



# Why The Thigh?

## *The Rationale and Data on Using the Femoral Site for IO Infusions*

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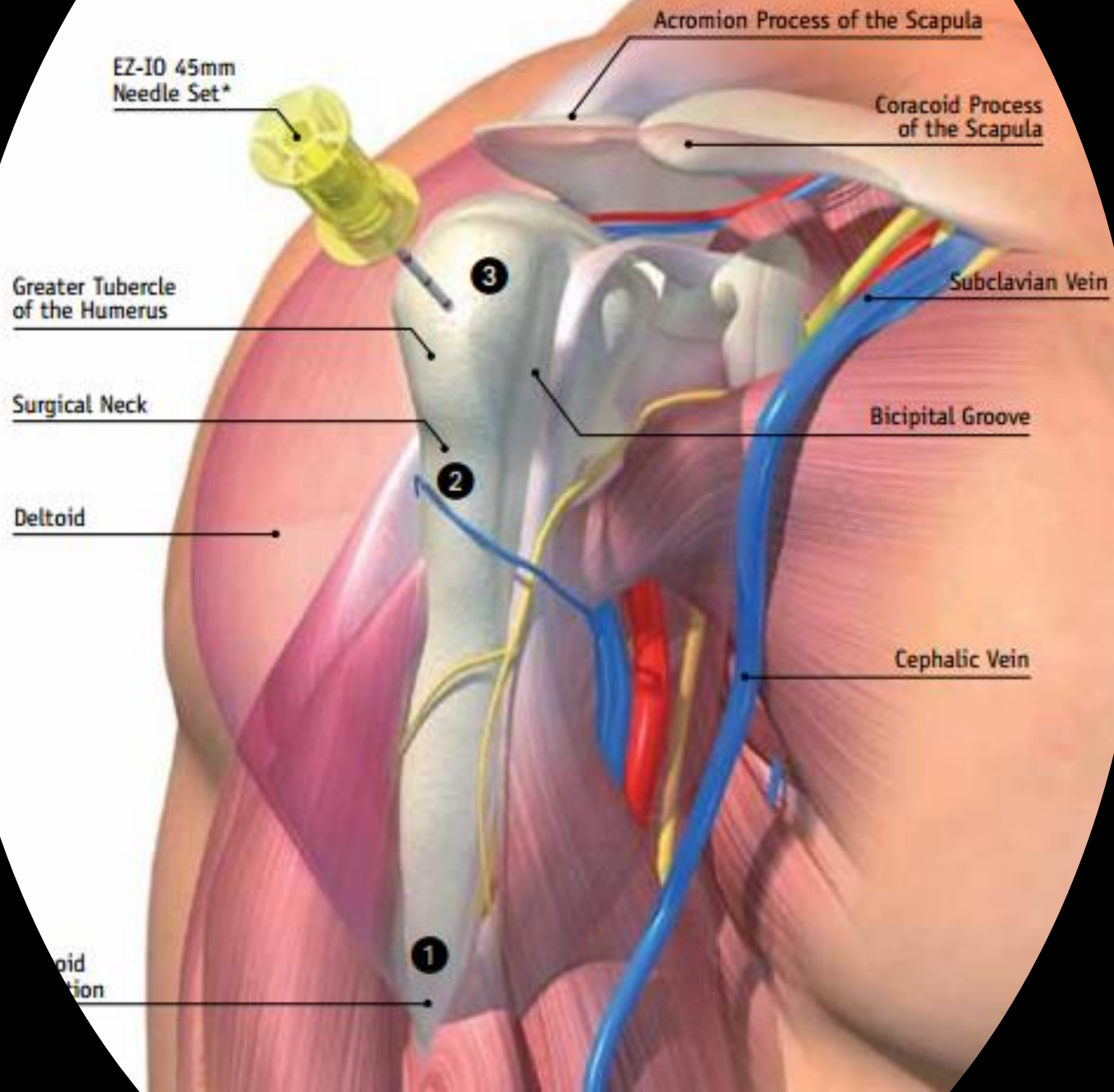
# Disclosures

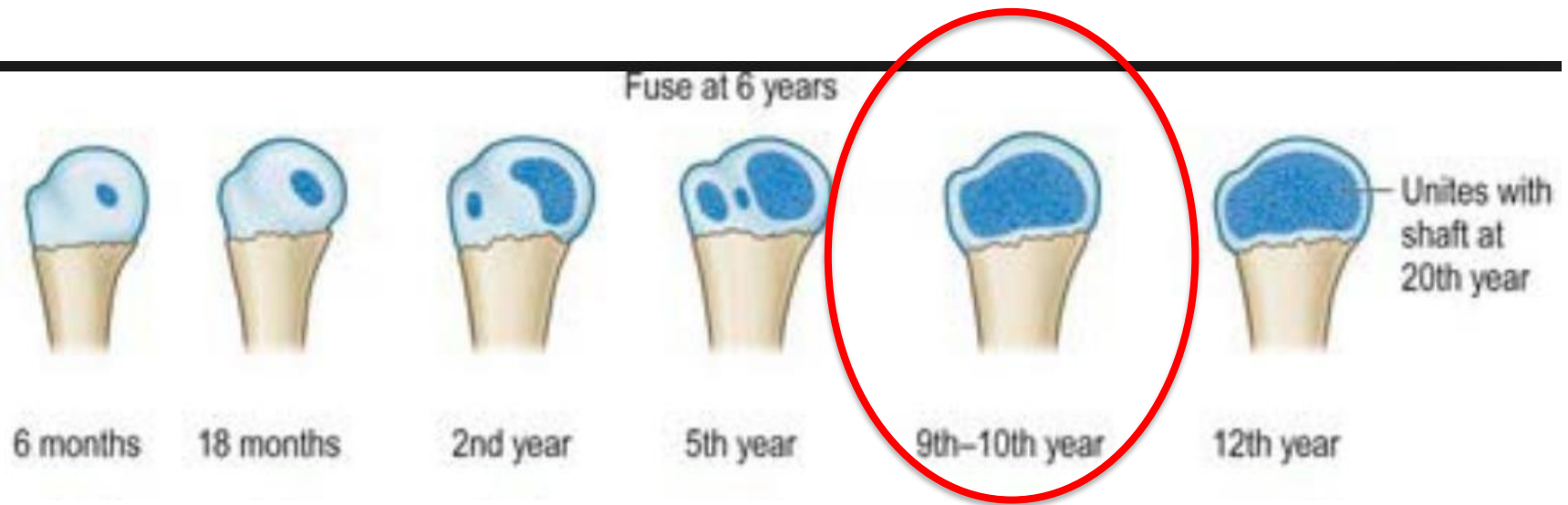
- Founder & Chief Medical Officer  
Handtevy - Pediatric Emergency Standards, Inc.

# Questions

- Should we stop placing the tibial IO?
- Can we use the distal femur in adults?
- Does IO Amio & Lido work?

– EZ-IO Proximal Humerus Insertion Site





## ***Humeral Head Insertion Site Selection***

- Humeral Head fully ossified during 9-10<sup>th</sup> YR
- Consider IO at this age

**Adult**



**Infant/Child**



# Proximal Tibia *Landmarks*

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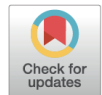
# Resuscitation

journal homepage: [www.elsevier.com/locate/resuscitation](http://www.elsevier.com/locate/resuscitation)



## Clinical paper

# Intraosseous needles in pediatric cadavers: Rate of malposition



*Daniel Maxien<sup>a,e,\*</sup>, Stefan Wirth<sup>a,d</sup>, Oliver Peschel<sup>c</sup>, Alexander Sterzik<sup>f</sup>,  
Sonja Kirchhoff<sup>g</sup>, Uwe Kreimeier<sup>b</sup>, Maximilian F. Reiser<sup>a</sup>, Fabian G. Mück<sup>d</sup>*

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**Table 2 – Infant cadavers (age <1 year).**

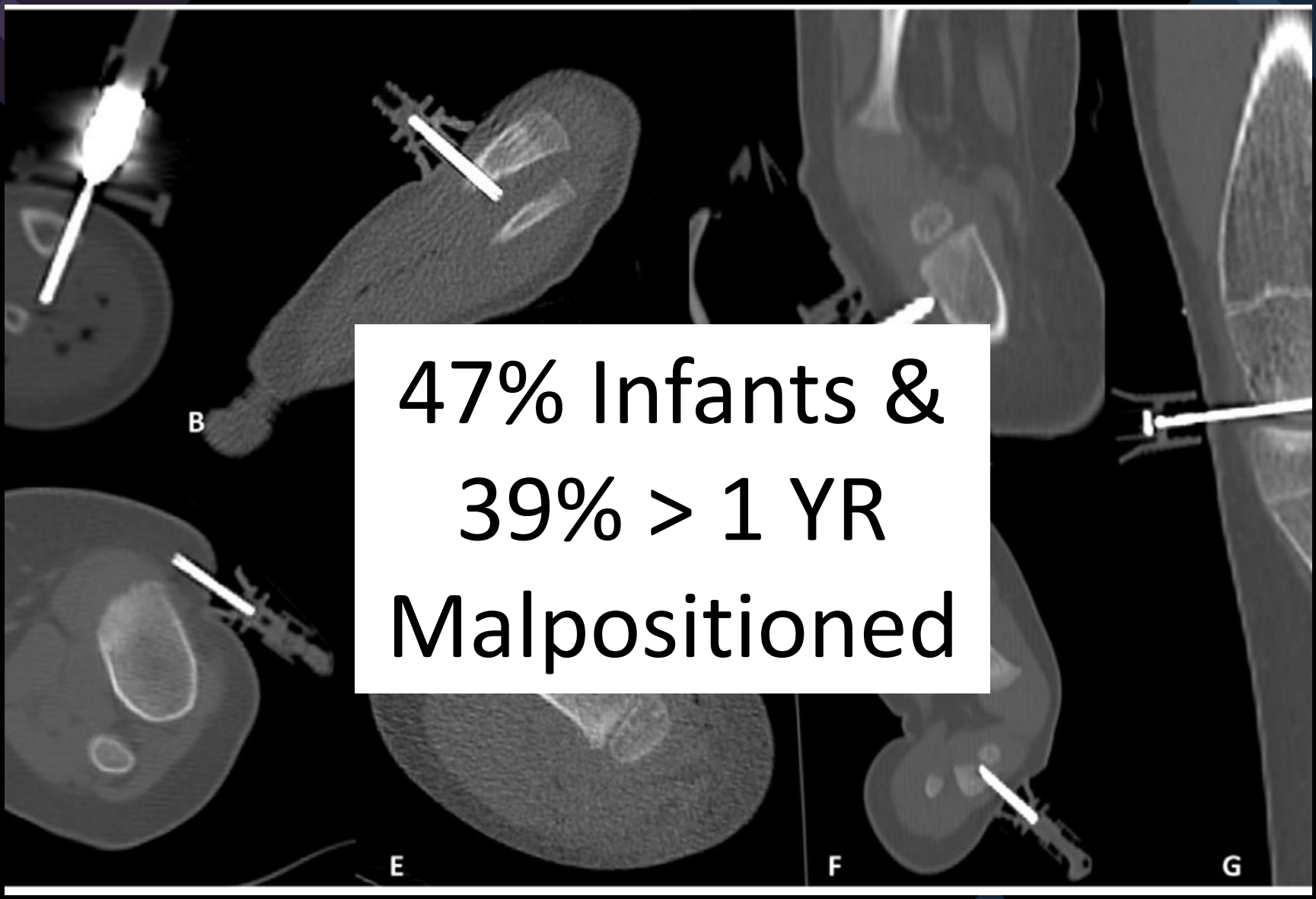
|  | All IO devices |    | EZ-IO           |    | Manual devices |    |
|--|----------------|----|-----------------|----|----------------|----|
|  | n Cases        | %  | n Cases         | %  | n Cases        | %  |
| Cadavers   | 22             |    | 16 <sup>b</sup> |    | 7 <sup>b</sup> |    |
| ION <sup>a</sup>   | 34             |    | 25              |    | 9              |    |
| Number of cadavers with at least one malpositioned ION         | 14             | 64 | 11              | 69 | 4              | 44 |
| Number of malpositioned ION                                    | 16             | 47 | 12              | 48 | 4              | 44 |
| Number of malpositioned ION perforating the bone on both sides | 5              | 31 | 4               | 33 | 1              | 25 |
| Cadavers without a correctly placed ION                        | 7              | 32 | 5               | 31 | 1              | 11 |
| Cadavers with two ION  | 10             | 45 | 8 <sup>b</sup>  | 50 | 3 <sup>b</sup> | 33 |
| Cadavers with three ION  | 1              | 5  | 1               | 6  | 0              | 0  |

<sup>a</sup> Intraosseous needle.<sup>b</sup> One cadaver with one EZ-IO and one manual device.**Table 3 – Child cadavers (age ≥1 year).**

|   | All IO devices |    | EZ-IO   |    | Manual devices |    |
|---|----------------|----|---------|----|----------------|----|
|   | n Cases        | %  | n Cases | %  | n Cases        | %  |
| Cadavers  | 16             |    | 14      |    | 2              |    |
| ION <sup>a</sup>  | 23             |    | 22      |    | 2              |    |
| Number of subjects with at least one malpositioned ION                        | 8              | 50 | 7       | 50 | 1              | 50 |
| Number of malpositioned ION   | 9              | 39 | 8       | 38 | 1              | 50 |
| Number of malpositioned ION perforating the proximal and distal cortical bone | 1              | 11 | 1       | 13 | 0              | 0  |
| Cadavers without a correctly placed ION                                       | 3              | 19 | 2       | 14 | 1              | 50 |
| Cadavers with two ION   | 5              | 31 | 5       | 31 | 0              | 0  |
| Cadavers with three ION   | 1              | 6  | 1       | 6  | 0              | 0  |

<sup>a</sup> Intraosseous needle.





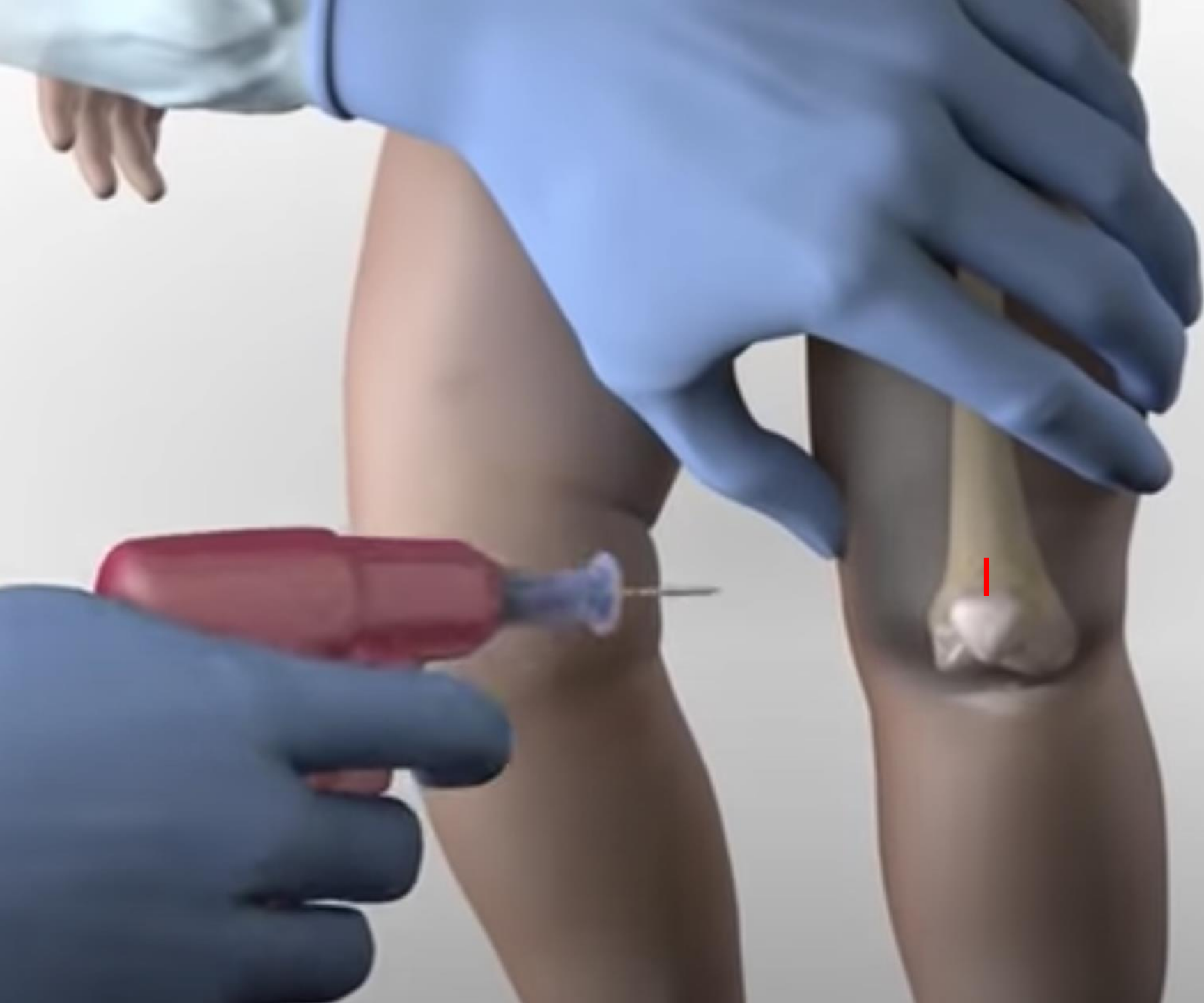
47% Infants &  
39% > 1 YR  
Malpositioned



# EZ-IO

## Distal Femur Site Identification

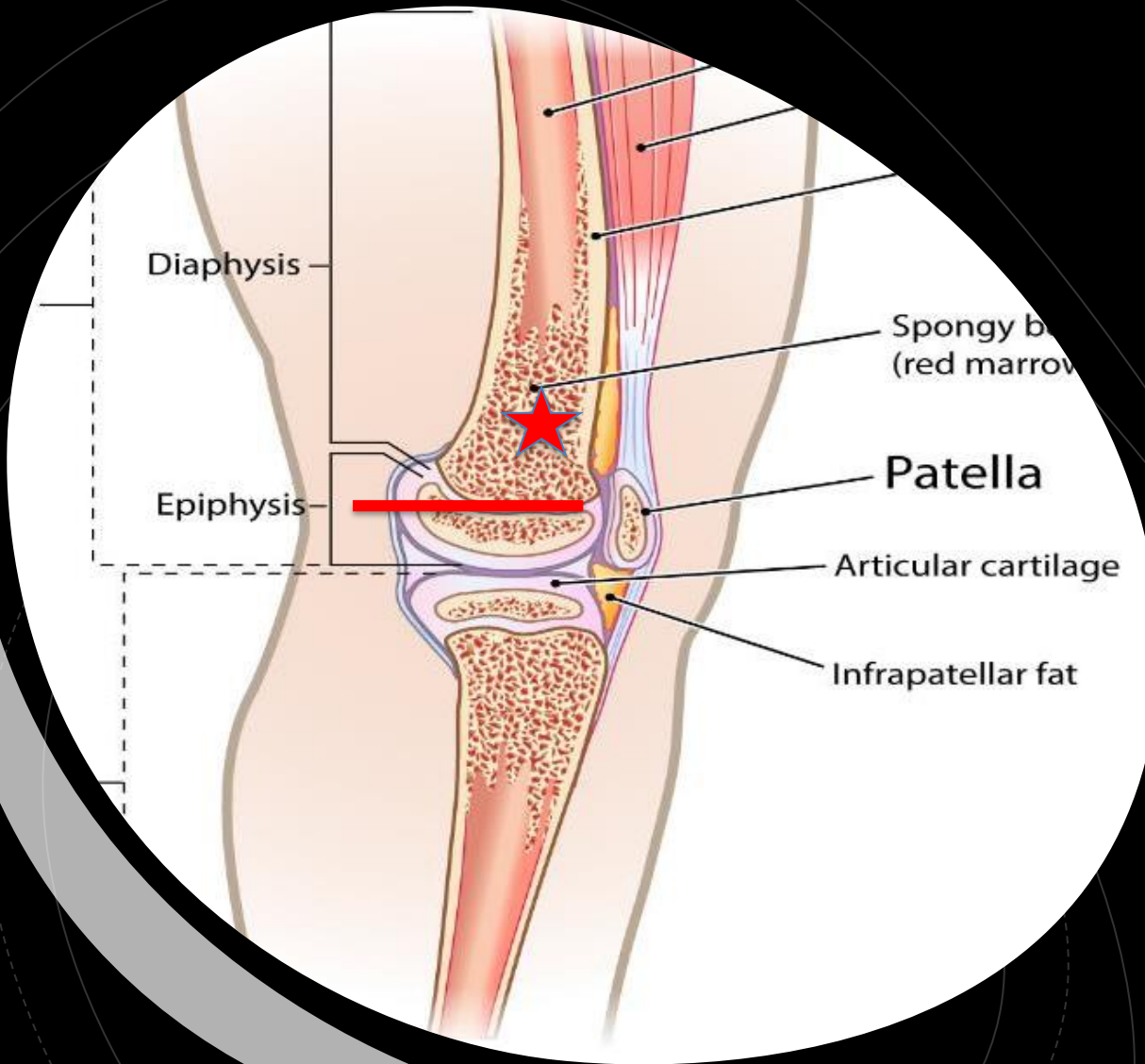
- Out-stretched leg
- Palpate the patella
- The insertion site is just proximal to the patella (maximum 1cm) and approximately 1-2 cm medial to midline.





## Distal Femur *Pediatric* *Landmarks*

- The insertion site proximal to the patella (maximum 1cm) and 1-2 cm **medial** to midline
- No risk to the growth plate



# Distal Femur *Pediatric Landmarks*



## Distal Femur *Clinical Pearls*

- Recommended Site in the unconscious patient (arrest)
- Is too painful in the awake patient compared to the proximal tibia
- Do not use pink (15 mm) needle



**25 mm**

Needle selection  
is based on  
patient weight,  
anatomy and  
tissue depth  
overlying the  
insertion site

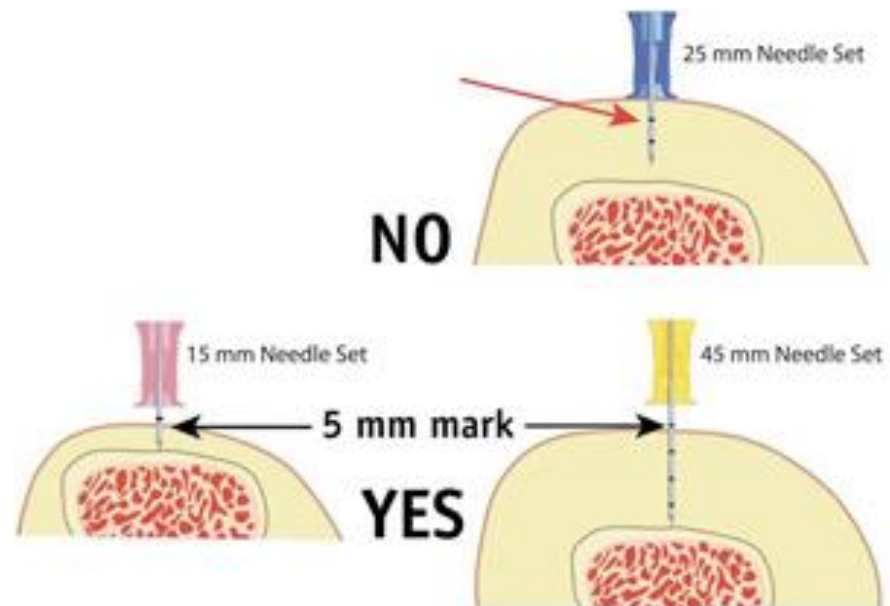


**45 mm**

**EZ-IO<sup>®</sup> Needle Set  
Selection**

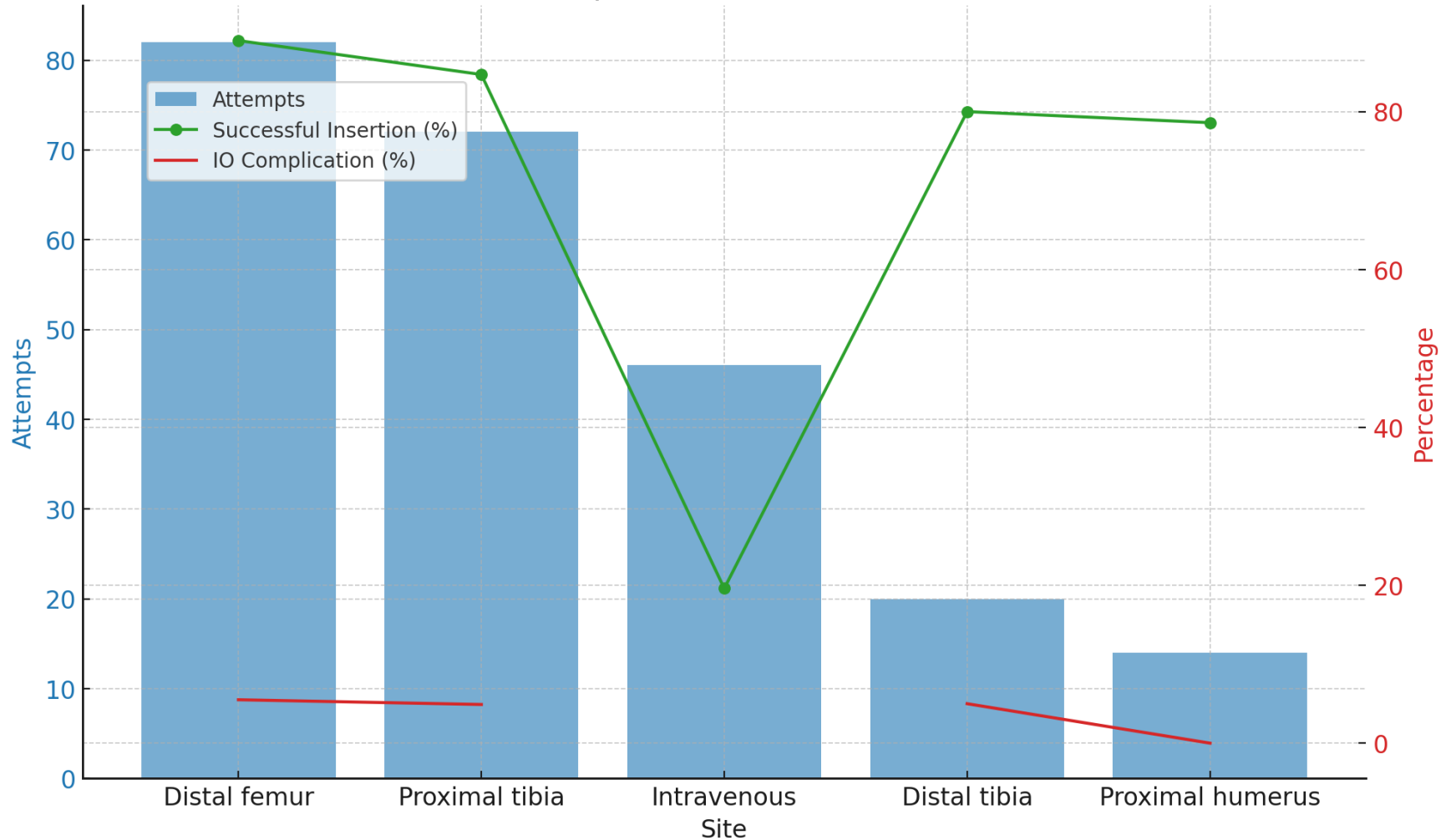


# Correct Placement



# PBCFR Data

Vascular Access Attempts and Outcomes in Pediatric Patients



# PBCFR Data

| Site             | Attempts<br>n (% of total) | Successful Insertion<br>% |
|------------------|----------------------------|---------------------------|
| Distal femur     | 82 (34.9%)                 | 89.0%                     |
| Proximal tibia   | 72 (30.8%)                 | 84.7%                     |
| Intravenous      | 46 (19.7%)                 | 19.6%                     |
| Distal tibia     | 20 (8.5%)                  | 80.0%                     |
| Proximal humerus | 14 (6.0%)                  | 78.6%                     |
| Total            | 234 (100%)                 | 72.6%                     |



**What About Adult Data?**



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# Resuscitation

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RESUSCITATION  
COUNCIL

## Clinical paper

# Distal femur versus humeral or tibial IO, access in adult out of hospital cardiac resuscitation

Emmanuel Giovanni Rayas<sup>a</sup>, Christopher Winckler<sup>a</sup>, Scotty Bolleter<sup>b</sup>,  
Michael Stringfellow<sup>c</sup>, David Miramontes<sup>a</sup>, Joi Shumaker<sup>a</sup>, Alan Lewis<sup>a</sup>,  
David Wampler<sup>a,\*</sup>

<sup>a</sup> University of Texas Health Science Center at San Antonio, Department of Emergency Health Sciences, 4522 Fredericksburg Dr. Suite 101, San Antonio, TX 78201, United States

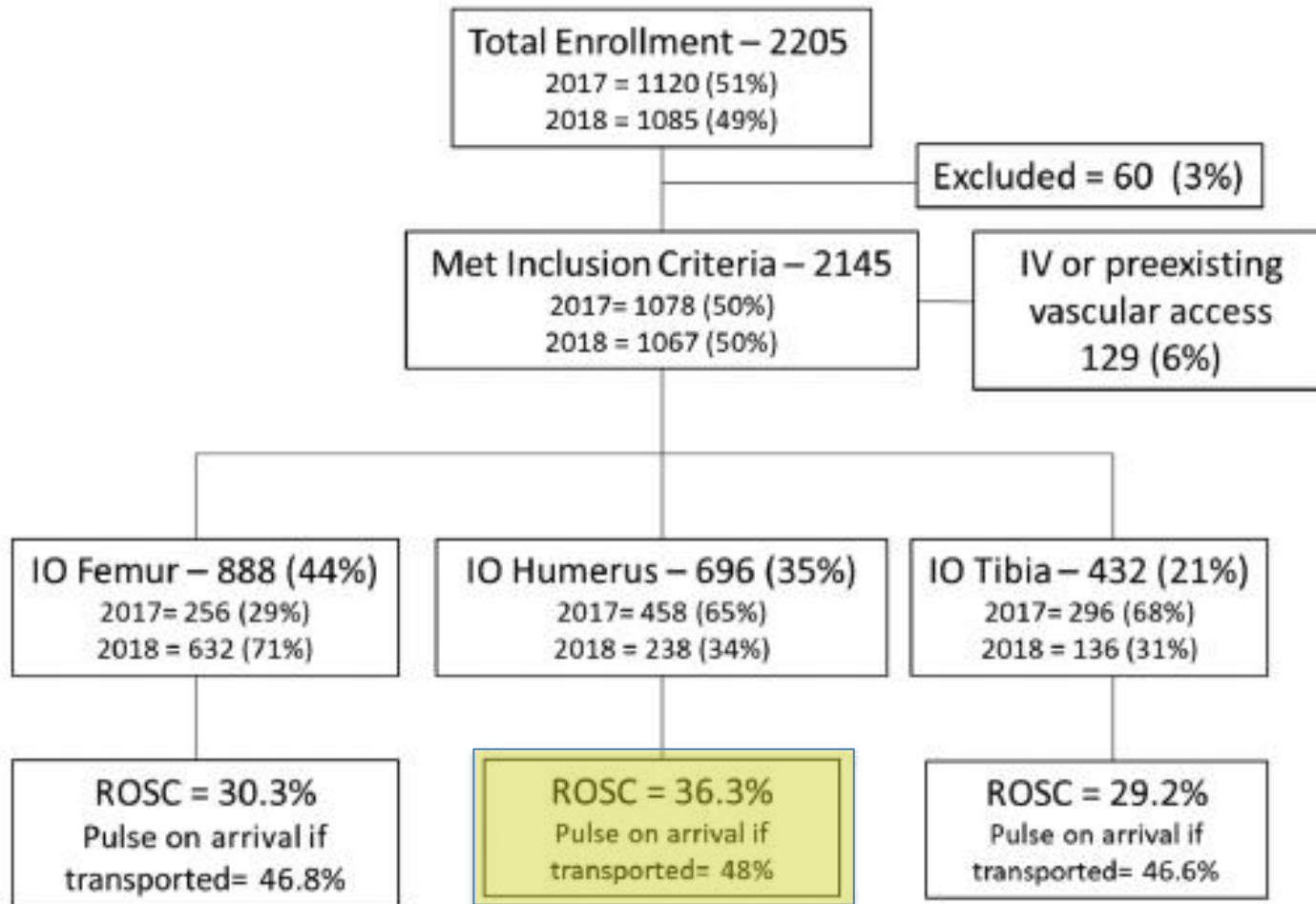
<sup>b</sup> Bulverde Spring Branch Emergency Services, Centre for Emergency Health Sciences, Spring Branch, TX, United States

<sup>c</sup> San Antonio Fire Department EMS, San Antonio, TX, United States

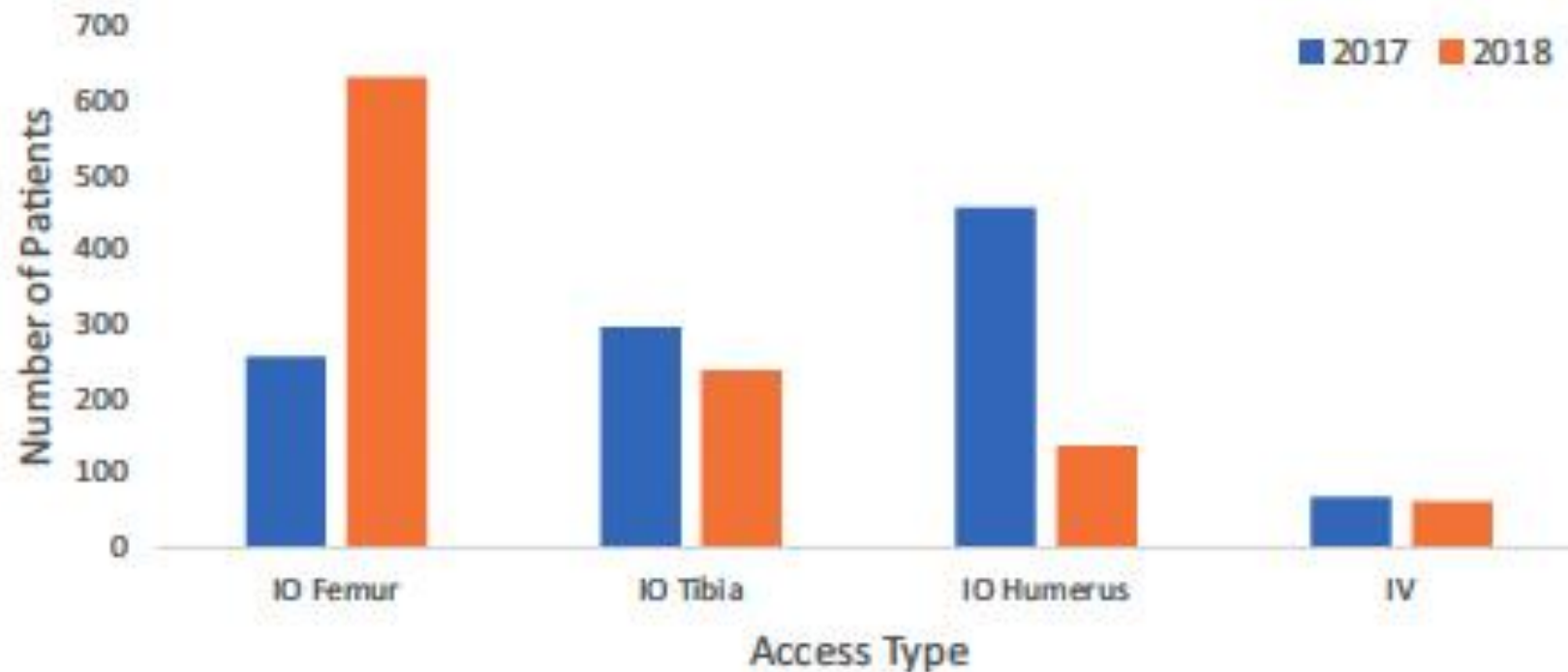
## Abstract

**Background:** Intraosseous (IO) vascular access is a well-established method for fluid and drug administration in the critically ill. The Food and Drug Administration has approved adult IO access at the proximal humerus, proximal tibia, and the sternum; all three sites have significant limitations. The Distal Femur is away from the chest, with high flow rates. The objective of this study was to evaluate the distal femur site during resuscitation of adult out-of-hospital cardiac arrest.

**Methods:** A retrospective analysis of adult out of hospital cardiac arrest patients treated by the San Antonio Fire Department. IO access was



## Reported IO and IV Access of OHCA Patients in 2017 and 2018







# Stop Giving IO Amiodarone / Lidocaine for OHCA?

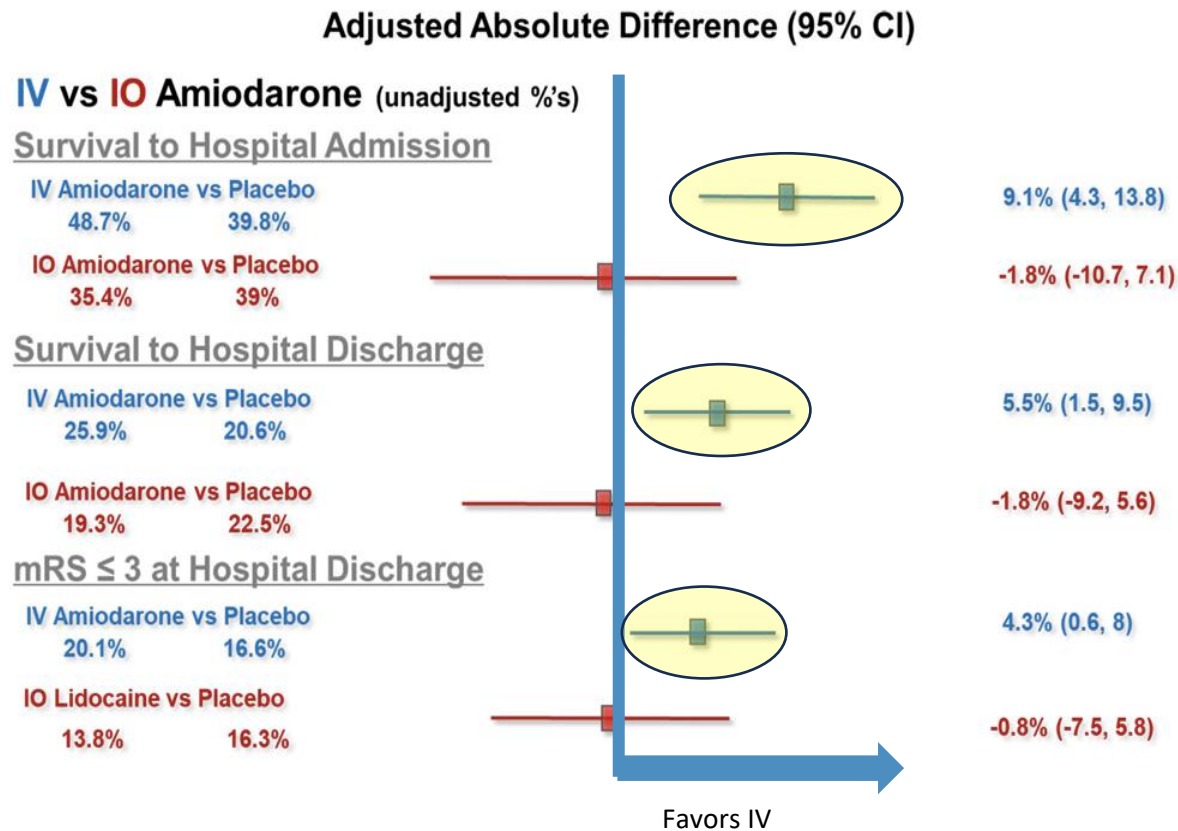
**Survival After Intravenous Versus Intraosseous Amiodarone,  
Lidocaine or Placebo in Out-of-Hospital Shock-Refractory  
Cardiac Arrest**

Mohamud R. Daya, MD, MS<sup>1</sup>, Brian G. Leroux, PhD<sup>2</sup>, Paul Dorian, MD, MSc<sup>3</sup>, Thomas D. Rea, MD, MPH<sup>4</sup>, Craig D. Newgard, MD, MPH<sup>5</sup>, Laurie J. Morrison, MD, MSc<sup>6</sup>, Joshua R. Lupton, MD, MPH<sup>1</sup>, James J. Menegazzi, PhD<sup>7</sup>, Joseph P. Ornato, MD<sup>8</sup>, George Sopko, MD<sup>9</sup>, Jim Christenson, MD<sup>10</sup>, Ahamed Idris, MD<sup>11</sup>, Purav Mody, MD<sup>12</sup>, Gary M. Vilke, MD<sup>13</sup>, Caroline Herdeman, BA, CCRC<sup>14</sup>, David Barbic, MD, MSc<sup>15</sup>, Peter J. Kudenchuk, MD<sup>16</sup>, Resuscitation Outcomes Consortium Investigators

# Amio IO = Placebo | Amio IV = Imp. Survival

Daya et al.

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# Same Thing for Lidocaine

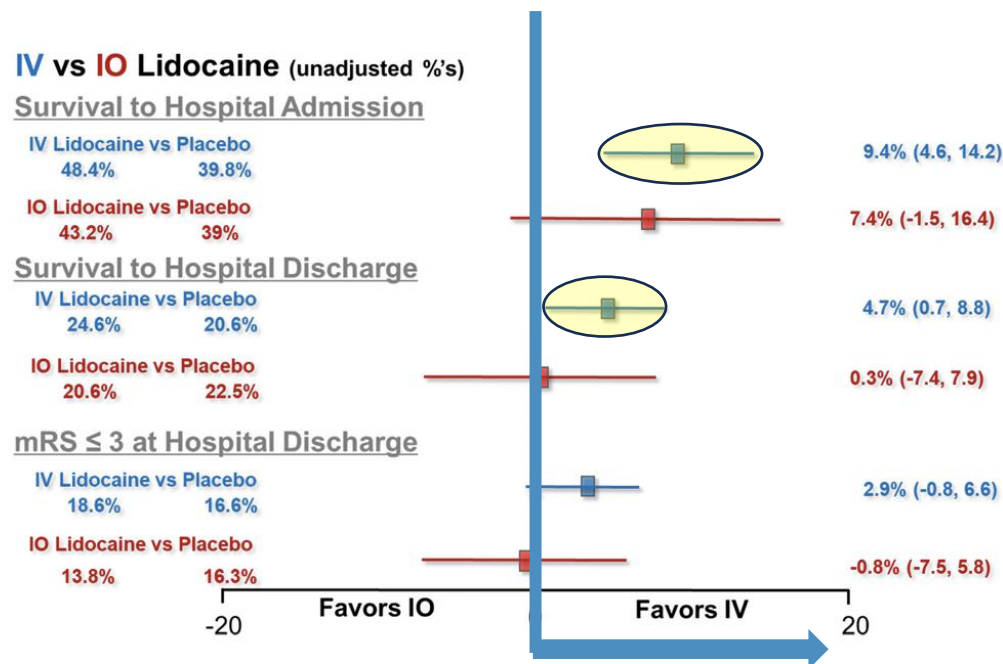


Figure 2.

Another  
Study in  
2023  
Showed  
the Same

## scientific reports

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### Association of intraosseous and intravenous access with patient outcome in out-of-hospital cardiac arrest

Frederik Nancke Nilsson<sup>1</sup>, Søren Bie-Bogh<sup>2</sup>, Louise Milling<sup>1,3</sup>, Peter Martin Hansen<sup>1,4</sup>, Helena Pedersen<sup>1</sup>, Erika F. Christensen<sup>5,6</sup>, Jens Stubager Knudsen<sup>4,7</sup>, Helle Collatz Christensen<sup>8,9,10</sup>, Fredrik Folke<sup>11,12</sup>, David Høen-Beck<sup>13</sup>, Ulla Væggemose<sup>14,15</sup>, Anne Craveiro Brøchner<sup>1,7</sup> & Søren Mikkelsen<sup>1,16,17</sup>✉

Here we report the results of a study on the association between drug delivery via intravenous route or intraosseous route in out-of-hospital cardiac arrest. Intraosseous drug delivery is considered an alternative option in resuscitation if intravenous access is difficult or impossible. Intraosseous uptake of drugs may, however, be compromised. We have performed a retrospective cohort study of all Danish patients with out-of-hospital cardiac arrest in the years 2016–2020 to investigate whether mortality is associated with the route of drug delivery. Outcome was 30-day mortality, death at the scene, no prehospital return of spontaneous circulation, and 7- and 90-days mortality. 17,250 patients had out-of-hospital cardiac arrest. 6243 patients received no treatment and were excluded. 1908 patients had sustained return of spontaneous circulation before access to the vascular bed was obtained. 2061 patients were unidentified, and 286 cases were erroneously registered. Thus, this report consist of results from 6752 patients. Drug delivery by intraosseous route is associated with increased OR of: No spontaneous circulation at any time (OR 1.51), Death at 7 days (OR 1.94), 30 days (2.02), and 90 days (OR 2.29). Intraosseous drug delivery in out-of-hospital cardiac arrest is associated with overall poorer outcomes than intravenous drug delivery.

# Increased Mortality with IO Amiodarone

| Intravenous access  | Reference         | Crude OR          |                              | Adjusted OR       |                              |
|---------------------|-------------------|-------------------|------------------------------|-------------------|------------------------------|
|                     |                   | 1                 |                              | 1                 |                              |
|                     |                   |                   | <i>P</i> -value <sup>a</sup> | OR                | <i>P</i> -value <sup>a</sup> |
| Intraosseous access | No ROSC           | 1.55 (1.31; 1.83) | <0.001                       | 1.51 (1.23; 1.84) | <0.001                       |
|                     | Dead at the scene | 1.47 (1.19; 1.82) | <0.001                       | 1.28 (0.96; 1.61) | 0.102                        |
|                     | 7-day mortality   | 2.22 (1.64; 3.00) | <0.001                       | 1.94 (1.34; 2.79) | 0.001                        |
|                     | 30-day mortality  | 2.28 (1.62; 3.22) | <0.001                       | 2.02 (1.34; 3.05) | 0.001                        |
|                     | 90-day mortality  | 2.60 (1.79; 3.79) | <0.001                       | 2.29 (1.47; 3.56) | 0.001                        |

Amiodarone IO =  
2X Rate of Death

**Table 2.** Association of No ROSC, Dead at the scene, 7-day mortality, 30-day mortality, and 90-day mortality, intraosseous administration of drugs; intravenous administration of drugs as reference. Crude Odds-Ratio and Odds-Ratio adjusted for sex, age, witnessed cardiac arrest, basic life support before ambulance arrival, defibrillation given by bystander, defibrillation given by ambulance personnel, response time. <sup>a</sup> All *p*-values derived from logistic regression analyses.

# Questions

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- Can we use the distal femur in adults?
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