The University of Texas Medical Branch
Intraosseous (IO) Overview (June 2013)

General Principles

1. The basic principle of intraosseous infusion is the vascularity of the bone. The IO space is connected to the central circulation through a system of noncollapsible bony sinusoids and vessels.
2. **Indications** for the insertion of an intraosseous catheter include short-term treatment when intravascular access cannot be achieved.
3. **Contraindications** for the insertion of an intraosseous catheter include:
    - **a.** Placement in a fractured bone or in a limb with vascular injury
    - **b.** Compartment syndrome
    - **c.** Cellulitis or burns at the site
    - **d.** Underlying bone disease, such as osteoporosis
    - **e.** Previous orthopedic procedures, such as prosthetic limb or joint
    - **f.** Soft tissue infection
    - **g.** Excessive tissue and/or absence of adequate anatomical landmarks
    - **h.** Once a bone has been punctured by an IO attempt it cannot be used again for a time period of 24 hours

Insertion of the IO Catheter

Individuals who may insert an intraosseous catheter include:

1.) Trained physicians who have completed the required Intraosseous catheter training under the direction of a credentialed faculty member
2.) Specially-trained nurses who have completed required training may insert IO's in emergent/urgent patient scenarios, such as resuscitation.

Aseptic technique and standard precautions shall be utilized.

Administration of Medications & Monitoring

Nurses who have completed required training will assume primary responsibility for the following:

a. Administration of medications via the intraosseous catheter
b. Monitoring of the IO site for signs of complications
c. Notification of the ordering provider if any complications develop

Flushing the catheter prior to use will help facilitate flow: NO FLUSH = NO FLOW
10 ml of 0.9% normal saline for adult patients
5 ml of 0.9% normal saline for pediatric patients

After a bolus drug administration, flush the catheter with 3-10 cc of 0.9% normal saline

Dosage of medications or infusions are considered to be equivalent when comparing intraosseous and intravenous.

Administration of medications via intraosseous access is considered preferable in comparison to endotracheal administration, due to a more predictable pharmacologic effect from the intraosseous route.

Avoid rocking the EZ-IO catheter during use

Pain Management In Conscious/Awake Patients:

Pain Management in the Conscious/Awake ***Adult*** Patient:
1.) Infiltration of the area with 1% lidocaine is recommended, prior to insertion.
2.) Pain is also a consideration after insertion and before medication/fluid administration. There are somatic pain sensors within the skin and periosteum of bone, and visceral pain sensors within the intraosseous space.
If indicated, prior to IO syringe bolus (flush) or continuous infusions in alert patients, SLOWLY administer Lidocaine 2% (Preservative Free) through the EZ-IO hub (0.2 ml at a time until desired numbing effect accomplished in the IO space). *Ensure that the patient has no allergies or sensitivities to Lidocaine.*
Usual Dosage: 20-40 mg of 2% Lidocaine for adults (rate: over 30-60 seconds)

Pain Management in the Conscious/Awake ***Pediatric*** Patient:
The EZ-IO product vendor advocates Lidocaine IO for pain relief in Pediatric patients. ***However***, due to lack of appropriate evidence-based literature, Lidocaine will NOT routinely be given IO to Pediatric patients at UTMB for pain control. Pain management will be at the discretion of the physician managing the patient at the time of resuscitation.

Discontinuation of the IO Catheter

1. The intraosseous catheter must be removed **within 24 hours of insertion**
2. Physicians and specially-trained nurses who have completed the required training will discontinue the intraosseous catheter
3. If the patient deteriorates and IO access is required again, bone that has been accessed within the previous 24 hours cannot be accessed again for a time period of 24 hours

Documentation

Documentation shall include:

- Indications and absence of contraindications (procedure note)
- IO site, use of anesthetic, adult or pediatric IO
- Patient tolerance of procedure, # of attempts (if more than one)
- Date and time of insertion
- Date and time of discontinuation
- Assessment of site for signs of infection and/or extravasation
- Patient and/or family teaching

Procedure

Equipment (required):

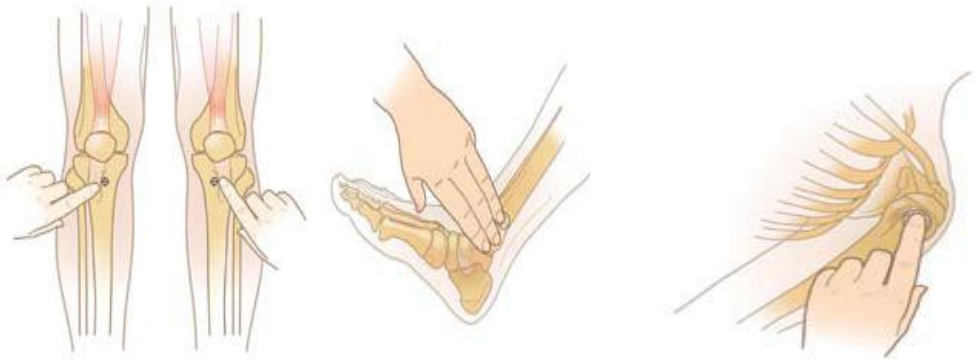
Gloves, mask with splashguard
EZ-IO Driver and needle set
Alcohol or betadine swab or chlorhexidine swab
Extension set (packaged in the EZ-IO kit)
Leurlock 10 ml syringe
Normal Saline for flush
Yellow wristband (packaged in the EZ-IO kit)
Transparent dressing

Equipment (might be required):

Lidocaine 1% (for conscious/alert patient)
Lidocaine 2% preservative free (for conscious/alert patient)
If IV drip to be started: IV tubing, solution, infusion pump and/or pressure bag

Insertion Procedure:

1. Utilize standard precautions
2. Review Indications and Rule out Contraindications
3. Locate appropriate insertion site
   FDA approved sites:
   a. Proximal/Distal Tibia
   b. Proximal Humerus



4. Prepare insertion site using aseptic technique
5. Prepare the EZ-IO driver and appropriate needle set

   Needle size and length:
   For patients weighing between 3-39 kg, 15 gauge, 15 mm long needles
   (Pediatric needles have a pink colored base. Pedi=Pink)
   For patients weighing 40 kg and greater, 15 gauge, 25 mm long needle

6. Stabilize site and insert appropriate needle set
   Insertion Tips
   a. Hold the EZ-IO driver (with the appropriate needle set attached) lightly in your dominant hand
   b. Position driver at insertion site with needle set at **90-degree angle** to the bone. **Gently** power or press needle set until needle set tip touches bone.
   c. Ensure at least 5 mm of the catheter is visible
   d. Penetrate bone cortex by squeezing the driver's trigger and applying **gentle, steady downward** pressure (*Note*: if the driver stalls and will not penetrate the bone you may be applying too much downward pressure)

   e. Release driver's trigger and stop insertion process when:
      1. A sudden "give" or "pop" is felt upon entry into the medullary space
      2. A desired depth is obtained

   For pediatrics, the procedure is similar. Allow the driver to do the work. Do not "pulse" or intermittently push the trigger – complete the insertion in one "smooth motion". DO NOT PUSH – Gently guide instead. Stop when you feel the "pop"
7. Remove the EZ-IO driver from the needle set while stabilizing catheter hub
8. Remove stylet from catheter, place stylet in sharps container
9. Confirm placement
10. Connect primed extension set. DO NOT ATTACH A SYRINGE DIRECTLY TO THE EZ-IO CATHETER HUB.
11. Slowly administer appropriate dose of Lidocaine 2% (preservative free) **to conscious patients if indicated**
12. Syringe bolus (flush) the catheter with normal saline (10 ml adults; 5 ml pedi)

13. Administer medications, or initiate infusion
14. Dress site (opsite may be preferred to visualize the site) and secure tubing
15. Apply yellow wristband to patient. Add date and time of insertion to wristband
16. Monitor site and patient condition. REMOVE CATHETER WITHIN 24 HOURS.

Successful placement of an intraosseous access is dependent upon factors such as appropriate identification of anatomical landmarks, the correct application of the device, and absence of factors preventing the reaching of the marrow space, such as morbid obesity.

Confirmation of Placement

The following are examples of ways confirmation of placement can be accomplished:

1. The catheter is firmly seated and does not move
2. You observe blood on the stylet tip prior to placing it in the sharps container
3. You note blood at the catheter hub
4. You are able to aspirate blood or marrow from the catheter
5. Drugs or fluids flow without difficulty (there may be some resistance with first flush, pressure bag needs to be utilized for fluids) – there are no signs of extravasation
6. You note the effects of administered drugs
7. X-ray confirmation

Intraosseous flow rates may vary, depending on age and anatomy of the patient, insertion site, and use of a pressure bag. Flow rates are commonly slower than most peripheral catheters due to the anatomy of the intraosseous space. A pressure bag or stopcock syringe may need to be utilized.

Complication rates are reported to be low. The most common complication is extravasation. This is evidenced by local swelling of surrounding tissue, increased circumference of the affected extremity, or increased infusion resistance. If extravasation is detected, the intraosseous device should be removed, and the patient should be closely monitored for the development of compartment syndrome.
Other complications may include infection, compartment syndrome, bone fractures, and osteomyelitis. Conditions which may be associated with a greater risk for osteomyelitis include prolonged IO use, bacteremia, and the administration of hypertonic fluids.

Intraosseous access is safe and effective for fluid resuscitation, medication administration, blood product administration, and blood sampling for laboratory evaluation. The results of laboratory tests may be slightly different from venous samples because of low flow and stasis in the bone marrow. If blood sampling is necessary, the following procedure may be utilized:

1. Aspirate 3 ml of blood, reclamp extension set, and discard this first syringe of blood
2. Aseptically attach another syringe to the extension set. Withdraw the appropriate amount of blood for laboratory tests.
3. Flush the IO with 3-10 cc of 0.9% normal saline
4. Note on lab request that the specimen is from the IO site

Discontinuation of Intraosseous Catheter:

1. Stabilize patient's extremity
2. Connect sterile Luer Lock syringe to hub of catheter
3. Maintain a 90 degree angle during removal
4. Rotate catheter clockwise – while gently pulling. DO NOT ROCK the catheter while removing. Rocking or bending the catheter with a syringe may cause the catheter to separate from the hub.
   Note: If the catheter and hub separate or break simply grasp the exposed catheter tip with a hemostat. Maintain the catheter at a 90 degree angle, then rotate the catheter (clockwise/ counter clockwise) while gently pulling
5. When the catheter has been removed, place in a sharps container

6. Cover the site (small bandage should be sufficient) and continue to monitor
7. If the patient bleeds from the site, apply direct pressure

Intraosseous Reference List

American Heart Association (2005). Part 7.2: Management of Cardiac Arrest. *Circulation*, 112, IV-58 – IV-66.

Blumberg, S., Gorn, M., & Crain, E. (2008). Intraosseous Infusion. A review of Methods and Novel Devices. *Pediatric Emergency Care*, 24(1), 50-59.

Buck, M, Wiggins, B., & Sesler, J. (2007). Intraosseous Drug Administration in Children and Adults During Cardiopulmonary Resuscitation. *The Annals of Pharmacotherapy*, 41, 1679-1686.

Dager, W., Sanoski, C., Wiggins, B., & Tisdale, J. (2006). Pharmacotherapy Considerations in Advanced Cardiac Life Support. *Pharmacotherapy*, 26(12), 1703-1729.

EZ-IO. Retrieved August 2008 from http://www.vidacare.com/Products/index_4_29.html

Fowlwe, R., Gallagher, J., Isaacs, S., Ossman, E., Pepe, P., & Wayne, M. (2007). The Role of Intraosseous Vascular Access in the Out-Of-Hospital Environment (Resource Document to NAEMSP Position Statement). *Prehospital Emergency Care*, 11(1), 63-66.

Gorski, L. (2008). Standard 63: Intraosseous Access Devices. *Journal of Infusion Nursing*, 31(3), 146-147.

Hays, A. & Corso, Y. (2007). Pharmacotherapy for a Pulseless Cardiac Arrest. *AACN Advanced Critical Care*, 18(4), 337-345.

Koschel, M. (2005). Sternal Intraosseous Infusions. *American Journal of Nursing*, 105(1), 66-68.

Langley, D., & Moran, M. (2008). Intraosseous Needles: They're Not Just For Kids Anymore. *Journal of Emergency Nursing*, 34(4), 318-319.

Schwartz, D., Amir, L., Dichter, R., & Figenberg, Z. (2008). The Use of a Powered Device for Intraosseous Drug and Fluid Administration in a National EMS: A 4-Year Experience. *The Journal of Trauma Injury, Infection, and Critical Care*, 64(3), 650-655.

Tay, E. eMedicine – Intraosseous Access. Retrieved 8/21/08 from http://www.emedicine.com/proc/topic80431.htm

The National Association of EMS Physicians (2007). Position Paper: Intraosseous Vascular Access in the Out-Of-Hospital Setting Position Statement of the National Association of EMS Physicians. *Prehospital Emergency Care*, 11(1), 62.

Von Hoff, D., Kuhn, J., Burris, H., & Miller, L. (2008). Does intraosseous equal intravenous? A pharmacokinetic study. *American Journal of Emergency Medicine*, 26, 31-38.