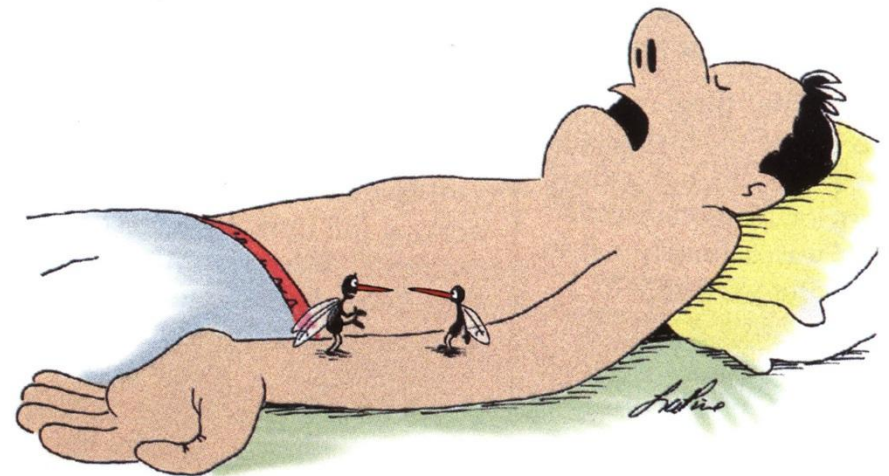


# Když nejde zajistit žílu...

## Up to date 2016

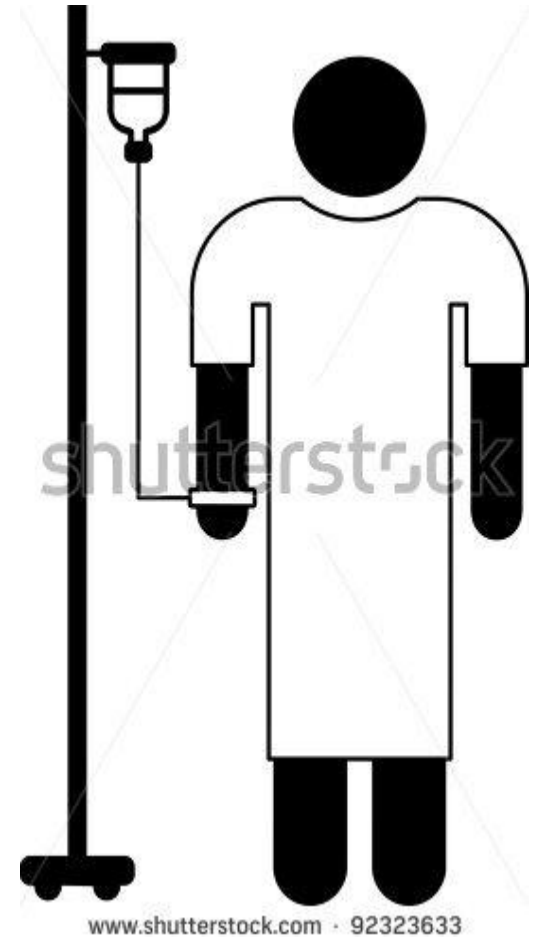
Jana Kubalová  
ZZS Jihomoravského kraje  
*Akutně 19. 11. 2016*



"Sometimes I can't find a vein,  
even when my life depends on it"

# Obsah

- Kdy i. os?
- Máme se bát komplikací?
- Čím?
- Správné provedení
- Místa zavedení
- i. os. při vědomí
- Novinky



# Indikace k i. os. zavedení

**Děti i dospělí, v jakékoliv situaci, kdy je nutné co nejrychleji zajistit žilní vstup a selhaly pokusy o punkci periferní žíly**

## KPR GL:

- Dospělí: 1. alternativa při selhání PIV, 2x pokus
- Děti: pokud se nezdaří PIV do 1 min => IO (GL 2010)
- **Děti zástava oběhu nebo dekomp. šok (adrenalin, tekutiny): i. os = 1. volba!!!**
- Podávání léků ET: nepředvídatelná plazmatická koncentrace, neznámá optimální dávka řady léků pro ET podání
- Od CV vstupu je odrazováno – nutnost přerušení KPR

Nolan, J.P. et al/ Resuscitation 81 (2010) 1219-1276  
C.D. Deakin et al./ Resuscitation 81 (2010) 1305 – 1352  
D.Biarent et al./ Resuscitation 81 (2010) 1364 – 1388

Resuscitation 95 (2015) 223–248



Contents lists available at ScienceDirect

Resuscitation

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



European Resuscitation Council Guidelines for Resuscitation 2015  
Section 6. Paediatric life support

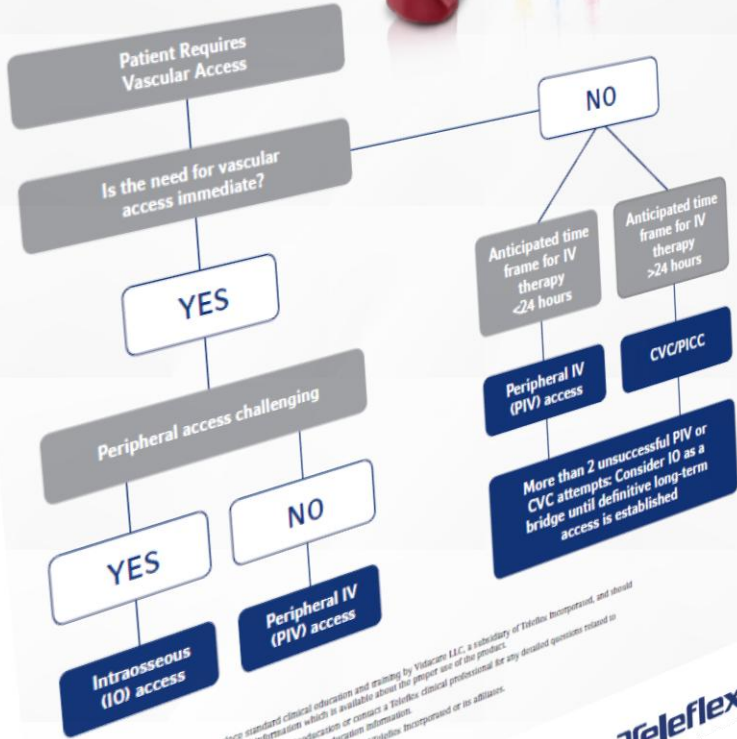


Ian K. Maconochie<sup>a,\*</sup>, Robert Bingham<sup>b</sup>, Christoph Eich<sup>c</sup>, Jesús López-Herce<sup>d</sup>,  
Antonio Rodríguez-Núñez<sup>e</sup>, Thomas Rajka<sup>f</sup>, Patrick Van de Voorde<sup>g</sup>, David A. Zideman<sup>h</sup>,  
Dominique Biarent<sup>i</sup>, on behalf of the Paediatric life support section Collaborators<sup>1</sup>

# ARROW® EZ-IO™

INTRASOSEOUS VASCULAR ACCESS

CLINICAL RESOURCE:  
DIFFICULT VASCULAR ALGORITHM  
24 HOUR CLINICAL SUPPORT: 1.800.680.4911



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View educational resources at [www.teleflex.com/education](http://www.teleflex.com/education) or contact a Teleflex clinical professional for any detailed questions related to product insertion, maintenance, removal and other clinical education information.  
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**Teleflex**



Contents lists available at ScienceDirect

## Resuscitation

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

Short communication

### Efficacy and safety of the EZ-IO™ intraosseous device: Out-of-hospital implementation of a management algorithm for difficult vascular access☆☆☆

Nicolas Gazin<sup>a</sup>, Harold Auger<sup>a</sup>, Patricia Jabre<sup>a,b,c</sup>, Christine Jaulin<sup>a</sup>, Eric Lecarpentier<sup>a</sup>, Catherine Bertrand<sup>a</sup>, Alain Margenet<sup>a</sup>, Xavier Combes<sup>a,\*</sup>

<sup>a</sup> Service d'Anesthésie Réanimation and SAMU 94, CHU H Mondor (AP-HP), 94000 Créteil, France  
<sup>b</sup> Department of Health Sciences Research, Mayo Clinic, Rochester, USA  
<sup>c</sup> INSERM U570 - Centre de recherche cardiovasculaire de Paris, France

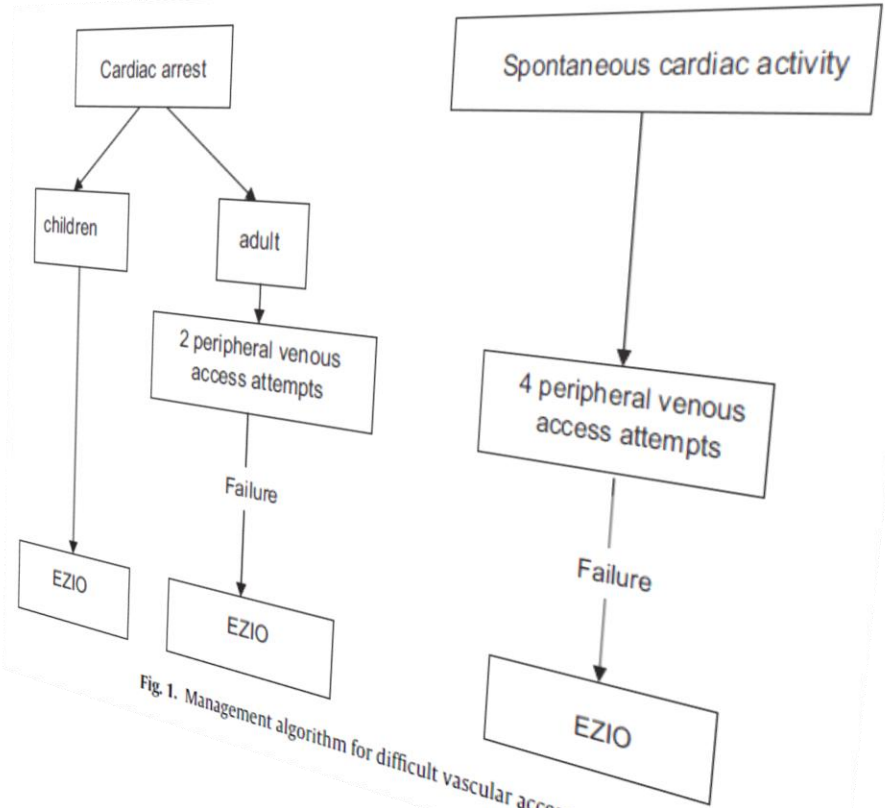


Fig. 1. Management algorithm for difficult vascular access.

Research

## Is the intraosseous access route fast and effective compared to conventional central venous catheterization for vascular access during resuscitation in the emergency department? An observational pilot study

Bernd A Leidel\*<sup>1,3</sup>, Chlodwig Kirchhoff<sup>2</sup>, Viktoria Bogner<sup>1</sup>, Wolf Mutschler<sup>2</sup>, Karl-Georg Kanz<sup>2</sup> and Volker Braunstein<sup>1</sup>

Address: <sup>1</sup>Department of Emergency Medicine, Charité - University Medicine Berlin, Campus Berlin, Germany, <sup>2</sup>Department of Trauma, University Medical Centre of Munich, Downtown Munich, Germany, <sup>3</sup>Helicopter Emergency Medical Service Christoph 31, ADAC Luftrettung air rescue service, Benjamin Franklin, Hindenburgdamm 30, 12203 Berlin, Germany

Email: Bernd A Leidel\* - bernd.a.leidel@charite.de; Chlodwig Kirchhoff - kirchhoff@lrz.uni-muenchen.de; Viktoria Bogner - viktoriam.bogner@med.uni-muenchen.de; Julia Stegmaier - julia.stegmaier@med.uni-muenchen.de; Wolf Mutschler - mutschler@med.uni-muenchen.de; Karl-Georg Kanz - karl-georg.kanz@med.uni-muenchen.de; Volker Braunstein - volker.braunstein@med.uni-muenchen.de

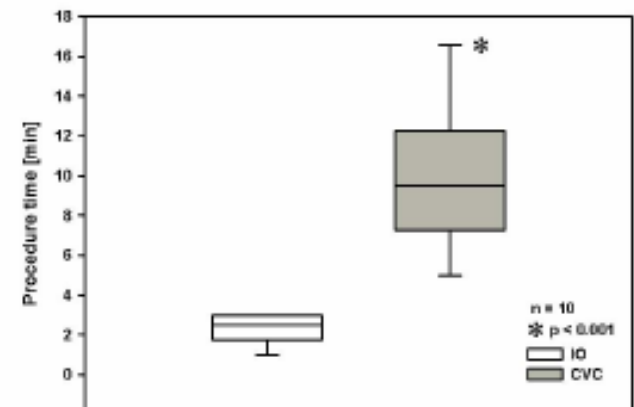
\* Corresponding author

Published: 8 October 2009

Received: 2 June 2009

**Results:** Ten consecutive adult patients under resuscitation, each receiving IO access and CVC, were analyzed. IO access was performed with 10 tibial or humeral insertions, CVC in 10 internal jugular or subclavian veins. The success rate on first attempt was 90% for IO insertion versus 60% for CVC. Mean procedure time was significantly lower for IO cannulation (2.3 min ± 0.8) compared to CVC (9.9 min ± 3.1) in 10 patients, while two complications, like

**Conclusion:** Preliminary data demonstrate that IO access is a reliable bridging method to gain vascular access for in-hospital adult emergency patients under trauma or medical resuscitation with impossible peripheral IV access. Furthermore, IO cannulation requires significantly less time to enable administration of drugs or infusion solutions compared to CVC. Because CVC was slower and less efficacious, IO access may improve the safety of adult patients under resuscitation in the emergency department.



**Figure 3**  
Procedure time of intraosseous (IO) cannulation was significantly shorter than central venous catheterization (CVC) for vascular access to enable drug and fluid administration in adult emergency patients under resuscitation.

# IO vs. CVK

- Dolister M, Miller S, Borron S, Truemper E, Shah M, Lanford MR, Philbeck TE, Intraosseous vascular access is safe, effective and costs less than central venous catheters for patients in the hospital setting, *J Vasc Access* 2013; 14(3): 216 – 224
- **„Results:** A total of 105 cases were studied from six centers. Mean age was  $48.0 \pm 28.0$  years and 53% were men; 85% of the patients were medical cases, and 53% were in cardiac/respiratory arrest. Of those, 48% returned to spontaneous circulation. A total of 94% of placements were successful on the first attempt. Mean time to IO access was  $103.6 \pm 96.2$  seconds. There was one serious complication – a lower extremity compartment syndrome. IO access costs \$100/patient.
- **Conclusions:** The data revealed faster and more successful IO catheter placement than reported for CVCs, few complications and high user satisfaction. For simple placements, cost savings for IO access vs. CVCs was \$195/procedure. If 20% of the 3.5 million CVCs placed annually were replaced with IO catheters, cost savings could approach \$650 million/year. We conclude that IO access in place of CVCs delivers high value in terms of being a safe, fast and effective mode of vascular access for patients in the hospital setting, with potentially substantial cost savings. These data indicate that IO access is a cost effective and viable alternative to problematic CVC lines.“



# Průtok kanylou

- Hagen-Poiseuilleův zákon:  $Q = \pi r^4 \cdot \Delta P / 8 \mu l$

- $Q$  = průtok
- $r$  = poloměr kanyly
- $\Delta P$  = tlakový gradient mezi začátkem a koncem
- $M$  = viskozita podávaného roztoku
- $l$  = délka kanyly

⇒ průtok závisí přímo úměrně na čtvrté mocnině poloměru

⇒ průtok krátkou kanylou zavedenou do PŽ ( $l=4,5\text{cm}$ ) bude min.  $3x\uparrow$  než průtok katétrem téhož kalibru zavedeném do CŽ ( $l=15 - 20\text{cm}$ )

⇒ video



MC-001297 Proximal Humerus Subclavian Vein Dissected and Flush (Cadaveri....mov)

# Komplikace

## Závažné komplikace IO:

osteomyelitis, fraktura, infekce, extravazace, kompartment syndrom a poranění růstové ploténky

## Studie:

- **Dospělí – (2004-2009) < 0,004%**
- **Děti – osteomyelitis < 0,6% (4200 pacientů, komplikace = bakteriémie v době vpichu, prodloužená doba inserce)**
- **Na histopat. změny ve dřeni po IO inf. nemá vliv ani rychlost ani osmolalita (u prasat)**
- **Pozor na inf. > 2 hod (chemoter., cytotox., hyperosmol. léky)**



Manufacture's database, VidaCare Corporation

Davidoff J, Fowler R, Gordon D, et al. Clinical evaluation of a novel intraosseous device for adults. JEMS 2005; suppl: 20-23

Rossetti, VA, Thompson, BM, Miller, J et al. Intraosseus infusion: an alternative route of pediatric access. Ann Emerg Med 1985; 14:885-8

Brickman KR, Rega P, Schoolfield L, Harkins K, Weisbrode SE, Reynolds G: Investigation of bone developmental and histopathologic changes from intraosseous infusion. Ann Emerg Med October 1996;28:430-435



## Complication with Intraosseous Access: Scandinavian Users' Experience

Peter Hallas, MD,\* [Mikkel Brabrand](#), MD,<sup>†</sup> and [Lars Folkestad](#), MD<sup>‡</sup>

Complication with Intraosseous Access

Hallas et al

**Table.** Complication rate with intraosseous access (IO) reported by Scandinavian users - listed by device.

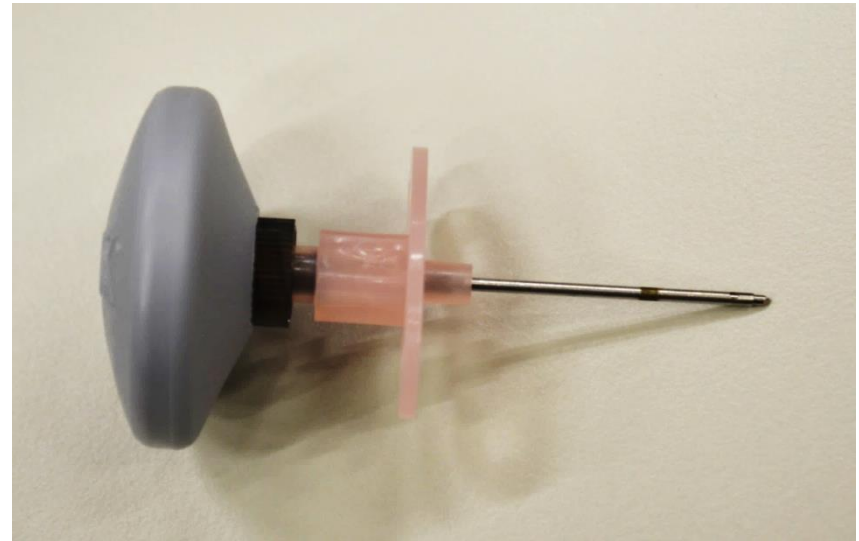
IO-equipment used	All	%	EZ-IO	B.I.G	Cook	Others	p-value*
Cases reported	1,802	100.0	861	255	418	268	
Start complications							
Equipment difficult to assemble	36	2.0	4	21	5	6	< 0.0001
Difficult to identify correct anatomical site	57	3.2	28	17	5	7	0.0013
Bended or broken needle	72	4.0	11	17	20	24	< 0.0001
Patient discomfort / pain	128	7.1	73	13	20	22	0.0663
Difficult to penetrate the periosteum	186	10.3	18	56	51	61	< 0.0001
Difficult to aspirate bone marrow	221	12.3	92	51	38	40	< 0.0001
Complications in use							
Difficult to inject fluid and drugs	133	7.4	59	33	27	14	0.0026
Slow infusion despite use of pressure bag	159	8.8	77	32	34	16	0.0610
Displacement after insertion	153	8.5	47	50	38	18	< 0.0001
Extravasation	66	3.7	25	12	17	12	0.4089
Late complications							
Compartment syndrome	10	0.6	6	1	1	2	0.796
Osteomyelitis	7	0.4	4	1	1	1	1.000
Skin infection	6	0.3	4	1	1	0	0.829

Čím?



# Manuální

- Více typů, Dieckmann™ (Cook Critical Care)



- Nutný nácvik a zkušenosti
- Obtížné užití, nutná síla k zavedení
- Často opomínány při užití pro psychologickou bariéru personálu
- Bezpečné, dostupné řadu let, lze řídit hloubku zavedení během výkonu
- Většinou využívány v pediatrii (měkčí kost)

# Semi-automatické

B.I.G.™ 15G, 18G - WeisMed Ltd.

NIO™ – PerSys Medical

- Jednoduchá aplikace, do 17s vč. přípravy a inserce
- Nutné pečlivé vyhledání místa inserce a stabilizace končetiny
- Hloubka inserce se musí přednastavit předem dle věku a místa vpichu, po vystřelení již nelze upravit



# Semi-automatické s pohonem - Arrow EZ-IO™ - EZ(Easy) IO(IntraOsseus) access



- Snadné použití a kontrola hloubky zavedení
- Příprava místa a zavedení 6 – 10 s
- Vysoké procento úspěšnosti 97% a minimální riziko komplikací

Efficacy and safety of the EZ-IO™ intraosseous device: Out-of-hospital implementation of a management algorithm for difficult vascular access<sup>☆,☆☆</sup>

Nicolas Gazin<sup>a</sup>, Harold Auger<sup>a</sup>, Patricia Jabre<sup>a,b,c</sup>, Christine Jaulin<sup>a</sup>, Eric Lecarpentier<sup>a</sup>, Catherine Bertrand<sup>a</sup>, Alain Margenet<sup>a</sup>, Xavier Combes<sup>a,\*</sup>

# Co si vybrat?



- **Olaussen A, Williams B., Intraosseous access in the prehospital setting: literature review.**  
**Prehosp Disaster Med. 2012 Oct;27(5):468-72. doi: 10.1017/S1049023X12001124. Epub 2012 Aug 9. (2100 => 20)**
- „**FINDINGS:** The review also noted that use of IO access (regardless of technique) offers a safe and simple method for gaining access to the patients' vascular system. A number of studies found that the use of semiautomatic devices offers better and faster intraosseous access compared with the use of manual devices, and also were associated with fewer complications. The findings also suggest that the use of semiautomatic devices can reduce insertion times and the number of insertion attempts when contrasted with the use of manual insertion techniques“.
- **Weiser G, Hoffmann Y, Galbraith R, Shavit I, Current advances in intraosseous infusion - a systematic review, Resuscitation, 2012 Jan;83(1):20-6. doi: 10.1016/j.resuscitation.2011.07.020. Epub 2011 Aug 24. (179 => 10)**
- „**RESULTS:** The search strategy yielded 179 papers. Ten studies met full criteria for further review. Of these, two were LOE 1 (randomized controlled trials), one was LOE 2 (non-randomized, concurrent controls), one was LOE 3 (retrospective controls), and six were LOE 5 (simulation-based study). One of the six LOE 5 studies was a non-peer reviewed article.
- **CONCLUSIONS:** Only a few studies compared the performance of different types of IO infusion devices, most of them have a low level of evidence. These studies suggested a superiority of the battery-powered IO driver over manual needles, and other semi-automatic IO infusion devices.“

RESUSCITATION

OFFICIAL JOURNAL OF THE  
EUROPEAN RESUSCITATION COUNCIL





# Správné provedení



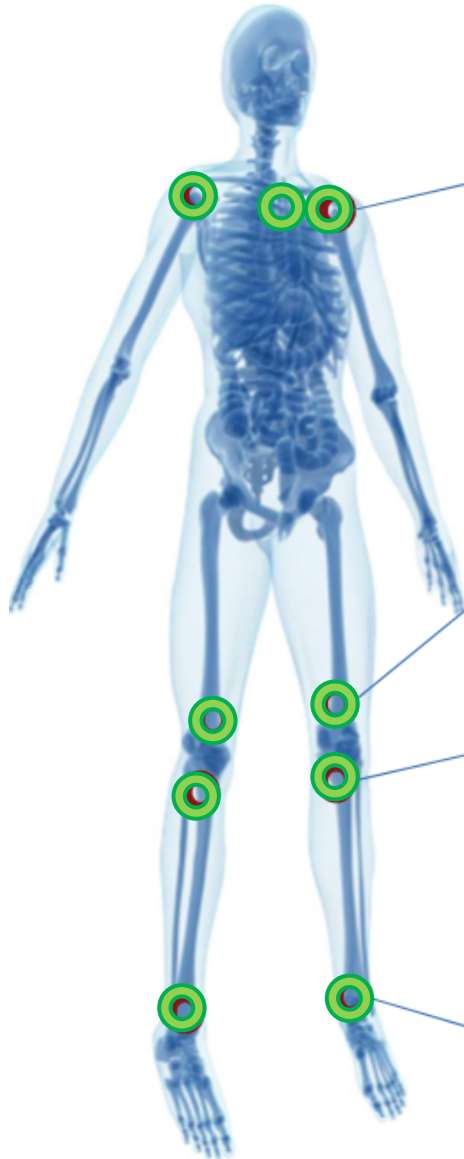
# 1. VYHLEDAT MÍSTO VPICHU

A close-up photograph of a person's back, showing the spine and surrounding skin. A hand wearing a blue nitrile glove is palpating the spine, likely to find a suitable site for an EZ-IO procedure. The skin has some minor discoloration and bruising. The background is dark and out of focus.

- Dle situace
- Dle věku
- Dle dostupného zařízení
- EZ-IO zvolit správnou délku jehly

# Místa zavedení

## 4 Sites, 8 Targets



### Proximal Humerus

Preferred site for adults  
Optimal site for high flow and quick drug uptake  
Awake, responsive patients  
Less painful

### Distal Femur

Best under 12 years

### Proximal Tibia

Unresponsive  
Unfamiliarity with other sites  
Unable to landmark other sites

### Distal Tibia

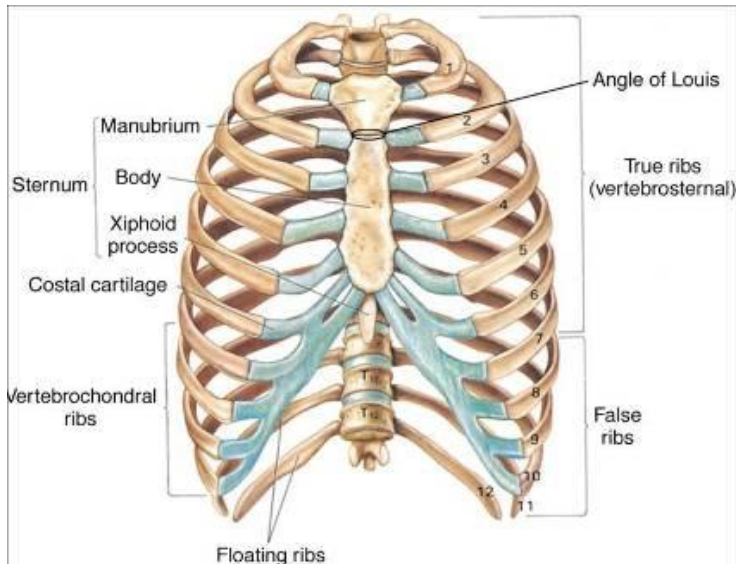
Larger patient  
Unable to access other sites

### Site selection

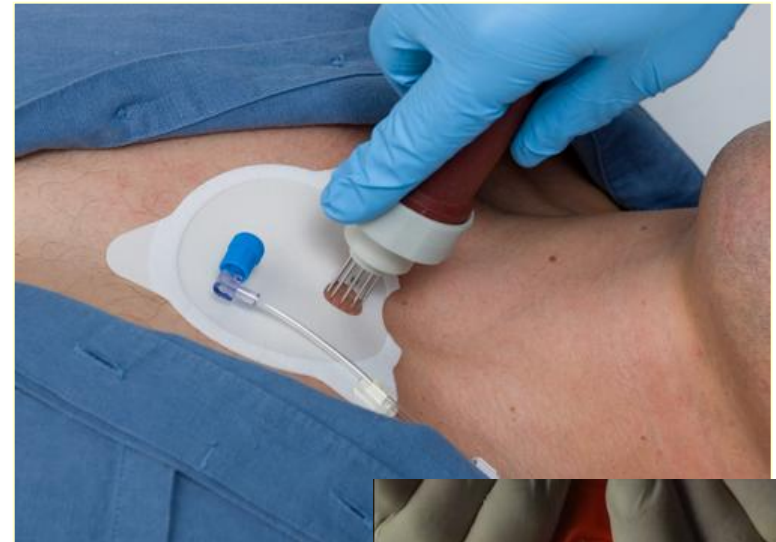
Dependent upon:

- No previous IO in 48 hours
- Absence of contraindications
- Accessibility
- Ability to secure & monitor

# Sternum?



FAST 1™- Pyng Medical  
First Access for Shock and Trauma



FAST Responder - Pyng Medical  
<https://www.youtube.com/watch?v=FG6aO1sj3Ow>



# EZ-IO - použití v jakémkoliv věku a konstituci pacienta, podmínka: možnost najít místo vpichu



EZ-IO PD 15 mm Needle Set

Krátká 1,5 cm,  
převážně děti,  
orient. do 39kg



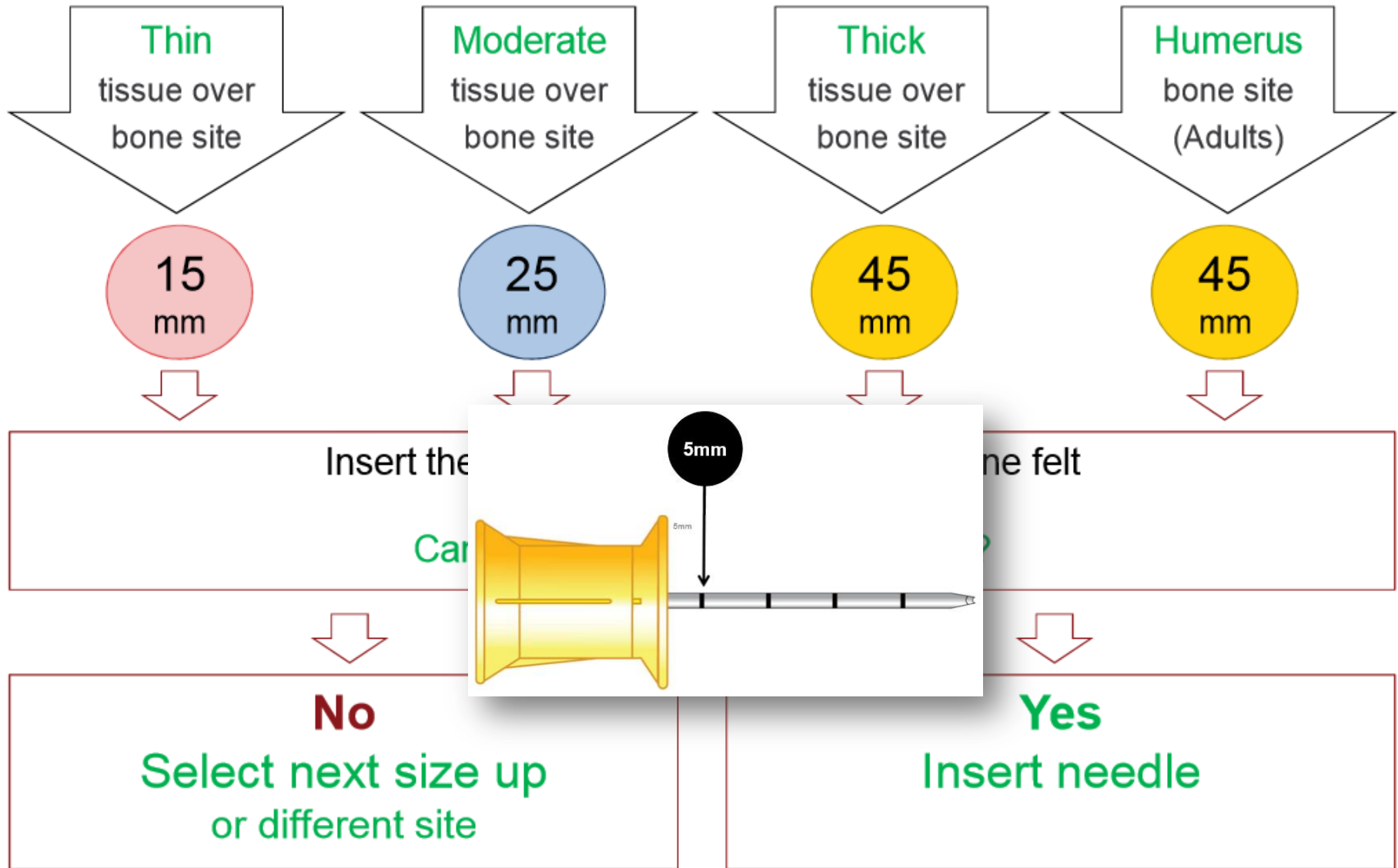
EZ-IO AD 25 mm Needle Set

Střední – 2,5 cm,  
nad 3 kg



EZ-IO LD 45 mm Needle Set

Dlouhá – 4,5 cm,  
obézní pacienti,  
humerus





## 2. PŘÍPRAVA MÍSTA VPICHU



- Dezinfekce
- Asepse



3. PROPÍCHNOUT KŮŽI





4. VRTAT (frézovat)...







..... DO ZTRÁTY ODPORU



5. ROZŠROUBOVAT





6. VYTÁHNOUT ZAVÁDĚCÍ JEHLU



**NO FLUSH = NO  
FLOW**

6. ASPIROVAT, APLIKOVAT BOLUS!!!  
(během 5 s 5 - 10 ml FR, děti 2 – 5 ml)





7. FIXOVAT, APLIKOVAT INFÚZI  
PŘETLAKEM (300 mmHg)

# Průtok v závislosti na přetlaku

Proximal Tibia

Proximal Humerus

5000

2500

ml/hour

100

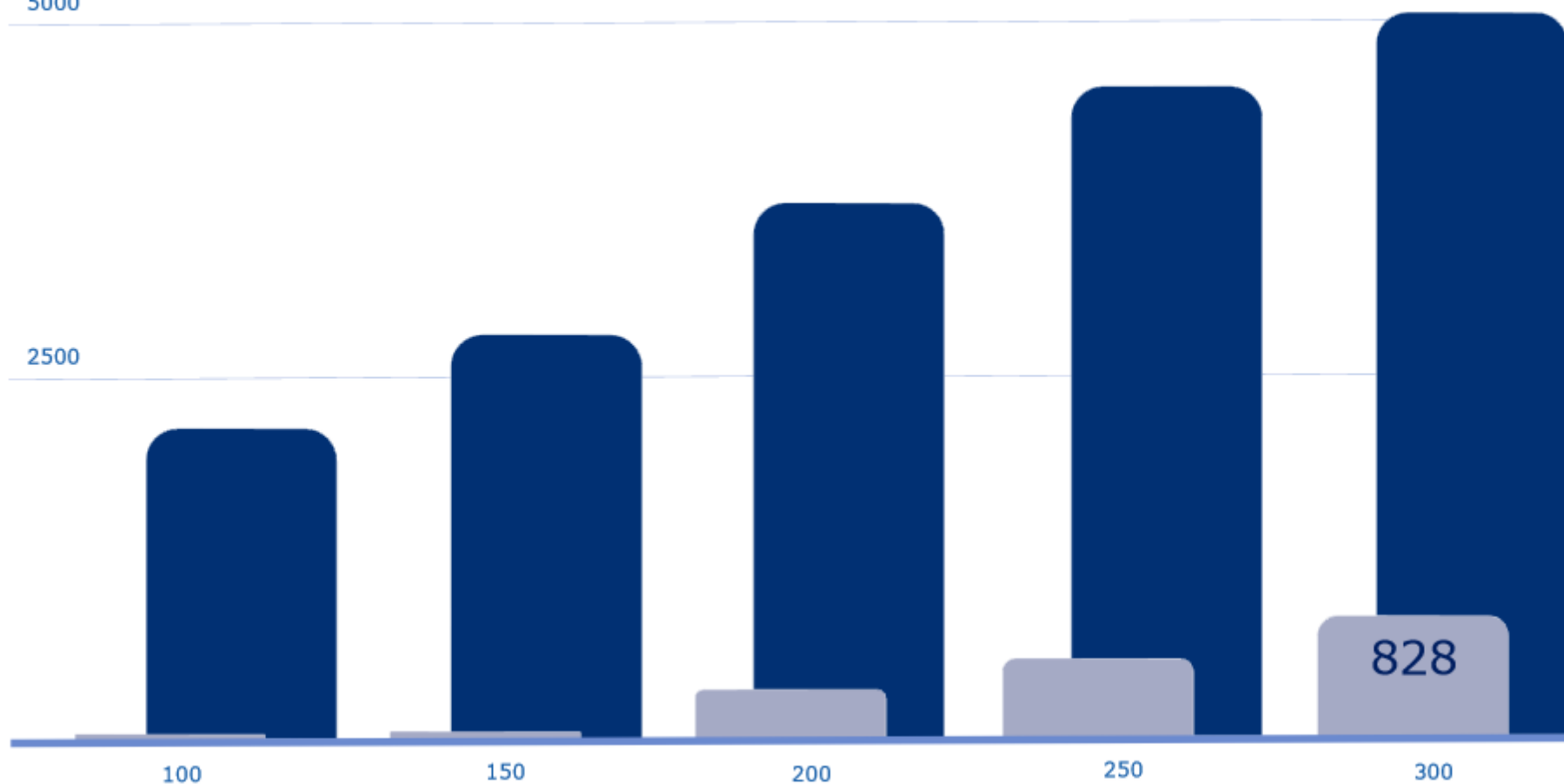
150

200

250

300

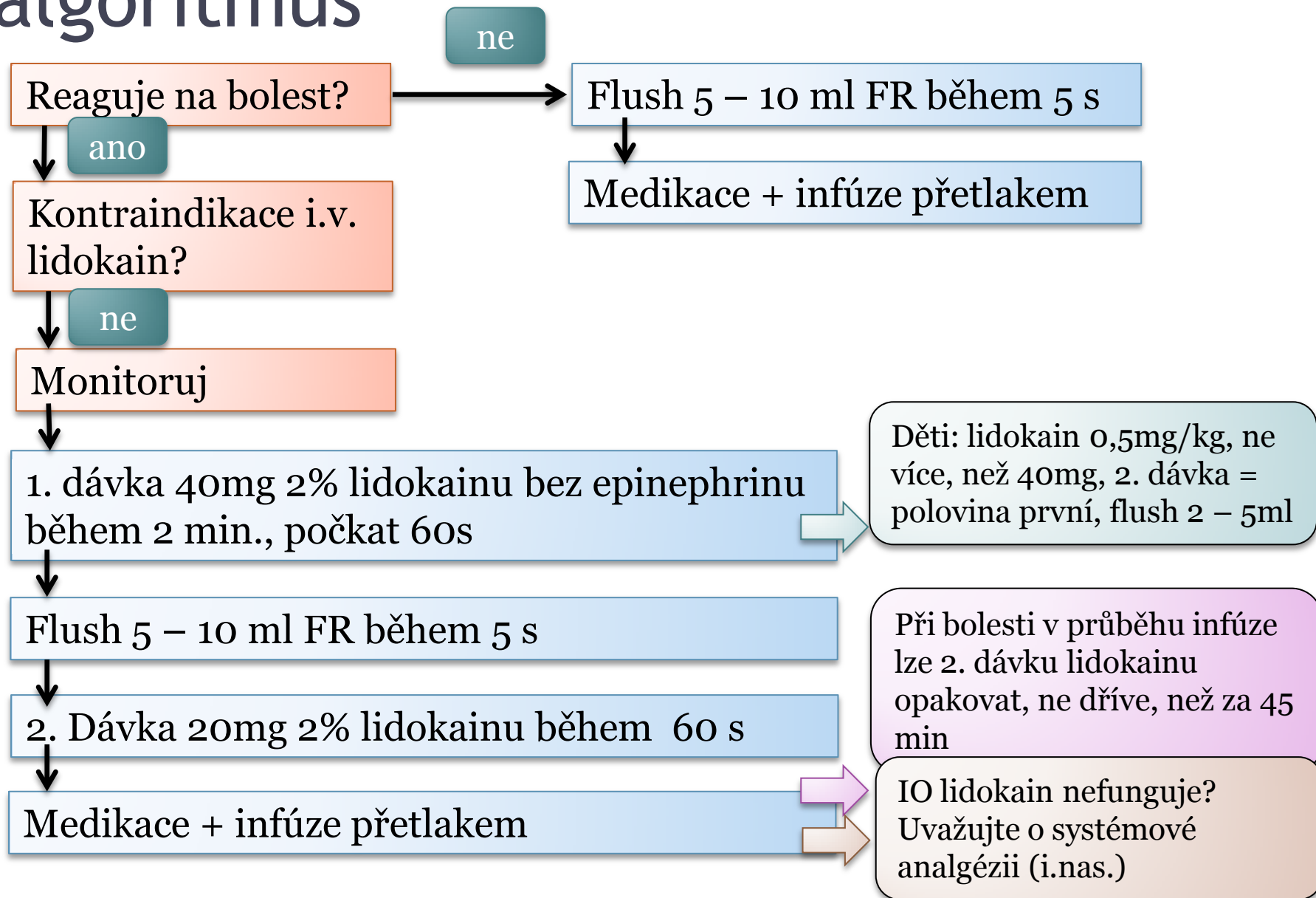
828



# Pacient při vědomí

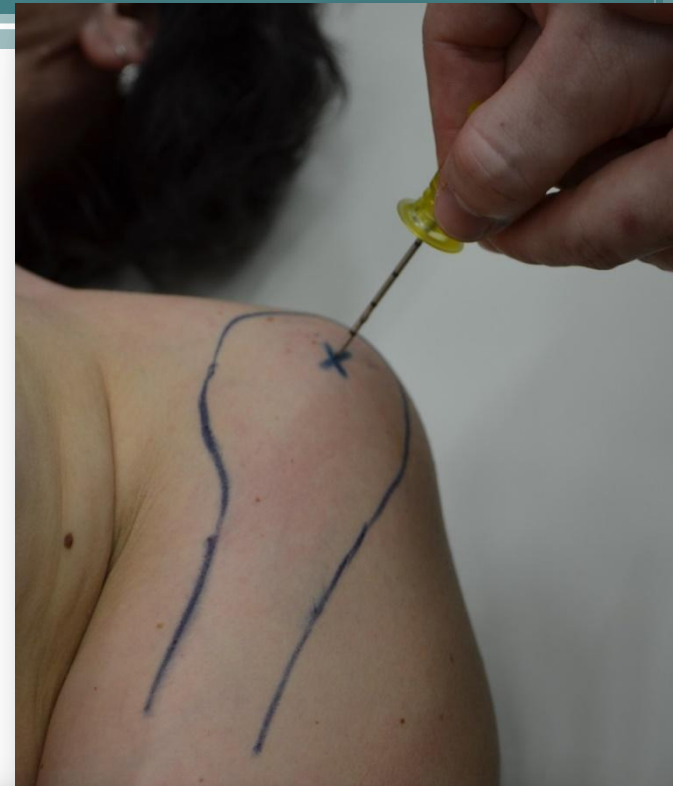
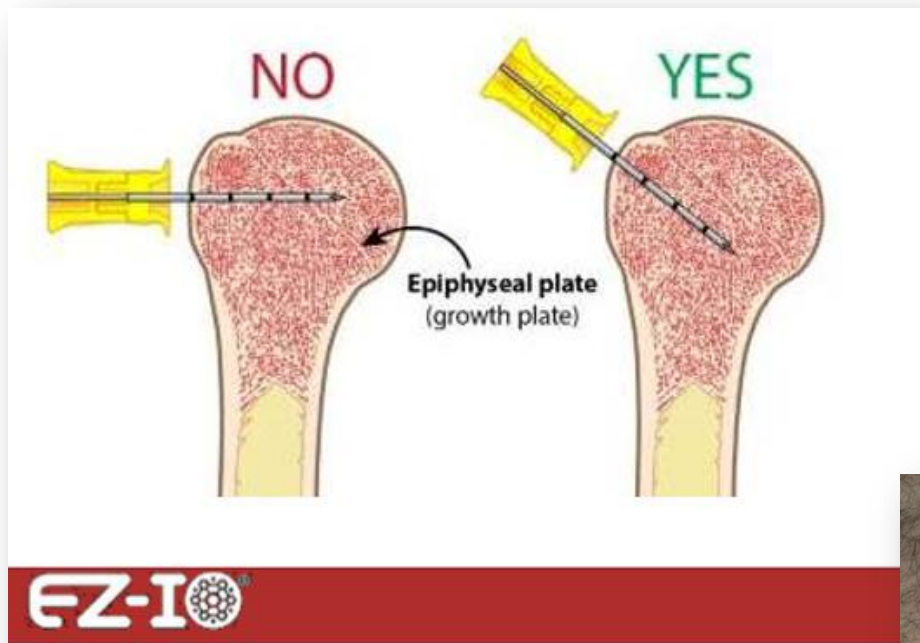
Author, date and country	Patient group	Study type (level of evidence)	Outcomes	Key results	Study Weaknesses
Philbeck et al, 2009, USA	10 volunteers, <b>Proximal humerus, 20 mg lidocaine</b> , 10 ml saline flush followed by further <b>40 mg lidocaine</b>	Open-label trial	Pain on IO insertion	Mean 3.9 ( $\pm 1.5$ )	Conference abstract only; small numbers; healthy volunteers; sponsored by device manufacturer
			Pain during infusion	Mean 2.0 ( $\pm 1.2$ ) after 20 mg initial bolus; <b>no pain</b> after 40 mg initial bolus	
Philbeck et al, 2010 USA	<p>1. 10 healthy volunteers <b>left prox. tibia, 40 mg =&gt; flush =&gt; 20 mg 2% lidocaine.</b></p> <p>2. <b>right prox. tibia 80 mg =&gt; flush =&gt; 20 mg 2% lidocaine.</b></p> <p>3. 6 volunteers <b>proximal right humerus 40 mg =&gt; flush =&gt; 20 mg 2% lidocaine.</b></p>	Open-label trial	Mean pain <b>during IO insertion</b>	Tibia left: 4.4 ( $\pm 2.6$ ) Tibia right 3.6 ( $\pm 2.3$ ) Humerus: 3.0 ( $\pm 1.5$ )	Healthy volunteers; 5 took part in both parts, so may have become 'habituated' to IO access. 1 new volunteer to part 2 withdrew after IO insertion because of excess pain; sponsored by manufacturer
			Mean pain score <b>during initial flush</b>	Tibia left: 6.8 ( $\pm 2.9$ ) Tibia right 7.9 ( $\pm 2.8$ ) Humerus: 4.6 ( $\pm 2.9$ )	
			Peak pain <b>during infusion</b>	Tibia: 2.9 Humerus: 1.4	

# algoritmus





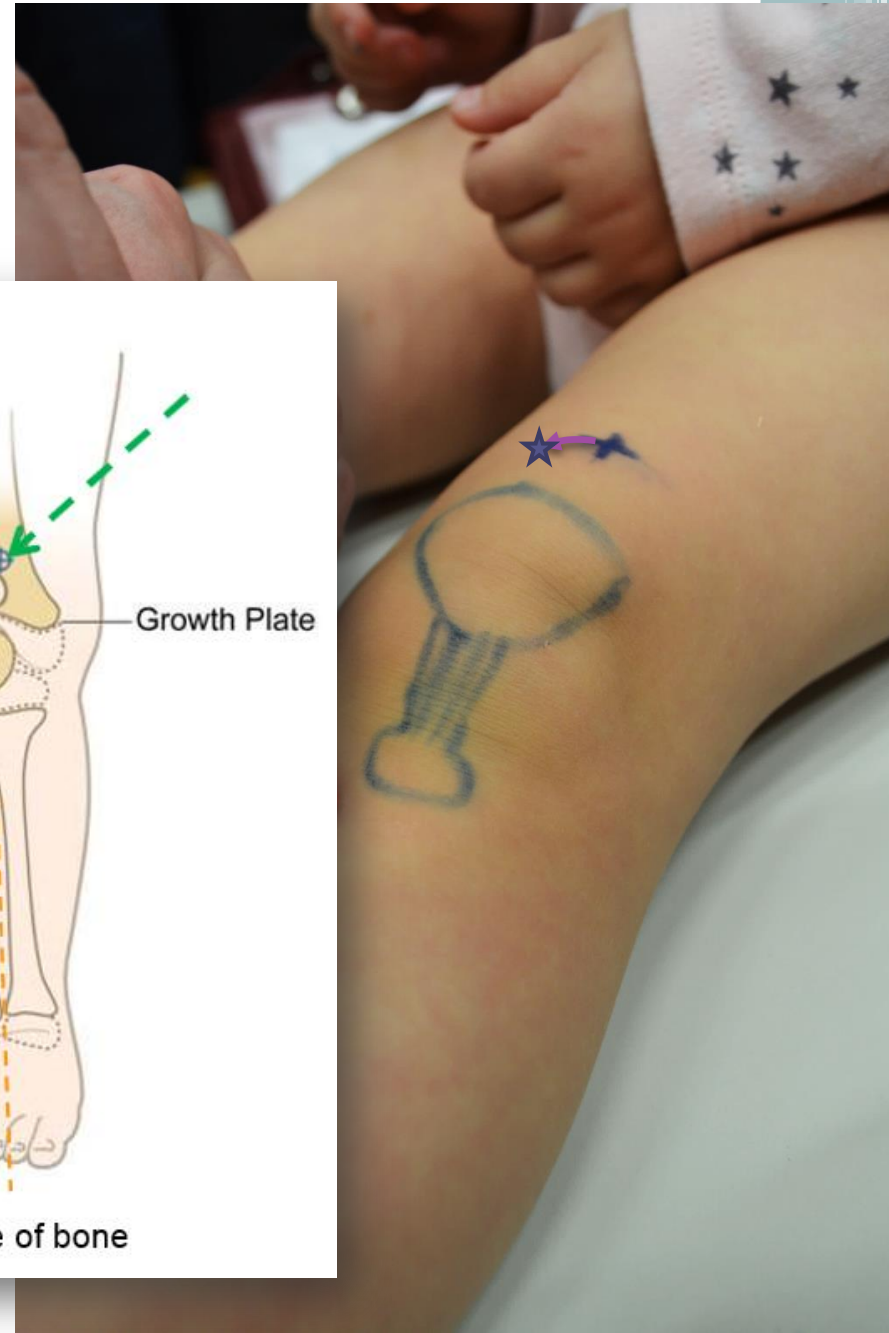
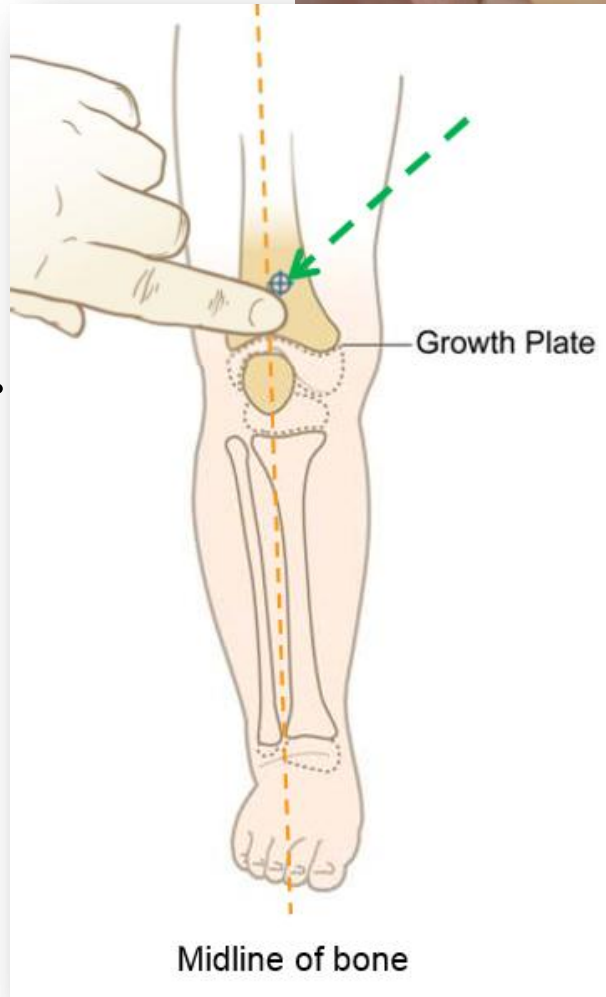
# Proximální humerus



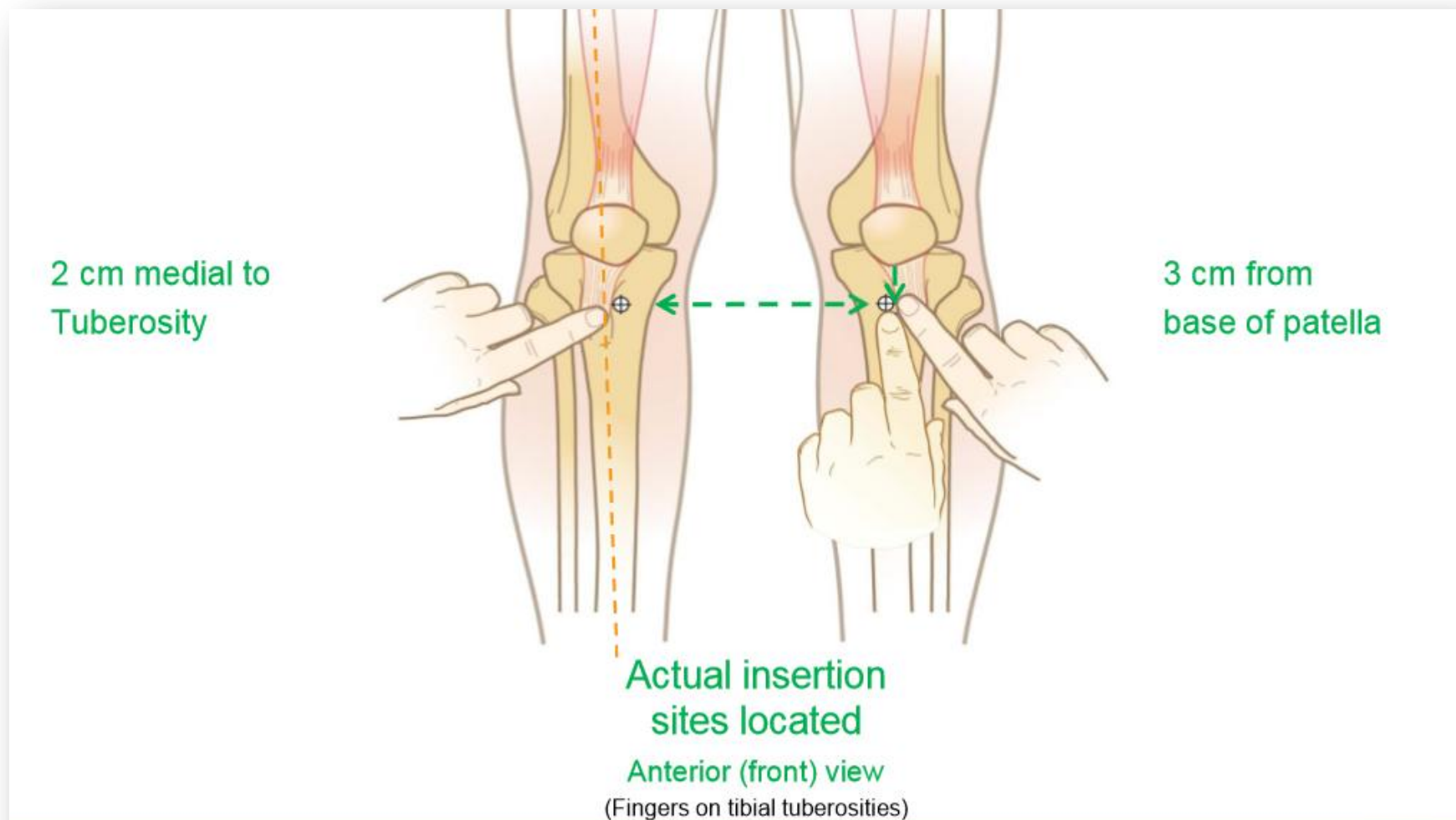
- Stabilizovat jehlu
- Stabilizovat končetinu

# Distální femur

- Do 12 let věku
- Jeden prst nad koleno, lehce vycentrovat med. ne přes šlachu
- Jehla 2,5 cm

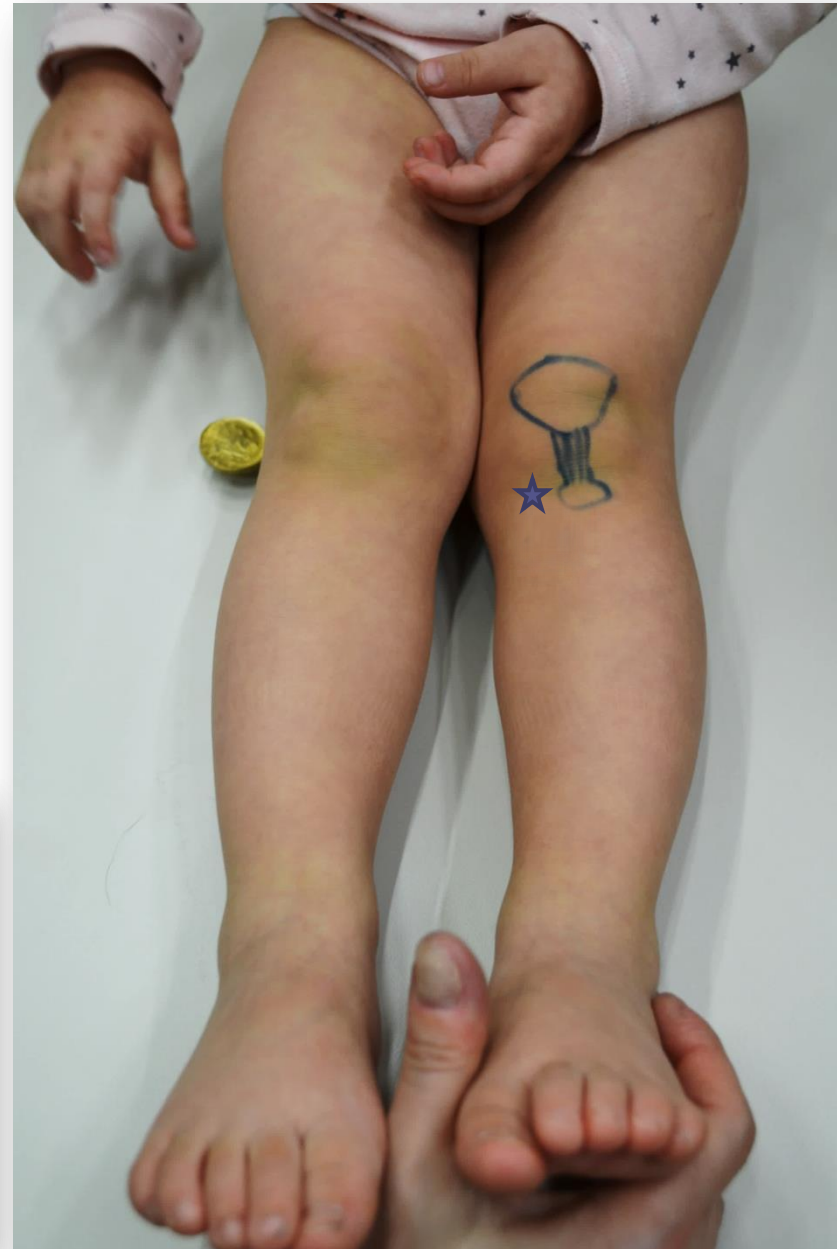
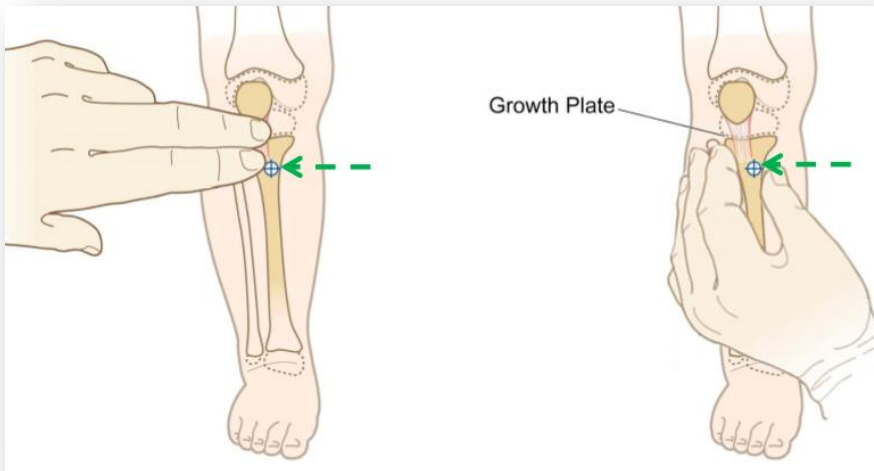


# Proximální tibie > 40 kg



# Proximální tibia

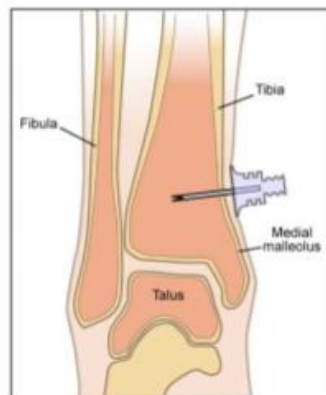
- Děti < 39 kg
- Vyhmatat tuberositas tibiae + 1 cm mediálně
- 2 prsty pod patelu + 1 cm mediálně
- Vhodné vyhmatat mediální hranu tibiae





# Distální tibie

DOSPĚLÍ:



3 cm proximal to the most prominent aspect of the medial malleolus

Midline of the bone

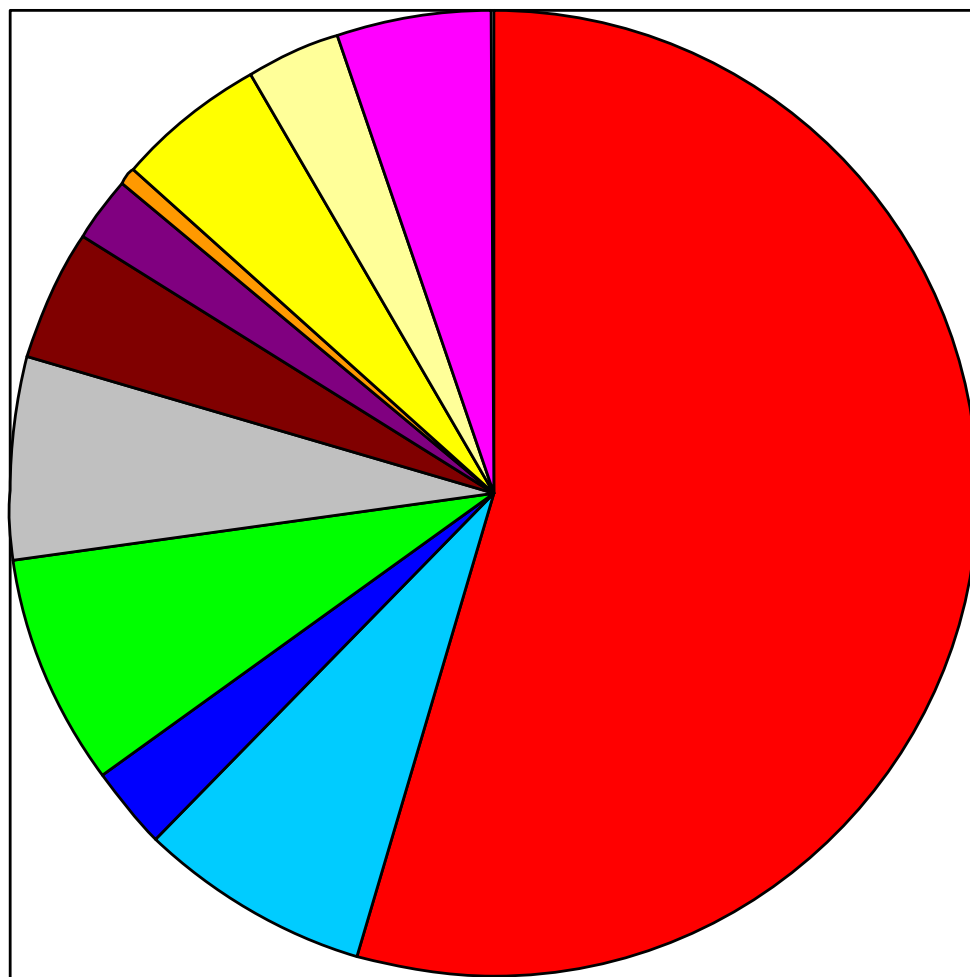


DĚTI:



1-2 cm proximal to the most prominent aspect of the medial malleolus

# IO v praxi - nejčastější indikace



- KPCR = 146 (55,7%)
- závažná neurologická dg. = 21 (8%)
- nitrolební poranění = 7 (2,7%)
- dekomp. DM = 16 (16,1%)
- polytrauma = 17 (6,5%)
- krvácení = 12 (4,6%)
- popáleniny = 6 (2,3%)
- anafylaxe = 1 (0,4%)
- kardiolog. dg. = 14 (5,3%)
- dechová insuf. = 8 (3,1%)
- jiné = 14 (5,3%)



# IO v praxi - statistika ZZS JmK

- Růžová:
  - 2014: 17
  - 2015: 17
- Modrá:
  - 2014: 101
  - 2015: 85
- Žlutá:
  - 2014: 38
  - 2015: 37



# Vychytávky

## Arrow EZ-IO®

By Ideawire,inc.

Open iTunes to buy and download apps.

[View More by This Developer](#)



[View in iTunes](#)

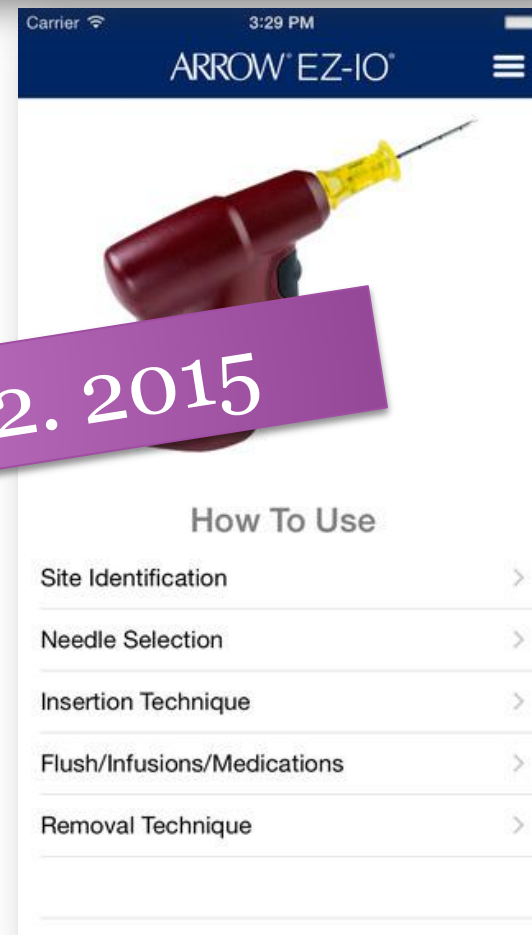
### Description

Arrow EZ-IO® app by Teleflex is a complete how to guide designed for the Health Care Professional application of the Arrow® EZ-IO® Intraosseous Vascular Access System

[Arrow EZ-IO® Support](#)

### What's New in Version 2.1

- Optimization for iPhone 6 and 6+ screen sizes
- Notifications of important announcements
- Live lab postings with registration functionality



Update 20. 2. 2015

# Těšíme se na vás v praktické části.....

1. Vyhledávání místa zavedení (anatomické známky)
2. Postup při zavedení i. os. inserce EZ-IO
3. Nácvik ovládnání vlastních svalů ruky a vrtačky EZ-IO

# Děkuji za pozornost

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ZZS JMK

Kamenice 798/1d

Brno

