INTRAOSSEOUS INFUSION

INDICATIONS:

Intraosseous (IO) access is indicated for the following conditions when fluid therapy (e.g., normal saline) or emergency life-saving medication administration is required AND adequate intravenous (IV) access is too difficult to establish rapidly:

1. Cardiopulmonary arrest (adult or child)
2. Respiratory arrest (adult or child)
3. Trauma related arrest (adult or child)
4. Life-threatening unstable ~~vital signs (refer to OCEMS Policy # 310.30)~~hypotension
   a. Age 0-9 years: Systolic BP < 70 + (2 x age in years) mm Hg
   b. Age 10 - 64 years: SBP < 90 mm Hg
   ~~4.~~c. Age > 65 years: SBP < 110 mm Hg
5. Unconscious diabetic with blood glucose less than 60, unresponsive to IM glucagon

CONTRAINDICATIONS:

1. Fracture of the extremity selected for IO infusion
~~1.~~2. Vascular disruption of the extremity selected for IO infusion
~~2.~~3. Excessive soft tissue at the insertion site, such that anatomic landmarks cannot be identified
~~3.~~4. Previous orthopedic procedures within the past six (6) weeks on extremity selected for IO Insertion, including prior IO insertion/attempt at that site
5. Obvious skin or other infection or burn at the site selected for IO insertion
~~4.~~6. Joint replacement or orthopedic hardware adjacent to the site of IO insertion

INSERTION SITES:

1. Proximal Tibia—This is the primary and preferred site for all patients of all ages unless unsuccessful or contraindicated.
2. Proximal Humerus—Adults age 18 years old and over
   - Paramedics are able to perform this procedure once their agency is approved by OCEMS and their training is complete. See Appendix B.
3. Distal Femur—Pediatric patients up to 6 years old and 3 to 39 kg
   - Paramedics are able to perform this procedure once their agency is approved by OCEMS and their training is complete. See Appendix B.

Commented [GG1]: These are the BP criteria in policy 310.30

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Commented [GG2]: This is the recommendation of literature presented and of UpToDate. It is recognized that there is a theoretical improvement in flow rate of the humeral IO, but there is not yet a proven benefit, and dislodgement rates are higher.

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Commented [GG3]: This allows incorporation of the initial adoption of the procedure and the QA needed initially presented in the request.

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PROCEDURE:

1. Confirm indication and review any contraindications. Do not attempt more than once at each bone.

2. Assemble equipment and maintain asepsis:~~,~~
   - ~~e~~Antiseptic solution or swab (e.g., alcohol or chlorhexidine)
   - Gloves
   - Sterile gauze
   - Saline flush
   - Clear IV extension tubing with connector and fluids ~~and select~~
   - IO device
   - ~~correct~~ Appropriate IO needle for size/age.
   - ~~1.~~• Conscious patients: lidocaine for pain control

3. Locate appropriate insertion site ~~at either leg proximal tibia~~:
   a. Proximal Tibia
   ~~2.~~
   - Extend the leg. Slight flexion of the knee with towels under it can be helpful.
   - Locate tibial tuberosity, the bony prominence just distal to the patella. The Insertion site is based on age and skeletal maturity.
   - ~~for a~~Adult—Insertion site is approximately 2 cm medial to the tibial tuberosity, or, if difficult to palpate, ~~size person is at the level of the bone that is~~ two (2) fingertip widths (~3 cm) ~~below~~ distal to the ~~tibia tuberosity~~patella and then ~~immediately~~ ~2 cm medial to ~~inside~~ the anterior midline of the tibia. Needle will be pointed at 90 degrees (perpendicular) to~~on~~ the flat table-like anteromedial surface of the tibia (avoid the top surface and knee joint).
   - Infants and children—Insertion site needs to avoid the growth plate. Go approximately 1 cm distal to the tibial tuberosity and approximately 1 cm medially. For younger children who do not have a palpable tibial tuberosity (under 12 kg) go ~~two (2) fingertip widths~~~2 cm ~~below~~ distal to the lower edge of the patella and then ~~immediately inside~~~1 cm medial to the anterior midline of the tibia. Needle will be pointed at 90 degrees (perpendicular) to~~on~~ the flat anteromedial surface of the tibia (avoid top surface and knee joint).
     ~~Do not attempt more than once at each tibia.~~

   b. Proximal Humerus

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- Place arm in abduction and internal rotation
  - Arm tight against body, elbow flexed 90 degrees and hand on umbilicus, or
  - Arm tight against body, elbow extended, and hand rotated so palm is facing outward and thumb is pointing down.
- Preferred method to locate site: Feel for the ball of the humeral head. Place the ulnar aspect of one hand vertically over the axilla. Place the ulnar aspect of the opposite hand along the midline of the upper arm laterally. Place your thumbs together over the arm and palpate the surgical neck of the humerus. This may feel like a golf ball (the greater tubercle) on a tee (the surgical neck). The insertion site is ~1-2 cm proximal to the surgical neck on the most prominent aspect of the greater tubercle.
- Alternate method: Place your thumb on the anteromedial part of the shoulder (coracoid process) and your fingers on the upper, outer part of the shoulder (acromion process). Find the greater tubercle ~2 cm below and slightly forward from the acromion process. This area should be firm and rounded.
- Insertion is at 45 degrees to the anterior sagittal plane and posteromedial, in somewhat the direction of the contralateral hip.

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c. Distal Femur

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- Extend the leg. Insertion site is ~1-2 cm proximal to the superior edge of the patella in the midline. Needle is pointed at 90 degrees (perpendicular) to the anterior sagittal plane.

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~~3.~~4. Use ~~sterile~~ aseptic technique, including ~~sterile~~ clean gloves and prepare insertion site with an alcohol or chlorhexidine prep.

Commented [GG4]: Sterile is ideal but not practical in prehospital space (partly equipment concerns).

~~4.~~5. Stabilize extremity and insert appropriate size IO device using manufacturer's recommendations. A battery-powered device is preferred over manual technique.

~~5.~~6. Determine penetration of needle into marrow space by feeling loss of resistance as needle penetrates inner bone surface.

~~6.~~7. Stabilize needle and remove any stylet within device. Place stylet in sharps container.

~~7.~~8. Connect IV tubing and normal saline to IO needle hub and confirm correct placement by the following:

- IO needle is firmly seated and stable

- Observe blood at the catheter hub or able to aspirate blood from IO needle

~~8.~~9. If patient is conscious, to decrease pain from IO infusion, slowly (over 1 minute) administer lidocaine 2% (Preservative Free) through IO needle:
- Adult/Adolescent: 20 mg 2% lidocaine, may repeat 20 mg once (total 40 mg) for pain control.
- Child (14 years and under): 0.5 mg/kg 2% lidocaine (maximum dose 20 mg) do not repeat.

~~9.~~10. Flush IO catheter with syringe filled with normal saline prior to infusion of fluid or medications:
- Adult/Adolescent: flush with 10 mL normal saline
- Child (14 years and under): flush with 5 mL normal saline
- Comments:
  A. Repeat syringe flush as needed to keep IO flowing
  B. Failure to syringe flush may result in limited or no flow through IO
  C. To maintain infusion after syringe flush, it may be necessary to pressurize the IV infusion bag by inflating a BP cuff around bag or applying manual squeezing pressure

~~10.~~11. Begin infusion of normal saline, administer any medications as appropriate.

~~11.~~12. Secure catheter and tubing from accidental bumping or pulling that may cause dislodgement.

~~12.~~13. Monitor IO infusion flow and device stability, observe extremity for any signs of extravasation

DOCUMENTATION:

1. Document all IO attempts and IO insertion site and time placed.

2. Notify receiving hospital staff of IO use and site (even when not successful).

REMOVAL OF IO NEEDLE:

1. Attach a syringe to the IO needle hub.

2. Support the patient's extremity while rotating the needle/syringe and gently pulling out.

3. Apply sterile dressings to site, warn patient of signs of infection (redness, swelling, increasing pain at site)

4. Dispose of IO in sharps container.

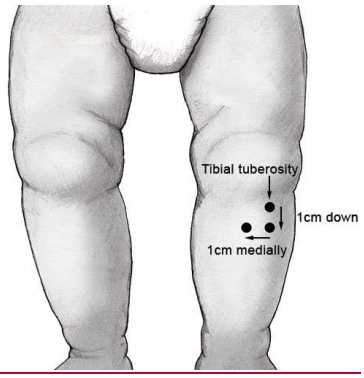
NOTES:

1. Adenosine is not effective when administered through an IO site.

2. Potential IO complications include:
   A. Local infiltration of infusion fluid or medications
   B. Infusion fails to flow due to IO occlusion from clot or tissue
   C. Infection at site or sepsis
   D. Fat or bone emboli
   E. Stress fracture from insertion of IO
   ~~E.~~F. Dislodgement

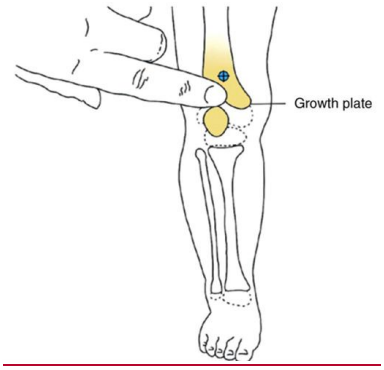
APPENDIX A – Figures

Proximal Tibia



Adult (Source: medical guidelines.msf.org) Infant (Source: fity.club)

Distal Femur



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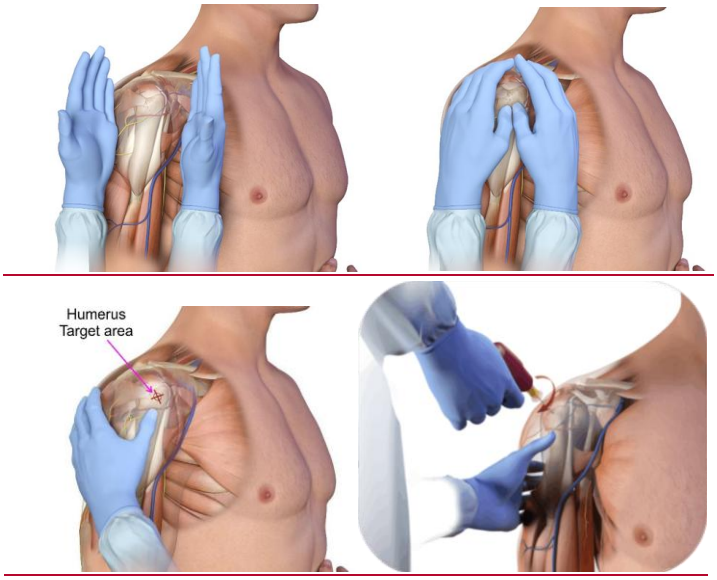
Proximal Humerus



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APPENDIX B – Approval Process for Humeral and Distal Femur IO Lines

Placement of humeral and distal femur intraosseous lines is subject to approval by OCEMS. Interested agencies shall complete the following steps.

I. Submit a training program that covers
   a. Didactic Presentation to include
      i. Anatomy and physiology of intraosseous sites
      ii. Indications and contraindications for IO placement
      iii. Criteria for each site
      iv. Device Overview and needle selection
      v. Insertion site identification
      vi. Insertion process and technique
      vii. Infusing medications and fluids
      viii. Pain management as needed
      ix. Assessment and documentation
      x. Removing the IO
      xi. Potential Complications
   b. Practical portion
      i. Hands on training to practice the technique on the different anatomic sites
   c. Competency Validation
      i. Written exam
      ii. Skills checklist
   d. Ongoing recertification

II. Once approved, agencies will train their providers and notify OCEMS once training is complete.
   a. Once complete, agencies will be cleared to begin field IO placement of the alternate sites

III. Commitment to ongoing quality assurance
   a. Each agency shall review all IO attempts and aggregate data
   b. Review metrics
      i. Success rate by site

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ii. First pass success rate
iii. Time to access
iv. Analgesia provided to conscious patients
v. Complications

c. Metrics shall be reviewed monthly and presented at CQI meetings for at least a year.
i. Targeted training if issues are identified
ii. Education of field personnel for ongoing learning and performance improvement.

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