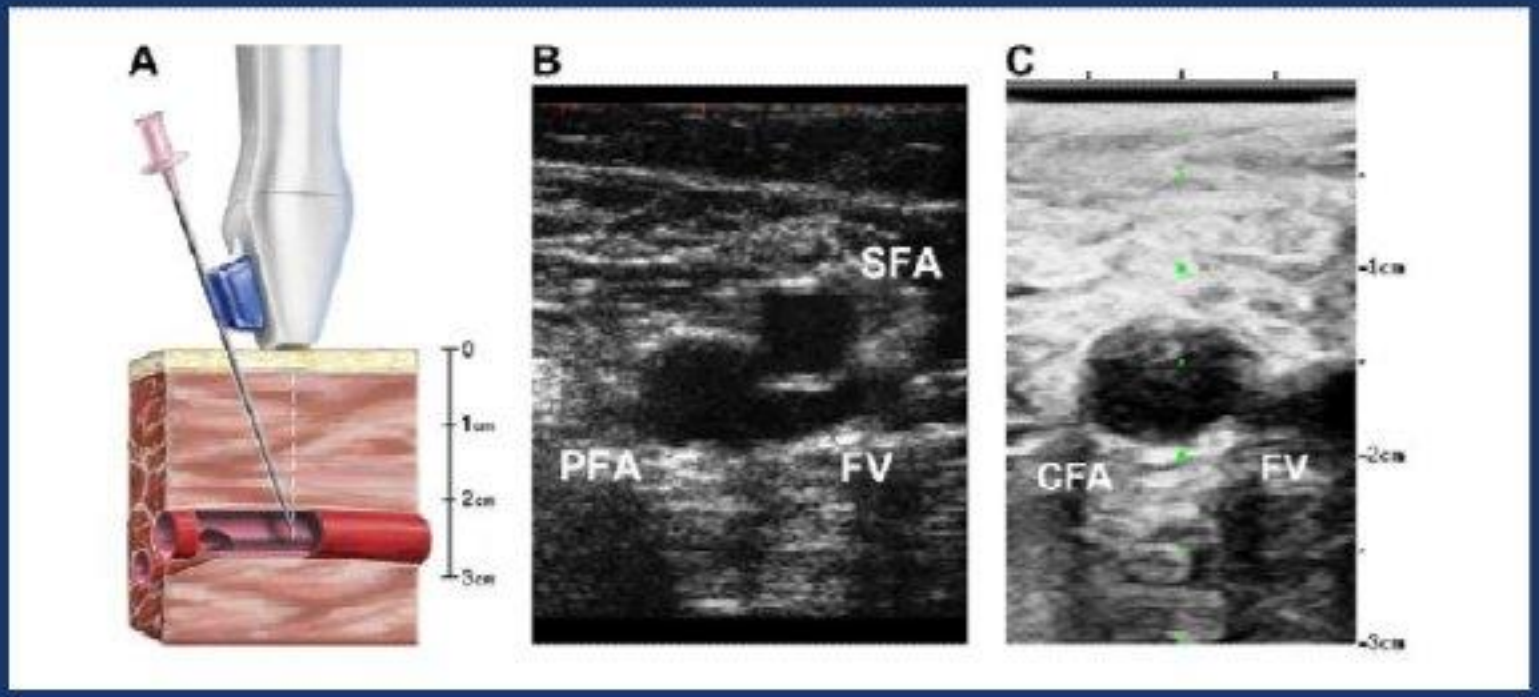
Arnold H. Seto, MD, MPA,* Mazen S. Abu-Fadel, MD,† Jeffrey M. Sparling, MD,†
Soni J. Zacharias, MD,† Timothy S. Daly, MD,† Alexander T. Harrison, MD,*
William M. Suh, MD,* Jesus A. Vera, MD,* Christopher E. Aston, PHD,‡
Rex J. Winters, MD,§ Pranav M. Patel, MD,* Thomas A. Hennebry, MB, BCH, BAO,†
Morton J. Kern, MD*

JACC: CARDIOVASCULAR INTERVENTIONS, VOL. 3, NO. 7, 2010
JULY 2010:751–8


Courtesy Walter Tan WakeMed Raleigh NC

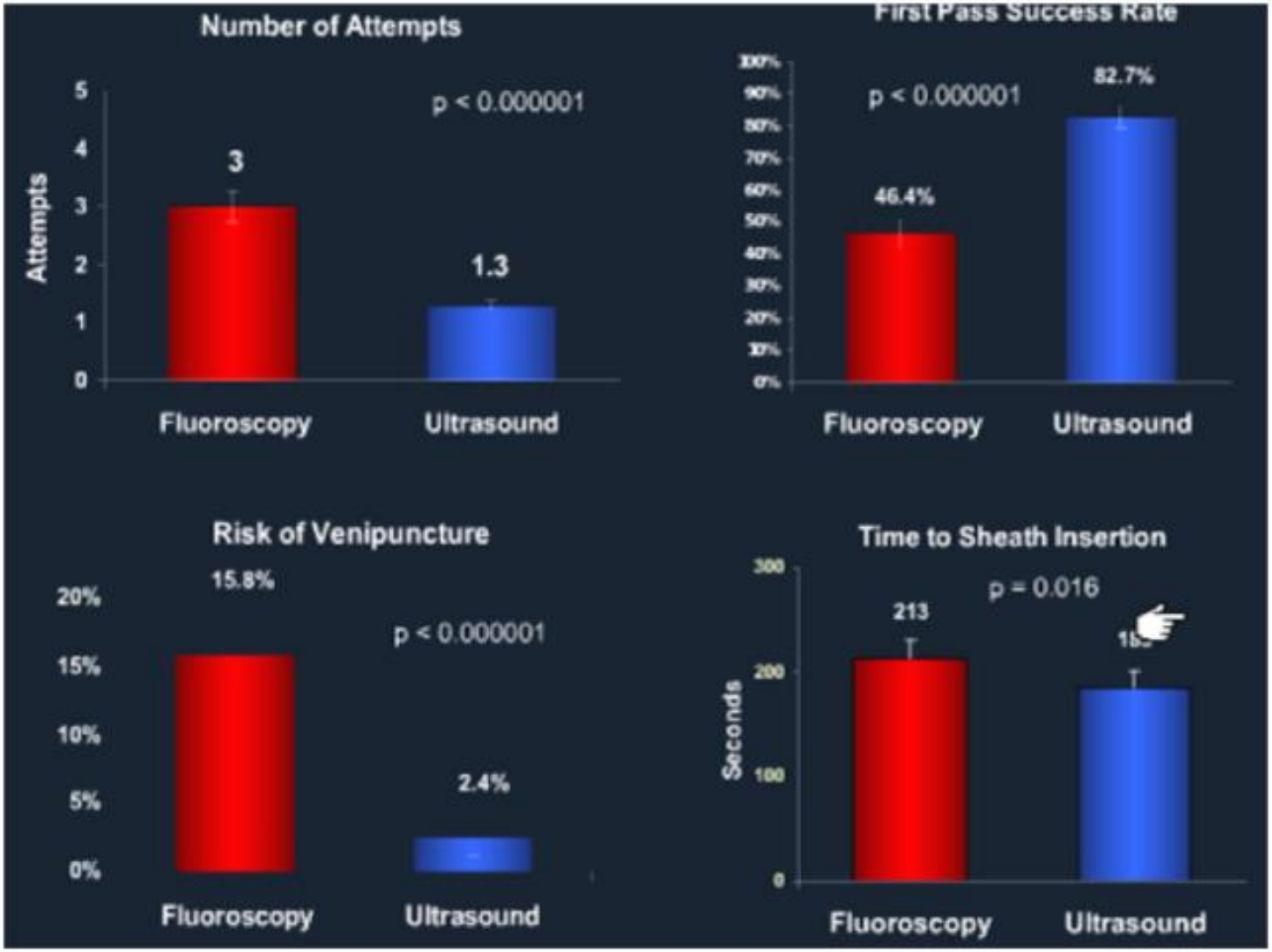
Courtesy Walter Tan WakeMed Raleigh NC

Transfemoral Access – Ultrasound Assisted



JACC: CARDIOVASCULAR INTERVENTIONS, VOL. 3, NO. 7, 2010
JULY 2010:751–8

FAUST: Ultrasound RCT Outcomes



Seto AH et al. JACC CV Interv '10; 3:751

Modified Seldinger Technique

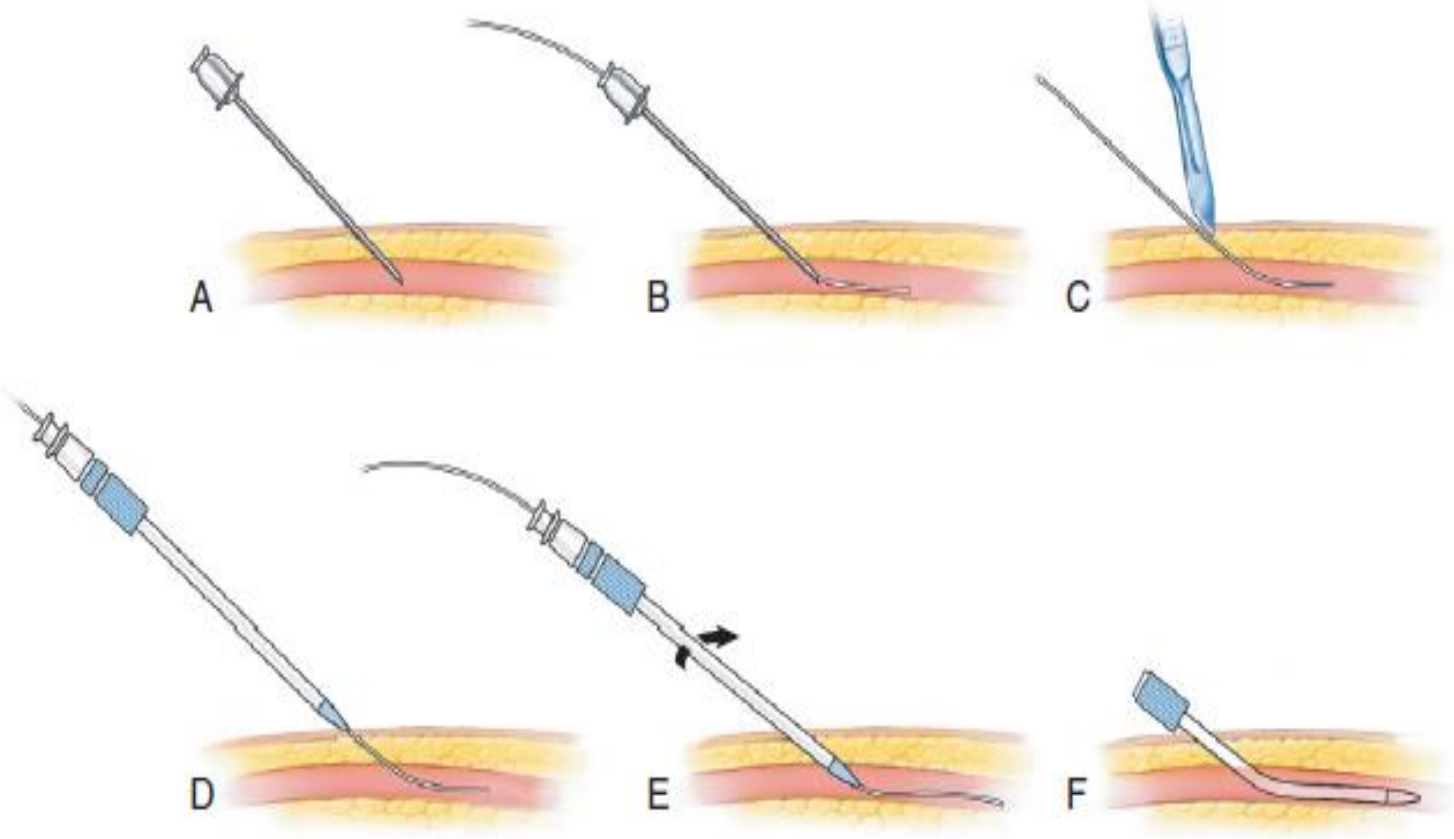


FIGURE 20-5 Modified Seldinger technique for percutaneous catheter sheath introduction. **A,** Vessel punctured by needle. **B,** Flexible guidewire placed into the vessel through the needle. **C,** The needle removed, the guidewire left in place, and the hole in the skin around the wire enlarged with a scalpel. **D,** Sheath and dilator placed over the guidewire. **E,** Sheath and dilator advanced over the guidewire and into the vessel. **F,** Dilator and guidewire removed while the sheath remains in the vessel. *(From Hill JA, Lambert CR, Vlietstra RE, Pepine CJ: Review of general catheterization techniques.* In *Pepine CJ, Hill JA, Lambert CR [eds]: Diagnostic and Therapeutic Cardiac Catheterization. 3rd ed. Baltimore, Williams & Wilkins, 1998, p 107.)*

Manual Compression

- Hold time ~ 2x sheath size ?
- Hold location - PROXIMAL
- Possible morbidity associated with prolonged bedrest and compression
- Use sterile technique

Transfemoral Access – Reducing Complications

Manual Sheath Removal

- *Immediately after procedure in diagnostic cases*
- *Delayed removal for PCI*
  - *ACT < 150s in case heparin was used*
  - *In 2 hours after stopping bivalirudin*
  - *After 6-8hrs of last enoxaparin dose*
  - *Even longer after fondaparinux*
  - *Increased sheath size increases complications*

The Promise of Vascular Closure Devices

- Patient comfort and convenience
  - Early ambulation
  - Early hemostasis
- ~~Decrease complication rate~~

Transfemoral Access – Arterial Closure Device (ACD)

Active

Plugs
Angioseal, Vascade - Collagen
Mynx – PEG

Suture
Perclose A-T
Prostar XL

Staple/Clip
Angiolink – Titanium staple
Starclose – Nitinol clip

Passive

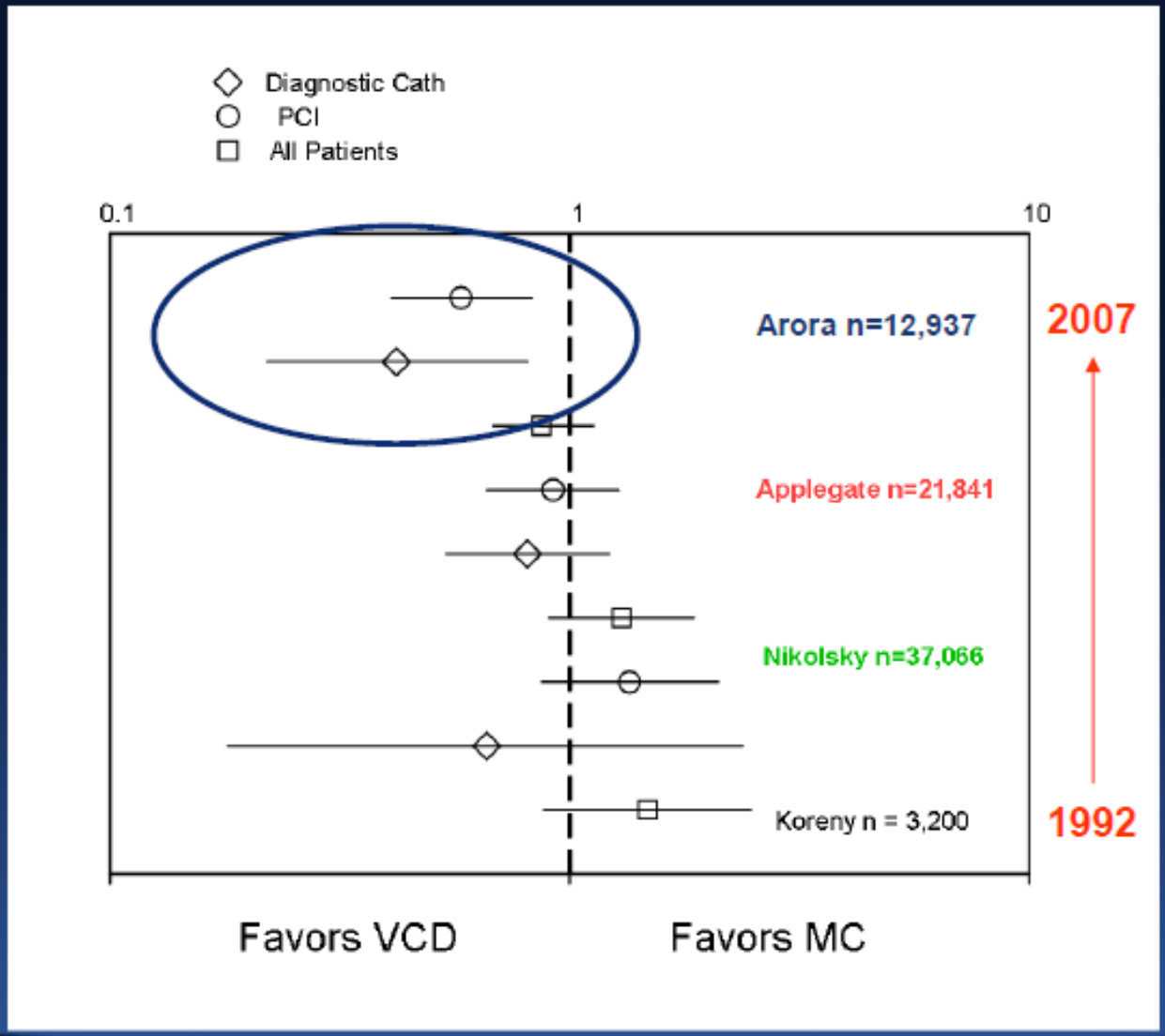
Patch
D-stat

Compression
FemStop
ClampEase

Others
Boomerang
SoundSeal
Quickclose

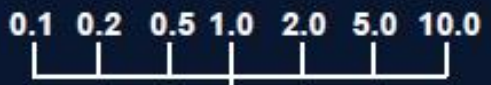
Vascular Closure Devices

Evidence base = Early hemostasis, early ambulation



ACC/AHA Class III indication to **lower** complication rates

Complication Rates

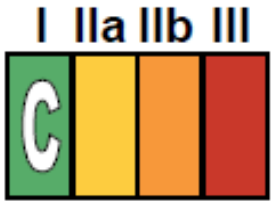


	OR (95% CI)	Heterogeneity test P-value
Dx studies	1.44 [0.43, 4.82]† 0.66 [0.18/, 2.38]*	0.0003 0.16
PCI studies	1.11 [0.94, 1.33]* 1.35 [0.87, 2.11]*	0.22 0.15
Both Dx+PCI studies	1.83[1.15,2.90]† 1.15 [0.67, 1.98]*	0.001 0.43
All studies	1.34 [1.01, 1.79]† 1.30 [0.90,1.87]*	<0.0001 0.19

Favors ACD Favors Control

Nikolsky et al. *JACC* 2004.

Vascular Closure Devices



Patients considered for vascular closure devices should undergo a femoral angiogram to ensure anatomic suitability for deployment.

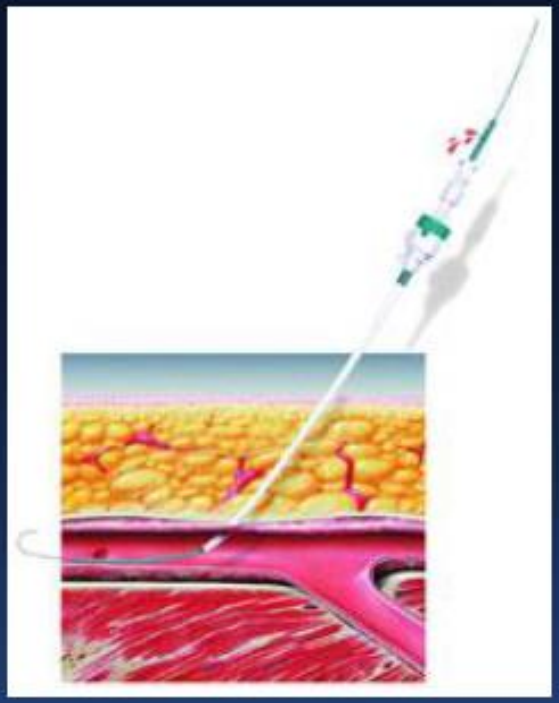
The use of vascular closure devices is reasonable for the purposes of achieving faster hemostasis and earlier ambulation compared with the use of manual compression.

No Benefit

The routine use of vascular closure devices is not recommended for the purpose of decreasing vascular complications, including bleeding.

Anchored Plugs

Active Approximation



Angio-Seal

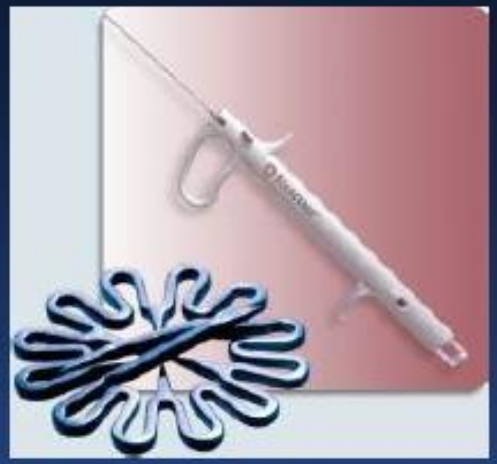
Thrombosing agent

\+ High success rate, short learning curve, short deployment time

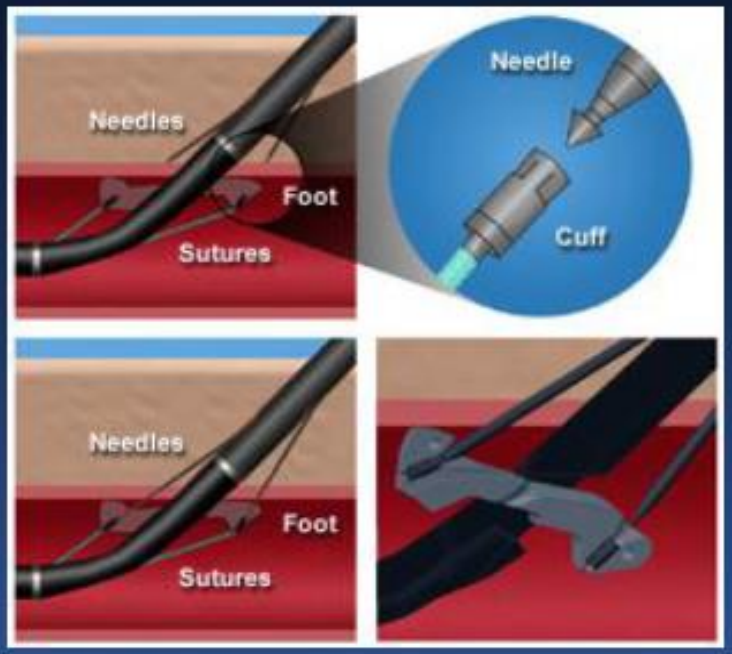
\- Vascular occlusion, infection

Suture or Staple/Clip Devices

Active Approximation

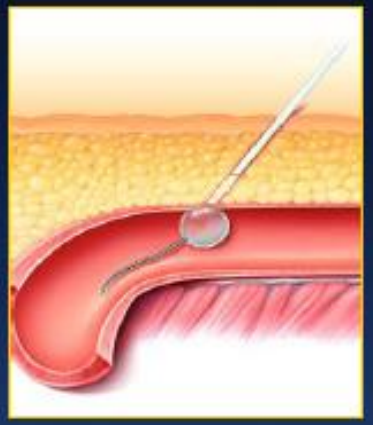


Perclose
StarClose



No thrombosing agent

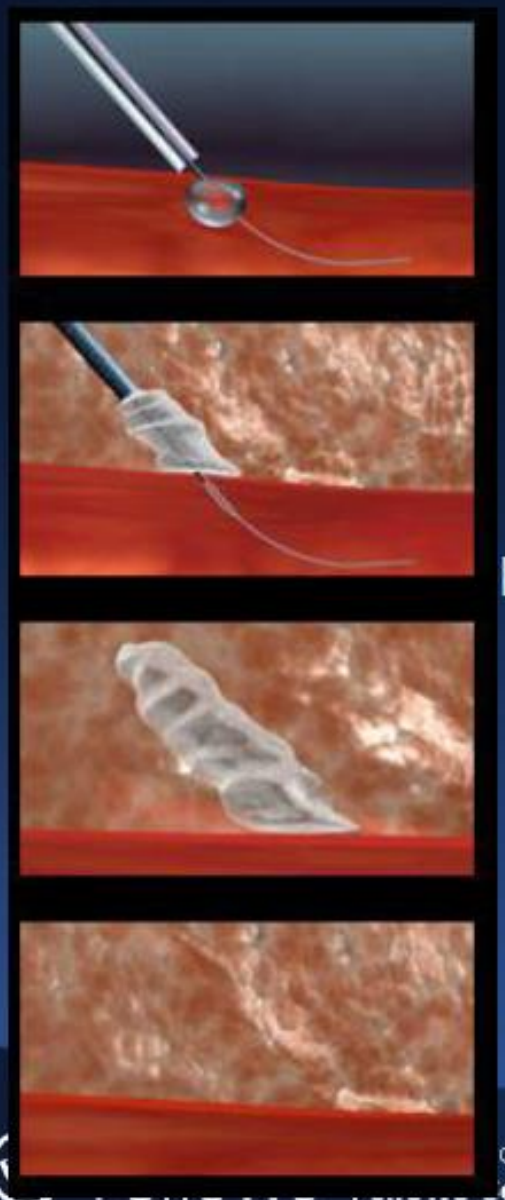
Unanchored Plugs



VasoSeal and Duett no longer marketed

Return of the Unanchored Plugs ?

- **Passive approximation**



Mynx

ExoSeal

\+ Through procedure sheath, simplified, resorption

\- Passive approximation

- **Sealing agent**

Local complications of FA access: 2-10%

- Hematoma (1-12%)
- Pseudoaneurysm (1-6%)
- AV fistula (<1%)
- Vessel laceration (<1%)
  - Free bleeding
- Intimal dissection
  - Ante- or retro-grade
- Acute vessel closure (<1%)
  - Thrombosis (small artery lumen)
- Retroperitoneal hemorrhage (0.2 – 0.9%)
- Thickening of the perivascular tissues
- Neural damage
- Infection
- Venous thrombosis
- Pericatheter clot

Complication rate persistent over many decades

Most common: hematoma

Most lethal: retroperitoneal hemorrhage

Transfemoral Access – Risk Factors for Complications

Patient Related

- *Advanced Age*
- *Female Gender*
- *Small Vessel Size*
- *↓ Body surface area*
- *Renal failure*
- *Diabetes*
- *Vascular disease*

Procedure Related

- *Increased Sheath size*
- *High or Low Puncture Site*
- *Prior procedures*
- *Anticoagulation (esp. w/IABP)*
- *GPIIb/IIIa infusion*
- *Lytic Use*

Transfemoral Access – Complications

Retroperitoneal Hematoma

TABLE II. Independent Correlates of Retroperitoneal Bleeding

	OR	95% CI	*P*-value
Sheath placement superior to inferior epigastric artery[a]	17.6	2.21–141.63	<0.001
Female sex	3.73	2.55–5.43	<0.001
Angioseal™	2.80	1.95–4.00	<0.001
GP IIb/IIIa inhibitor	1.92	1.31–2.82	0.001
Weight (per kg)	0.987	0.976–0.997	0.014
Acute MI	1.82	1.05–3.17	0.035

Ellis CCI 2006

Transfemoral Access – Complications

Retroperitoneal Hematoma

Clinical Signs

Anemia	100%
Hypotension	92%
Abdominal tenderness	69%
Diaphoresis	58%
Groin pain	46%
Low abdominal pain	42%
Groin hematoma	31%
Bradycardia	31%
Back pain	23%

Farroque JACC 2005

Cullen's Sign

Grey Turner's Sign

Mookadam NEJM 2005

Transfemoral Access – Complications
Retroperitoneal Hematoma

Management

Step 1. Treat Immediately!

Reverse Anticoagulation
Volume Resuscitation
Manual Compression

Step 2. Diagnosis

If hemodynamically unstable ----- > Cath Lab

If hemodynamically stable ------ > CT Scan

Transfemoral Access – Complications

Inguinal Hematoma

Transfemoral Access – Complications

Inguinal Hematoma

Most Common Complication
Results from lack of hemostasis

Signs and Symptoms

- Swelling
- Pain
- Ecchymosis
- Decreased Hemoglobin (late)
- Femoral Neuropathy (late)

Transfemoral Access – Complications

Haematoma after coronary angiography and percutaneous coronary intervention via the femoral artery frequency and risk factors

Kirsten Andersen*, Marianne Bregendahl, Helen Kaestel, Mette Skriver, Jan Ravkilde

- Female
- SBP > 160
- >1 Puncture attempt
- Sheath time > 16 minutes
- ACT > 175 seconds
- GPIIbIIIa use
- LMW use
- Anti-coagulation use
- Personnel change during groin hold

K. Andersen et al. / European Journal of Cardiovascular Nursing 4 (2005) 123–127

Transfemoral Access – Complications
Inguinal Hematoma

Management

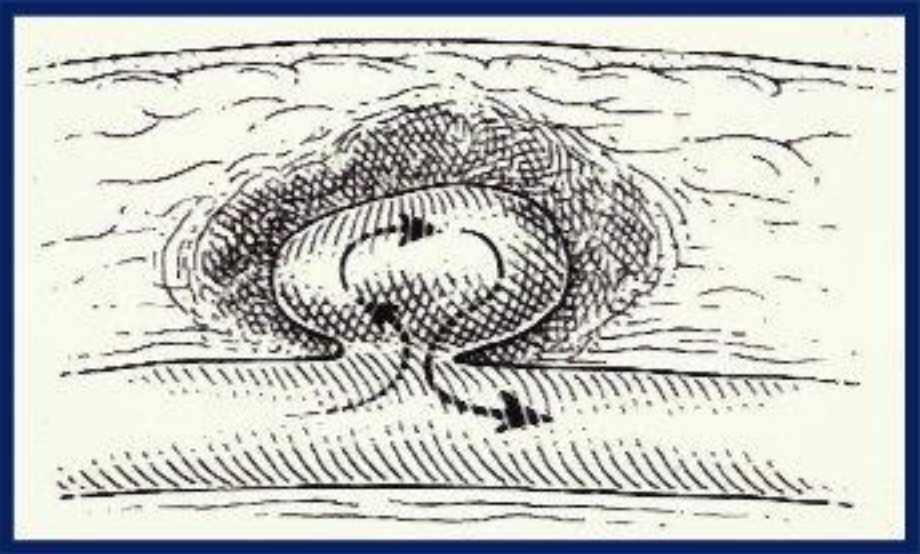
Manual Compression
Analgesics
Volume resuscitation

If unable to control --- > Cath Lab

Any significant hematoma should be evaluated for a pseudo-aneurysm

Transfemoral Access – Complications

Pseudoaneurym



Signs and symptoms: Pain, swelling, pulsitile mass, bruit…

May not present with any physical finding

Olin et al. *Circulation.* 2007;115:2666-2674

Transfemoral Access – Complications

Pseudoaneurym

Management

Observation
- *Small PA< 2.0cms*
- *Anticoagulation decreases rate thrombosis*

Compression
- *Largely abandoned*

Surgical Repair
- *Wide necked*

Thrombin injection
- *Main therapy*

Infections

- 0.3%
- Median incubation – 8 days
- Staph aureus 75%
- BC + 86%
- Diabetics 80%
- PSA 42%
- 6 % mortality

Sohail Mayo Clinic Proceedings

Courtesy Dr. John Eidt, UAMS.

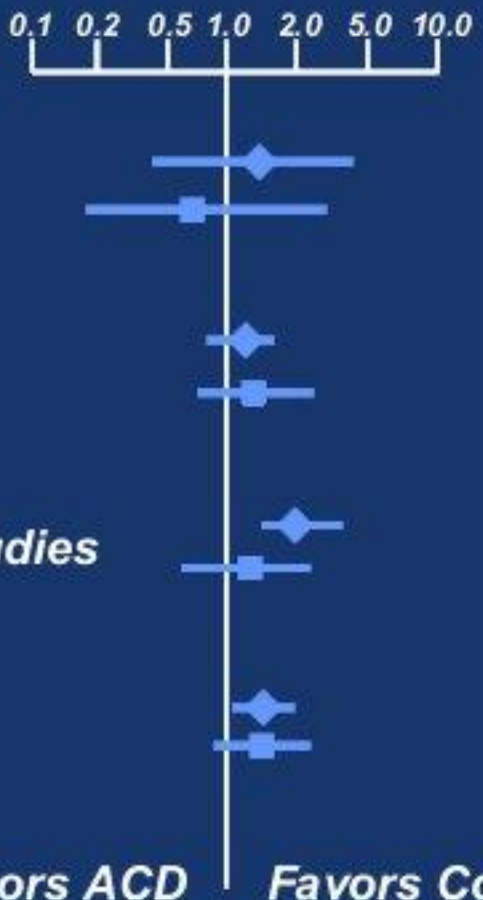
Why Femoral Infections Occur

- Bacteria friendly region
- Failure to maintain good sterile technique
- Insertion of foreign body in tissue track
- Sheath left indwelling
- Blood in deep track is great culture medium

Why Pseudoaneurysms

Location of puncture
Time held
Experience of sheath puller

Transfemoral Access – ACD



	OR (95% CI)	Heterogeneity test P-value
Dx studies	1.44 [0.43, 4.82]†	0.0003
	0.66 [0.18/, 2.38]*	0.16
PCI studies	1.11 [0.94, 1.33]*	0.22
	1.35 [0.87, 2.11]*	0.15
Both Dx+PCI studies	1.83[1.15,2.90]†	0.001
	1.15 [0.67, 1.98]*	0.43
All studies	1.34 [1.01, 1.79]†	<0.0001
	1.30 [0.90,1.87]*	0.19

Meta Analysis:
30 Studies
37,066 Patients

Nikolsky et al. JACC 2004.

Transfemoral Access – Complications
ACD Associated Injury

Early Diagnosis

- Document pre-VCD deployment vascular exam
- Have staff evaluate distal pulse after deployment
- Evaluate the foot for temperature difference, pallor

Management

- Reasonable to try an endovascular approach
- But remember the injury site is an area easily accessible to surgeons

Transfemoral Access – Complications
ACD Associated Injury

- *Device-related Complications*
  - *Vessel obstruction*
    - *Direct mechanical – foot plates*
    - *Embolization of plugs*
  - *Bleeding*
    - *Mechanical secondary to device*
    - *Secondary to early sheath pull (with subsequent failed closure)*
    - *Infection*
- *Some of these complications are arguably additive to those seen with manual compression*
- *There is no FDA database for complications of manual compression*

How to Decrease Risk of Complications

1. Access using fluoroscopy and/or ultrasound
2. Needle entry below centerline of femoral head
3. Femoral angiogram regardless of closure device use
4. Proceed to PCI (and anticoagulate) only if puncture in safe zone
5. Use micropuncture / active visualization

Limitation of Femoral Access

- Obese patients
- Inability to lie flat
- Peripheral arterial disease
- Abdominal aortic aneurysm
- Evidence of prior vascular surgery involving the site or path of access

The Way To The Heart Is Through The Wrist: Radial Catheterization Comes To America (Finally)

Zoltan G. Turi, MD

Fellows
19th Annual
Interventional Cardiology
Fellows Course

CARDIOVASCULAR RESEARCH FOUNDATION®

Acknowledgements

- Douglas E. Drachman, MD, FACC: Vascular access. Cath. Sap 4, 2014
- *Robert T. Pyo, MD:* **Arterial Vascular Access for Coronary Procedures, fellow course 2014**
- **Zoltan G. Turi: femoral vascular access and closure: step by step. fellow course 2013**

UPCOMING ACTIVITIES

- **THURSTHDAY 16 OCTOBER: FIRST EPS MEETING**
- **MONDAY 3 NOVOMBER: Cath SAP 4 INTERVENTIONAL CARDIOLOGY MEETING**


THANK YOU
مركز تقنية الاتصالات والمعلومات - جامعة المنصورة