

IRISH ASSOCIATION FOR EMERGENCY MEDICINE



IAEM Clinical Guideline

Paediatric Intraosseous Insertion

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DISCLAIMER

IAEM recognises that patients, their situations, Emergency Departments and staff all vary. These guidelines cannot cover all clinical scenarios. The ultimate responsibility for the interpretation and application of these guidelines, the use of current information and a patient's overall care and wellbeing resides with the treating clinician.

Revision History	Section	Summary of Changes	Author
V1.0	All	Final Version	SL/RMcN

CONTENTS

GLOSSARY OF TERMS	4
INTRODUCTION	5
PARAMETERS.....	6
AIMS.....	6
LANDMARKS FOR IO NEEDLE INSERTION	7
Figure 1: Paediatric Insertion Sites	7
Figure 2: Proximal Humerus Insertion Site Identification	9
MANUAL TECHNIQUE	10
Equipment.....	10
Procedure	10
Figure 3: Manual Technique Insertion	11
METHOD OF INSERTION USING EZ-IO®.....	11
Needle Selection.....	11
Figure 4: Needle Selection.....	12
Procedure	12
Figure 5: EZ-stabiliser dressing.....	13
MANUFACTURER'S DEMONSTRATION ANIMATIONS.....	14
SPECIAL CONSIDERATIONS	14
REFERENCES	15

GLOSSARY OF TERMS

IO	Intraosseous
IV	Intravenous

Paediatric Intraosseous Access

INTRODUCTION

Access to the circulation is a crucial step in delivering advanced paediatric life support. Many access routes are possible: IO access, peripheral venous access and central venous access. The route chosen will reflect both clinical need of the patient and the skills of the operator.

IO access is an effective route for fluid resuscitation, drug delivery and laboratory evaluation in all age groups, and has an acceptable safety profile. It is comparable to central access and can be attained rapidly in the emergent situation. The more proximal the IO insertion site, the greater the efficacy of flow to the heart.

Infusion pumps or paediatric infusion sets should be used for fluid administration, this avoids inadvertent overperfusion in small children.

PARAMETERS

Target audience	This guideline is directed at all clinical staff tasked with gaining IO access on a child.
Patient population	Children in which vascular access is difficult to obtain in emergent, urgent and medically necessary situations for up to 24 hours.
Indications	Recommended technique for circulatory access in cardiac arrest. In decompensated shock if venous access is not rapidly achieved: <ul style="list-style-type: none">○ Unsuccessful venous access after two attempts○ If venous access will take longer than 60 seconds to carry out
Contraindications	Fracture of the target bone. Osteogenesis imperfecta. Infection at the site of insertion. Prosthesis or orthopaedic procedures near insertion site. Inability to identify landmarks. IO access/ attempted IO access in target bone within previous 48 hours.
Complications	Compartment syndrome. Infection (cellulitis, osteomyelitis). Iatrogenic fracture. Failure to enter the bone marrow with extravasation/ subperiosteal infusion. Through and through penetration of the bone. Haematoma. Pressure necrosis of the skin.

AIMS

The aim of this guideline is to direct clinical staff in the optimal performance of an IO needle insertion.

LANDMARKS FOR IO NEEDLE INSERTION

Please see Figure 1 below.

- Distal femur: 1 cm proximal to superior border of patella and 1-2 cm medial to midline
- Proximal tibia: 1 cm medial to tibial tuberosity along the flat aspect
- Distal tibia: 1-2 cm proximal to medial malleolus along the flat aspect
- Proximal humerus: the most prominent part of the greater tubercle above surgical neck.

Only for older children >40kg using EZ-IO® (See Figure 2).

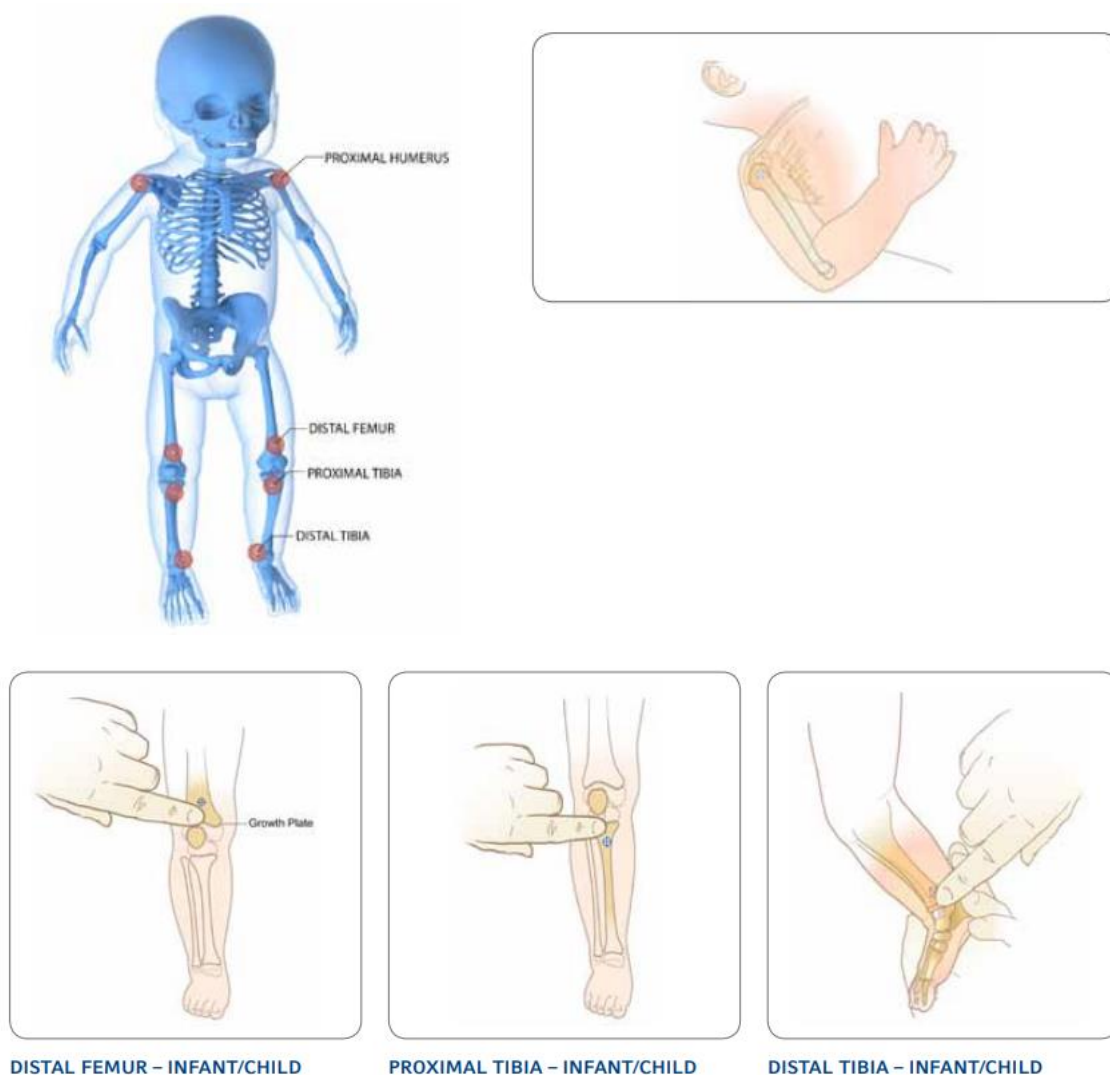


Figure 1: Paediatric Insertion Sites (https://www.teleflex.com/usa/en/product-areas/emergency-medicine/intraosseous-access/arrow-ez-io-system/literature/VA_IOS_Arrow-EZ-IO-Ped.pdf)

Landmark for proximal humerus insertion ([Figure 2](#)):

1. Place the patient's hand over the abdomen (elbow adducted and humerus internally rotated). Place your palm on the patient's shoulder anteriorly. The area that feels like a "ball" under your palm is the general target area. You should be able to feel this ball, even on obese patients, by pushing deeply.
2. Place the ulnar aspect of your hand vertically over the patient's axilla and the ulnar aspect of your other hand along the midline of the patient's upper arm laterally.
3. Place your thumbs together over the arm; this identifies the vertical line of insertion on the proximal humerus.
4. Palpate deeply up the humerus to the surgical neck. This may feel like a golf ball on a tee; the spot where the "ball" meets the "tee" is the surgical neck. The insertion site is above the surgical neck, on the most prominent aspect of the greater tubercle.
5. Point the needle set tip at a 45° angle in a posteromedial direction. (See Figure 2: Image E)

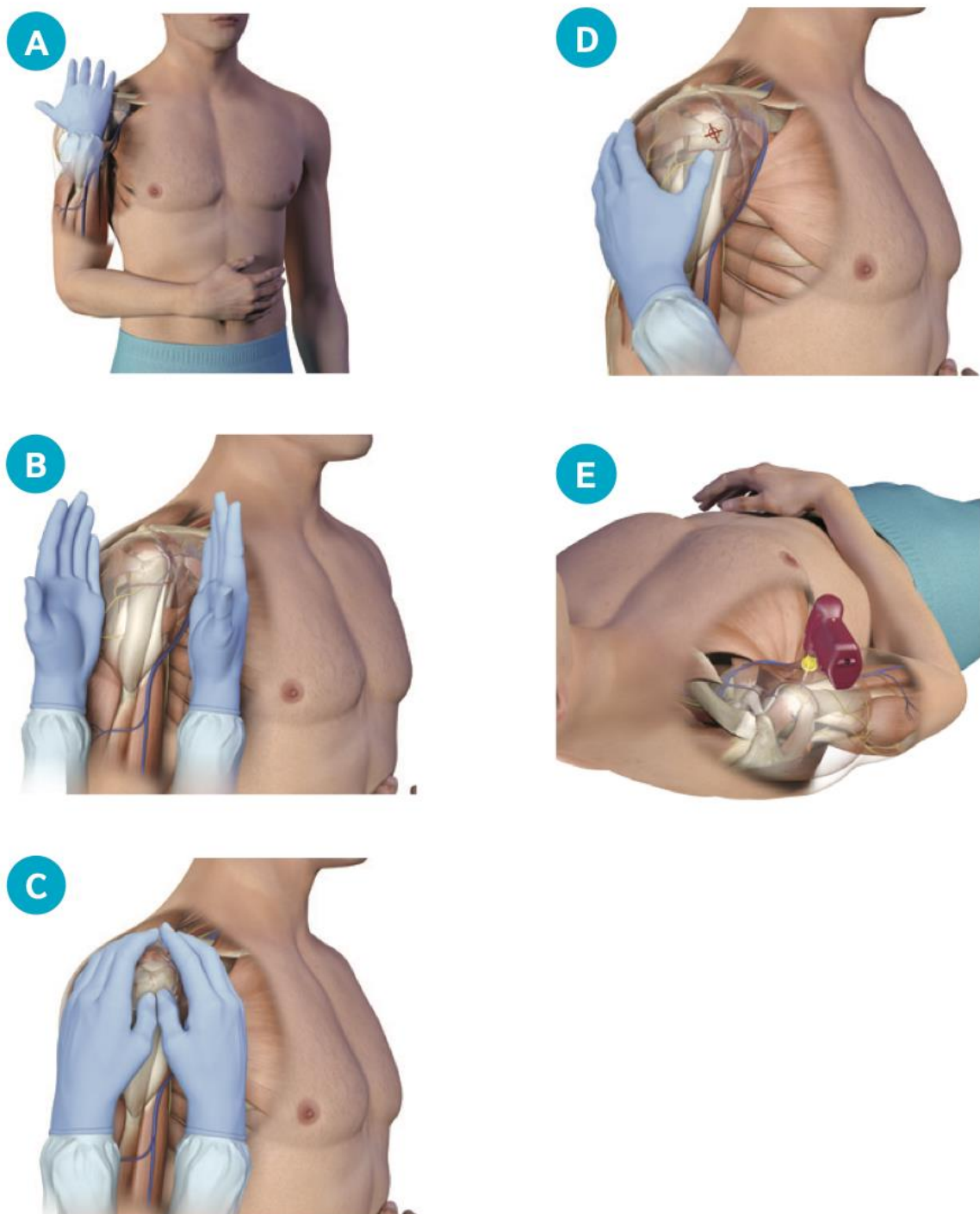


Figure 2: Proximal Humerus Insertion Site Identification (https://www.teleflex.com/usa/en/product-areas/mergency-medicine/intraosseous-access/arrow-ez-io-system/literature/VA_IOS_EZ-IO_Pocket_Guide.pdf)

MANUAL TECHNIQUE

Equipment

- Alcohol swabs
- 18G (in infants) or 15G (in young children) needle with trocar (at least 1.5cm in length)
- Syringe: 5 ml
- Syringe: 20 ml
- Infusion fluids

Procedure

- Identify landmark (please see Figure 1 above).
- Perform hand hygiene and maintain aseptic technique throughout the procedure.
- Pre-fill 20ml syringe with infusion fluids.
- Clean insertion site.
- Insert the needle perpendicularly to the skin. Push the needle tip through the skin until the tip rests against the bone. The 5mm mark must be visible above the skin (See Figure 3 below).
- Using a gentle twisting or boring motion, advance the needle until a 'give' is felt as the cortex is penetrated.
- Remove the stylet and attach the 5 ml syringe and aspirate. Blood marrow may be used to check blood glucose and provide blood culture. Flush to confirm correct positioning.
- Attach the pre-filled 20 ml syringe and push in the infusion fluid in boluses.
- Secure the needle and tubing in place.

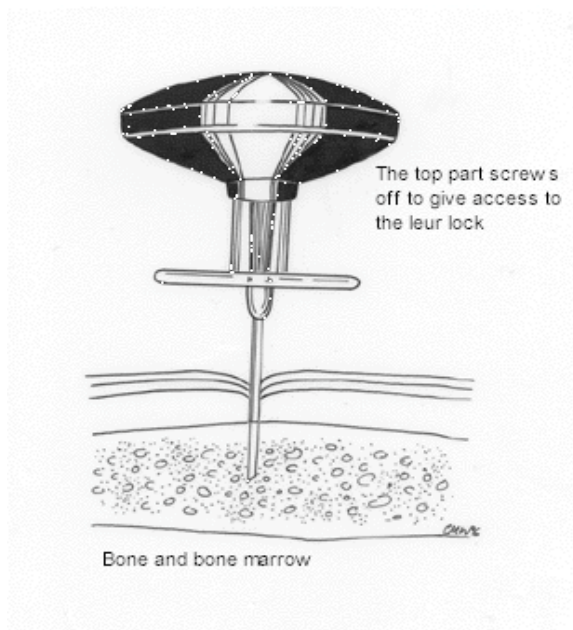


Figure 3: Manual Technique Insertion (<https://emed.ie/Procedures/IO.php>)

METHOD OF INSERTION USING EZ-IO®

The EZ-IO® drill is a powered device that enables rapid insertion of an IO needle. The same landmarks are used as for manual insertion and the procedure is less painful for the conscious victim due to its rapidity.

Needle Selection

Needle selection depends on patient weight, anatomy and tissue depth overlying the insertion site (see Figure 4).

- Pink: 15 mm 15 gauge (3-39 kg)
- Blue: 25 mm 15 gauge (>3 kg)
- Yellow: 45mm 15 gauge (>40 kg)



Figure 4: Needle Selection (https://www.teleflex.com/usa/en/product-areas/emergency-medicine/intraosseous-access/arrow-ez-io-system/literature/VA_IOS_Arrow-EZ-IO-Ped.pdf)

Procedure

- Identify landmark.
- Perform hand hygiene and maintain aseptic technique throughout the procedure.
- Clean insertion site.
- Choose appropriate size needle and attach to drill. It will fix magnetically. Remove the needle cover.
- Gently press the drill and needle through the skin at 90° until the tip touches the bone.
The 5 mm black mark on the needle set must be visible above the skin. If not, use the longer needle.
- Squeeze the trigger, apply gentle steady pressure (the minimal amount of pressure required to keep the driver advancing into the bone).
- In the event of driver failure, disconnect the power driver, grasp the Needle Set Hub by hand and advance into the medullary space while twisting.
- Immediately release the trigger when you feel the loss of resistance as the needle set enters the medullary space. Avoid recoil – do NOT pull back on the driver when releasing the trigger.
- Hold and stabilize the catheter hub if any manipulation is needed.

- Stabilize hub and remove driver and stylet. Place stylet in an appropriate sharps container.
- Properly secure using an EZ-Stabilizer® Dressing and stabilize the extremity.
- Aspirate the marrow if possible. Failure to aspirate marrow does not mean the insertion has failed.
- Attach primed extension set, firmly secure to catheter hub with clamp open.
- Remove adhesive from back of EZ-Stabilizer Dressing (figure 5) and apply dressing to skin.
- Confirm placement. Flush the EZ-IO Catheter with 2-5 ml normal saline. Prior to flush, consider IO 0.5mg/kg 2% preservative-free and epinephrine-free lidocaine, not to exceed 40mg.
- Medication and fluid administered via the IO route, are given in the same dose, rate and concentration as when delivered via the peripheral IV route.



Figure 5: EZ-stabiliser dressing

MANUFACTURER'S DEMONSTRATION ANIMATIONS

See here for the manufacturer's demonstration animations:

- Proximal Tibia

<https://www.youtube.com/watch?v=99DVtJSKi6k&list=PL75lb1atTs2ZXxboFk5XObRnlKHpXgU9o&index=19>

- Distal femur

<https://www.youtube.com/watch?v=1i46M1LnYWY&list=PL75lb1atTs2ZXxboFk5XObRnlKHpXgU9o&index=9>

SPECIAL CONSIDERATIONS

- Failed attempts at insertion can be identified by swelling around the insertion site and failure of fluids/drugs to flow. It should prompt discontinuation of fluid infusion and removal of the intraosseous device. In this situation, an alternate limb should be used to obtain further access if required. There should be no further attempts on the failed site for 72 hours.
- Bone marrow samples cannot be used for blood gas machines. It can be used for blood cultures, point of care glucometers and some biochemical tests – check with local laboratory. It needs to be labelled as intraosseous sample when it is being sent to the laboratory.
- The device should be removed within 24 hours or as soon other venous access has been obtained.
- To remove the device: Use a sterile luer-lock syringe as a handle, attach the syringe to the hub of catheter, maintain alignment and rotate clockwise while pulling straight up. Avoid rocking the catheter on removal. Dispose of catheter with syringe attached in an approved sharps container.

REFERENCES

- ATLS 10th Edition
- APLS 6th Edition
- EZ-IO® Paediatric Brochure: https://www.teleflex.com/usa/en/product-areas/emergency-medicine/intraosseous-access/arrow-ez-io-system/literature/VA_IOS_Arrow-EZ-IO-Ped.pdf
- EZ-IO® Pocket Guide: https://www.teleflex.com/usa/en/product-areas/emergency-medicine/intraosseous-access/arrow-ez-io-system/literature/VA_IOS_EZ-IO_Pocket_Guide.pdf
- The Science and Fundamentals of Intraosseous Vascular Access 2017. 3rd Ed. *Teleflex Global Research and Scientific Services, a Division of Clinical and Medical Affairs*
https://teleflex.com/usa/en/clinical-resources/ez-io/documents/EZ-IO_Science_Fundamentals_MC-003266-Rev1-1.pdf
- The Royal Children's Hospital Melbourne Clinical Practice Guideline IO Access
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