7 Reasons to Choose the Sternal Route for Intraosseous Infusion

an intraosseous infusion e-book by
Dr. Alan Moloff
Why Intraosseous Infusion?

Who Needs Rapid Vascular Access?

Rapid vascular access, getting critical medications and fluids into the bloodstream quickly, is an essential early treatment for many patients suffering from disease and trauma, whether in a hospital or pre-hospital environment.

Regardless of your level of training and expertise, the ability to rapidly administer medications and fluids is important, and in many cases your patient outcome depends on it.

This is especially critical when it comes to trauma on the battlefield, in motor vehicle accidents, or in a variety of complex disasters.

**Intraosseous infusion is a quick, effective and easy-to-learn skill that can provide rapid vascular access.**

Intraosseous infusion is a very quick, effective and easy-to-learn skill that can provide rapid vascular access for patients requiring fluids and medications in these circumstances.

When Is Intraosseous Infusion Used?

Rapid vascular access is required for a variety of medical conditions including, but not limited to, cardiac arrest, cardiac arrhythmias, myocardial infarctions, syncope, hypotension, anaphylactic shock, diabetes and numerous other commonly occurring medical conditions.

Any medication or fluid that can be administered by IV can also be administered by IO, with the same quantity and flow rate as IV. Traditionally, intravenous infusion (IV), using a peripheral vein, has been the preferred method to establish vascular access.

Many studies have demonstrated the numerous downfalls and challenges of solely relying on this technique (IV) for vascular access. IV’s, as taught in most classrooms and training programs, are usually successful and easy when performed on healthy, well hydrated fellow students. In the “real world” of patient care, especially in an emergency setting, IV’s are more difficult to use on patients who are obese, are hypovolemic, or have poor cardiac output.

Studies have demonstrated an only 60% to 95% initial success rate for IV attempts. Additionally, the time to start an IV varies from 1.5 to 13 minutes; in most cases significantly longer than the time required to place an IO device.

Intraosseous Infusion - A 90 Year History

Intraosseous infusion is not new. In fact, it has been a proven technique for more than 90 years, and IO devices were included in a variety of military medical kits during World War II. Classically, a hollow needle of various lengths was inserted using a manual twisting or boring motion.

In the early 1990’s Pyng Medical introduced FAST1, the first easy-to-use, easy-to-learn, depth-controlled sternal IO device that was cleared by the US FDA and approved for military use.

The FAST1 device has saved thousands of lives on the battlefield and in civilian communities by providing rapid and effective vascular access for all levels of health care providers.

In 2013, Pyng Medical released FASTResponder, a modified version of FAST1 developed specifically for use in civilian EMS and hospital settings. In 2016, Pyng released FASTTactical. This device is identical to FASTResponder in every way, except it comes in rigid tube packaging which both protects the device and keeps it sterile.
7 Reasons to Choose the Sternal Route for Intraosseous Infusion

1. Clinical Evidence Supports the Sternal IO Route

Clinical Studies Indicate the Sternal IO Route Improves Patient Outcomes

Current Guidelines (such as AHA) indicate that Intraosseous infusion (IO) is a rapid, safe and effective alternative to IV (intravenous) infusion for the administration of fluids and medications.

Recent studies highlight that IO may be particularly important to get critical medications into the central circulation faster, and in higher concentrations, during cardiac arrest.

"Based on the present data, we recommend that sternal IO route be considered as the first choice of drug delivery during CPR when IV access has not been established…"

Pharmacokinetics of Intraosseous and Central Venous Drug Delivery during Cardiopulmonary Resuscitation by Stephen Hoskins, et. al. (1)

Still more studies indicate that the sternal approach for the deployment of IO may be more effective in accomplishing this than when deploying IO infusion via other sites (body locations, such as the Tibia). These differences may be critical in increasing survivability and reducing mortality when treating patients requiring cardiopulmonary resuscitation (CPR) in non-shockable cardiac arrest rhythms (pulseless electrical activity and asystole).

"There may also be a relationship between the anatomical location of the IO device and serum drug concentrations; the more distal the IO infusion site is from the sampling site, the longer concentrations of drug take to rise."

Comparison of Tibial Intraosseous, Sternal Intraosseous and Intravenous Routes of Administration on Pharmacokinetics of Epinephrine during Cardiac Arrest by James Burgert, et. al. (2)

2. Faster Fluid Delivery Via the Sternum

The sternum (and manubrium) contains “red bone marrow” which has a rich blood supply and is physiologically active as compared to the “yellow bone marrow” of the extremities.

The venous system rapidly returns blood as well as administered fluids and medications through the superior vena cava directly to the heart.

With Sternal IO, fluids and medications travel a much shorter distance to the heart and vascular system.

Fluids and medications travel a much shorter distance and reach the heart and vascular system much more quickly as compared to fluids and medications administered by peripheral IV’s or Intraosseous Infusion in the extremities.

This is especially true when there is cardiovascular compromise, as in cardiac arrest or hypotension.

3. Sternal IO is Less Painful than Tibial or Humeral IO

It is well known that IO infusion into the long bones (humeral or tibial) is painful. It is not the penetration of the bone that hurts the most, but the entry of fluid or medications into the bone marrow that causes the most pain.

The main reason for this is the density and lack of elasticity in the “yellow marrow” of the long bones. The manufacturer of IO for the long bones recommends an initial bolus of lidocaine to decrease this initial pain in conscious patients.

Intraosseous Infusion via the sternal route is less painful than an IO into the long bones. The initial insertion into the sternum/manubrium is similar to a thump to the chest - it is a dull very short pain.

"Using Sternal IO, there is virtually no pain as the initial bolus of fluid or medication flows into the bone marrow."

With Sternal IO, there is virtually no pain as the initial bolus of fluid or medication flows into the bone marrow. This is because the “red bone marrow” of the sternum is less dense and much more elastic as compared to the bone marrow of the long bones.
Is Lidocaine Needed with Sternal IO?

Sternal IO is an important method to rapidly deliver fluids or medication to critical patients in emergency situations, and the insertion of a sternal IO device produces minimal pain. This minimal pain is often masked by the moderate to severe pain or decreased level of consciousness produced by the patient's underlying condition.

**Lidocaine is not required for sternal IO insertion or fluid delivery with a conscious patient.**

While lidocaine is not required when inserting or delivering fluid via a sternal IO device, such as FASTResponder, some healthcare organizations do recommend the injection of subcutaneous lidocaine prior to a sternal IO insertion on a conscious patient.

When considering whether you should, or should not use lidocaine, it is important to keep in mind that lidocaine itself does hurt when it is injected into the skin and it takes 10-15 minutes to become effective for pain relief.

The critical questions to consider are:
- How quickly does the patient need fluids or medications?
- Can you wait for the lidocaine to take effect?

4. The Sternum is an Easy & Consistent Site to Locate

The position for Sternal IO insertion is at the sternal notch, in the manubrium at the upper or cepheid portion of the sternum. This is a readily available and easily recognizable anatomic landmark regardless of body habitus.

The sternum (and manubrium) is a remarkably consistent bone regardless of the patient's size, muscle mass, obesity or age. The bone reaches a consistent level of bone thickness, bone density, and size of the bone marrow space beginning at 12 years of age.

To allow for accurate and consistent placement, sternal IO devices, such as FASTResponder and FASTTactical, include a target foot that is notched to approximate the sternal notch.

Because of the target foot notch and ease of placement, the device can be used in low lighting and, with practice, can be inserted with virtually no light.

5. Sternal IO Can Be Used with Standard EMS Procedures

**Sternal IO devices, such as FASTResponder, can be safely used with manual CPR and automated chest compression devices.**

While Sternal IO devices, like FASTResponder and FASTTactical, can be safely used with manual CPR and automated chest compression devices, there are a variety of beliefs or myths in the minds of some to the contrary.

**There have been no documented studies that demonstrate a failure of Sternal IO during manual or automated CPR.**

In fact, two recently published papers have examined sternal IO use during CPR using a porcine model.

In these papers, the animal was anesthetized and placed into cardiac arrest and CPR was initiated. Then, dye or epinephrine was administered using sternal IO, tibial IO, central venous line and peripheral intravenous administration techniques.

The concentration and time to reach the central circulation was measured and compared. In these studies the dye or epinephrine administered using sternal IO reached the central circulation quicker and in significantly higher concentrations than that of tibial IO.

In fact, sternal IO was comparable to central venous line administration during CPR in terms of time and medication concentration.

Low profile tubing and a protective dome decrease the chance that a sternal IO will dislodge during transport.
6. Sternal IO Devices Designed for the Needs of both the Military & Civilian EMS and Hospital Critical Care

FASTResponder and FASTTactical are sternal IO devices that were designed to meet the specific needs of civilian EMS and hospital critical care teams as well as the military.

**Reliable & Consistent Access with Automatic Depth Control Built In**

The engineering design of FASTResponder & FASTTactical includes precise "depth control release" to ensure effective penetration of the bone and entry into the bone marrow.

There is no need to worry about over penetration or going through the entire mandible. The design allows for consistent performance and enhanced muscle memory.

This enhanced muscle memory enables longer retention of the skills needed to perform this procedure long after initial training.

**Easy to Learn and Use with an All-in-one Design**

FASTResponder and FASTTactical were designed as all-in-one sternal IO devices in order to be as easy to learn and fail-safe as possible.

You don’t have to select from different sizes of needles. After insertion, you simply remove the device and your built-in IV connector is ready for you to simply insert your IV tube and rapidly deliver fluids and medication into the vascular system.

**Compact and Lightweight Design with No Batteries Needed**

FASTResponder’s light weight and small cubic volume makes it ideal for inclusion in a variety of tactical kits, emergency kits, medical pouches, uniform pocket, or on a crash cart.

Moreover, there are no batteries to test or replace making a sternal IO ideal for code carts in the hospital, infrequent EMS users or in disaster stockpiles.

FASTTactical takes this one step further with hard rigid tube packaging, which is both easy to fit in military or civilian emergency bags, but also provides added protection for the device and keeps it sterile.

**Less Chance of Dismodging During Transportation**

Once a sternal IO device has been placed, often a patient needs to be transported for further treatment.

FASTResponder & FASTTactical feature a target foot that is low profile and protects the insertion site. The target foot also has a strain relief hook that further ensures secure placement until it is ready to be removed, significantly decreasing the chance of accidental dislodgement or removal.

The protective dome can also be used to protect the insertion site during transport or patient movement, further protecting against accidental dislodgement or removal.

7. The Sternal IO Route Has Saved Lives for 13 Years

The use of the sternal route for Intraosseous Infusion is not new. In fact, the first FDA-cleared IO system (FAST1 by Pyng Medical) designed specifically for use in the sternum during adult emergency intervention was cleared in 1997 and adopted by the military.

FAST1 has been trusted and used by military and combat personnel for more than 12 years and has saved thousands of lives on the battlefield. More military and combat personnel use FAST1 sternal IO than any other sternal or tibial IO device.

In 2008, FAST1 was cleared for use in adolescents 12 years of age and over, and in 2013, Pyng Medical launched FASTResponder, which includes all the trusted and proven features of FAST1, but modified to specifically meet the needs of civilian emergency medical services and hospital critical care personnel. In 2016, Pyng launched FASTTactical. Identical in every way to FASTResponder, FASTTactical comes in hard tube packaging, which provides added protection for the device and keeps it sterile.

The FAST family of sternal IO devices have saved thousands of lives on the battlefield and in civilian communities.

About the Author

**Dr. Alan Moloff:**

Colonel (US Army, Retired), DO, MPH - Medical Director, Pyng Medical

The clinical studies and data referenced in this paper were summarized by Dr. Alan Moloff. Dr. Alan Moloff brings over 30 years of operational military medical experience. He is Board Certified in aerospace, undersea and disaster medicine.

Dr. Moloff’s final assignment encompassed four years as Commander of the Defense Medical Readiness Training Institute (DMRTI) where he focused on joint medical readiness, combat casualty care and the medical aspects of Homeland Security planning and training focused on CBRNE and complex disasters.

**References:**


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"We have placed over 40 of these devices and I am here to tell you no service should be without it.

When time and venous access are imperative, FAST can pull any provider out of a jam."

- Lt. Lanney C. Jones, Chief Flight Paramedic, MS Medflight E, Richmond, Virginia.
About Pyng Medical

Pyng Medical engineers, manufactures and distributes award-winning trauma and resuscitation products for front-line critical care personnel world-wide. Pyng’s product portfolio includes innovative Sternal Intraosseous (sternal IO), pelvic stabilization and tourniquet devices specifically designed and customized for both the military and civilian markets.

Pyng Medical is the pioneer in sternal intraosseous infusion technology. In 1997, Pyng received clearance for FAST1, the first FDA-cleared IO system designed specifically for use in the sternum during adult emergency intervention. In 2008, FAST1 was cleared for use in adolescents 12 years of age and over. FAST1 has been trusted and used by military and combat personnel for more than 12 years. In fact, more military and combat personnel use FAST1 sternal IO than any other sternal or tibial IO device.

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Saving Lives in Seconds

@pyngmedical  |  Phone: 604.303.7964
facebook.com/pyngmedical  |  info@pyng.com

www.pyng.com