



Figure 1. A, General landmarks for IO insertion in the leg of an infant. B, Locations for IO insertion in the proximal tibia and distal femur in older children. C, Location for IO insertion in the iliac crest. D, Location for IO insertion in the distal tibia. E, Technique for immobilizing the leg while twisting the IO needle into the leg of an infant.

Step	Action
1	<ul style="list-style-type: none"> To establish access in the proximal tibia, position the leg with slight external rotation. Identify the tibial tuberosity just below the knee joint. The insertion site is the flat part of the tibia, about 1 to 3 cm (about 1 finger's width) below and medial to this bony prominence (Figure 1). <p>Always use universal precautions when attempting vascular access. Disinfect the overlying skin and surrounding area with an appropriate agent.</p>
2	<ul style="list-style-type: none"> The stylet should remain in place during insertion to prevent the needle from becoming clogged with bone or tissue. Stabilize the leg on a firm surface to facilitate needle insertion. Do not place your hand behind the leg. <p>Note: If a standard IO needle or bone marrow needle is not available, a large-bore standard hypodermic needle can be substituted, but the lumen may become clogged with bone or bone marrow during insertion. Short, wide-gauge spinal needles with internal stylets can be used in an emergency, but they are not the preferred needles for IO use because they bend easily. A hemostat can be used to help control the needle during insertion. Use at least an 18-gauge spinal or hypodermic needle for this purpose.</p>
3	<ul style="list-style-type: none"> Insert the needle through the skin over the anteromedial surface of the tibia in a direction perpendicular to the tibia. This directs the needle to avoid injury to the growth plate. Use a twisting motion with gentle but firm pressure. Continue inserting the needle through the cortical bone until there is a sudden release of resistance as the needle enters the marrow space. If the needle is placed correctly, it should stand easily without support.

4	<ul style="list-style-type: none"> Remove the stylet and attach a syringe. Aspiration of bone marrow contents and blood in the hub of the needle confirms appropriate placement. Blood may be sent to the lab for study. (Note: Blood or bone marrow may not be aspirated in every case.) Infuse a small volume of saline and observe for swelling at the insertion site or posteriorly in the extremity opposite the insertion site. (Swelling will be observed if the needle has penetrated into and through the posterior cortical bone). Fluid should easily infuse with saline injection from the syringe.
5	There are several methods to stabilize the needle. You may place tape over the flange of the needle to provide some support and position gauze padding on both sides of the needle for additional support.
6	When connecting IV tubing, tape the tubing to the skin to avoid displacing the needle from tension placed on the tubing.
7	Volume resuscitation can be delivered via a stopcock attached to extension tubing or by infusion of fluid under pressure. When using a pressurized fluid bag, take care to avoid air embolism.
8	Any medication that can be administered IV can be given by the IO route, including vasoactive drug infusions such as an epinephrine drip. Follow all bolus medications with a saline flush.

After IO needle/catheter insertion keep the following points in mind:

- Check the site frequently for signs of swelling and needle displacement.
- Delivery of fluids or drugs through a displaced needle may cause severe complications, such as tissue necrosis or compartment syndrome.
- IO needles are intended for short-term use, generally less than 24 hours. Replacement with long-term vascular access is usually accomplished in the intensive care setting.