Obtaining intraosseous access in the distal femur

**Background**

Intraosseous (IO) needles are placed into bone marrow within a bone (usually in the proximal or distal ends of a long bone). Bone marrow is highly vascular and fluids and drugs administered into bone marrow are quickly and easily absorbed from the medullary space, through the vascular system and into the central circulation.

There are multiple techniques described for locating the site of placement (and none of these are wrong), however this skill sheet will only cover one or two techniques.

**Indications**

- The need for emergency vascular access when intravenous access cannot otherwise be easily obtained.

This requires a degree of clinical judgement; however, examples may include:

- Patients with significant compromise
- Patients who are trapped and vascular access is unobtainable
- Children

**Contraindications and cautions**

**Contraindications:**

- Infection at the site selected for insertion
- Fracture of the long bone selected for insertion
- Prosthetic limb/joint at the chosen site.

**Cautions:**

- Patients <3 kg and very small infants. Extreme caution should be used when obtaining IO access in neonates and very small infants, to avoid over insertion. Avoid applying too much pressure whilst using the drill and stop when you feel the ‘pop’.
- Conscious patient. Caution is advised when obtaining IO access in the conscious patient, as both the procedure and subsequent flushing of the needle can be painful; hence the use of effective and consistent communication regarding this procedure is essential.
- Previous IO insertion in the same limb within the last 48hrs (almost never an issue in the out-of-hospital setting).

**Procedure**

IO site selection is dependent on multiple factors such as patient age, size, presenting condition, ability to locate anatomical landmarks, clinical judgement and experience. Selection of the appropriate site is also highly dependent on the absence of contraindications, ability to access the site effectively, combined with the ability to secure the site. The distal femur is an authorised insertion site, and can be utilised in children between 3 kg and 39 kg in weight.

1. Ensure all the components of the EZ-IOTM intraosseous vascular access system are present. This includes:
   - EZ-IOTM driver/drift
   - EZ-IOTM needles – 15mm (pink), 25mm (blue), 45mm(yellow)
   - EZ stabiliser
   - EZ Connect
   - Individual sharps container (needleVISE)
   - IV pressure bag
   - Pink wrist band
2 Assemble the rest of the equipment required:
   - Alcohol swabs
   - Drawing up needle
   - 1% lignocaine ampoule (50mg/5ml)
   - 10 ml syringe
   - 10 ml 0.9% sodium chloride ampoule
   - 1 litre bag 0.9% sodium chloride
   - 1 IV administration set

3 Explain the procedure and gain informed consent where appropriate.

4 Maintaining aseptic techniques, open the pack, select the appropriately sized needle and apply to the drill.

5 Prime the extension set and have the needleVISE ready, along with the IO stabiliser.

6 Clean the insertion site area using alcohol swabs.

7 Locate the superior aspect of the patella.

8 Move 1cm up (1 finger breadth) and then slightly off centre- approximately 1cm medially to avoid the quadriceps tendon. With the needle tip aimed downward at a 90-degree angle to the horizontal plane push the needle through the skin until the tip rests against the bone.

9 Ensure at this point prior to insertion that you can visualise the 5mm black mark (line closest to the hub of the needle).

10 Applying steady pressure, drill into the femur advancing the needle until you feel a ‘pop’ or ‘give’.

11 Holding the hub of the needle in place pull the IO driver straight off. Continue to hold the hub whilst twisting the stylet off the hub with counter clockwise rotations. At this point the needle should feel firmly seated in the bone.

12 Place the stylet into the needleVISE container.

13 Place the IO stabiliser dressing over the hub then pulling the tabs off the dressing to expose the adhesive area, apply to skin.

14 Aspirate for bone marrow and then flush firmly with 5 ml of 0.9% sodium chloride.

15 Administer 1% lignocaine IO if clinically indicated.

16 Attach the primed extension set to the hub and secure firmly by twisting it clockwise.

17 Place patient’s leg in such a position that will reduce the risk of it being knocked/dislodged as well as allowing the clinician ease of access for drug and administration of fluids and having it visible in which to monitor for potential complications.

18 Apply wristband to leg that IO has been inserted, documenting date and time of insertion.

Distal femur (best for children under 6 years)

Potential complications of the procedure

- Haematoma
- Dislodgement of the IO cannula.
- Fracture, particularly in children. Children’s bones are unique in the fact that they are also subject to the unique injury of a growth plate fracture. These growth plates known as the physis or epiphyseal plate, are areas of cartilage located near the ends of bones which produce new bone tissue allowing bone growth to occur. When attempting IO access in the paediatric patient it is therefore imperative that this factor is considered and that the site for insertion is clearly identified to reduce the risk of causing a growth plate fracture and resulting in permanent damage and/or disability.

- Infection. With any invasive procedure it is important to adhere to, and apply aseptic techniques wherever possible. Because the cannula is being introduced directly into bone, there is a risk of introducing infection resulting in osteomyelitis if infection control measures have not been taken.
› Driver failure. The EZ-IO™ is designed to perform approximately 500 insertions and does not require routine testing. Loss of power therefore is more likely to be the slowing or stalling as a result of too much downward pressure being applied during insertion. The driver will only require a moderate level of pressure to achieve a safe result.

› Insertion failure. If the insertion attempt fails, a subsequent attempt cannot be reattempted on the same bone. This is since repeated penetration of the bone cortex is highly likely to cause extravasation and place the patient at risk of serious complications such as compartment syndrome. If a second attempt is required, then this must be carried out on a separate limb.

› Extravasation

› Compartment syndrome

› Air embolism

› Pain. The two causes of pain are related to insertion which is specific and of short duration, with the second cause due to the flush, aspiration and infusion of fluids and drugs which is general, diffuse and related to pressure. Lignocaine is not routinely required and should only be administered to those patients who are experiencing significant pain or discomfort from the infusion of fluids or drugs. When administering intraosseous 1% lignocaine:
  – Administer 5ml (50mg) for an adult slowly over 1–2 minutes and waiting a further minute before infusing fluids or drugs. This is to limit the amount of lignocaine available to be flushed into the central circulation.
  – This dose can be repeated once only after 15 minutes.
  – Refer to the paediatric drug dose tables for children.

**Additional information**

**5 mm black line**

The EZ-IO™ needles are marked with a black line 5 mm from the hub. When the needle is inserted through the soft tissue it should reach the bone AND the 5 mm mark should be visible above the skin. If the needle does not reach the bone, or the 5 mm mark is not visible above the skin, a longer needle or alternative site should be selected.

**Pressure Bag**

An IV pressure bag is contained within every EZ-IO™ kit. The bag is capable of generating 300mmHg of pressure which is usually required to infuse fluid into the IO space. Manually squeezing the IV bag is unlikely to be effective due to the inability of creating sufficient pressure.

Although there is no ‘maximum infusion pressure’, higher pressures are associated with pain as mentioned above, and therefore will require appropriate and effective pain management.

**Monitoring:**

Once IO access has been obtained it is essential that the clinician continues to monitor the site at regular intervals. The four key areas and what to monitor for are as follows:

**Site:**

› No leakage- Monitor for any signs of damp areas or obvious fluid loss at the needle site both at the point where the hub meets the skin as well as the hub/EZ connect point. If the EZ stabiliser is becoming unadhered from the skin, then this could indicate leakage.

› Look for signs of extravasation which could present as soft tissue swelling at the site of insertion.

**Needle:**

› Secure – ensure the needle is secure and note any changes if it appears it has moved post insertion.

› Intact – ensure the hub of the needle is intact as well as the needle itself still at a normal angle into the skin.

› Stabiliser is secure – if the stabiliser becomes unsecure then you must work out the reason as to why and fix the problem appropriately. This may involve the application of another stabiliser or using adhesive tape. Do not bandage around the site as this will cover the area, making it unavailable for the clinician to adequately assess and monitor the site appropriately.

› Connections are secure – check and recheck at regular intervals as well as post any treatment you give via the IO needle.

**Patient:**

› No pain from infusion- if the patient is complaining of pain, consider what the cause of the pain may be, rule out potential complications, and administer analgesia as per the CPG’s.

› Wrist band is in situ- this must be applied to the limb that has the IO inserted along with the date and time of insertion.

**Flow:**

› Pressurised infusion – check the IV pressure bag at regular intervals to ensure continuous pressure is being applied allowing fluids to be infused.

› Expected flow rates are being achieved – monitor flow rates that you are administering, specifically
looking for ‘no flow’ or at an extremely fast rate. This could indicate a possible blockage in the IO catheter or that it has become dislodged or disconnected.

Effects of – like any treatment you administer, assess and reassess for any improvement or decline post drug or fluid treatment.

Assessment information

If you are asked to demonstrate the procedure of gaining intraosseous access in the distal femur as part of an assessment, the following table gives you an idea of what the assessor will be expecting.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Competent</th>
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<tbody>
<tr>
<td>1. Describe the indications for obtaining intraosseous access</td>
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2. Apply wristband to leg that IO has been inserted, documenting date and time of insertion.

5. **Describe the potential complications of intraosseous access.**
   Answer must include the following:
   - Haematoma
   - Dislodgement of the IO cannula
   - Fracture, particularly in children
   - Infection
   - Driver failure
   - Insertion failure
   - Extravasation
   - Compartment syndrome
   - Air embolism
   - Pain.

6. **Describe the four key areas to be monitored once intraosseous access has been achieved.**
   Answer must include the following:
   - Site
   - Needle
   - Patient
   - Flow