

Intra-osseous drills: the ups and downs of a new device

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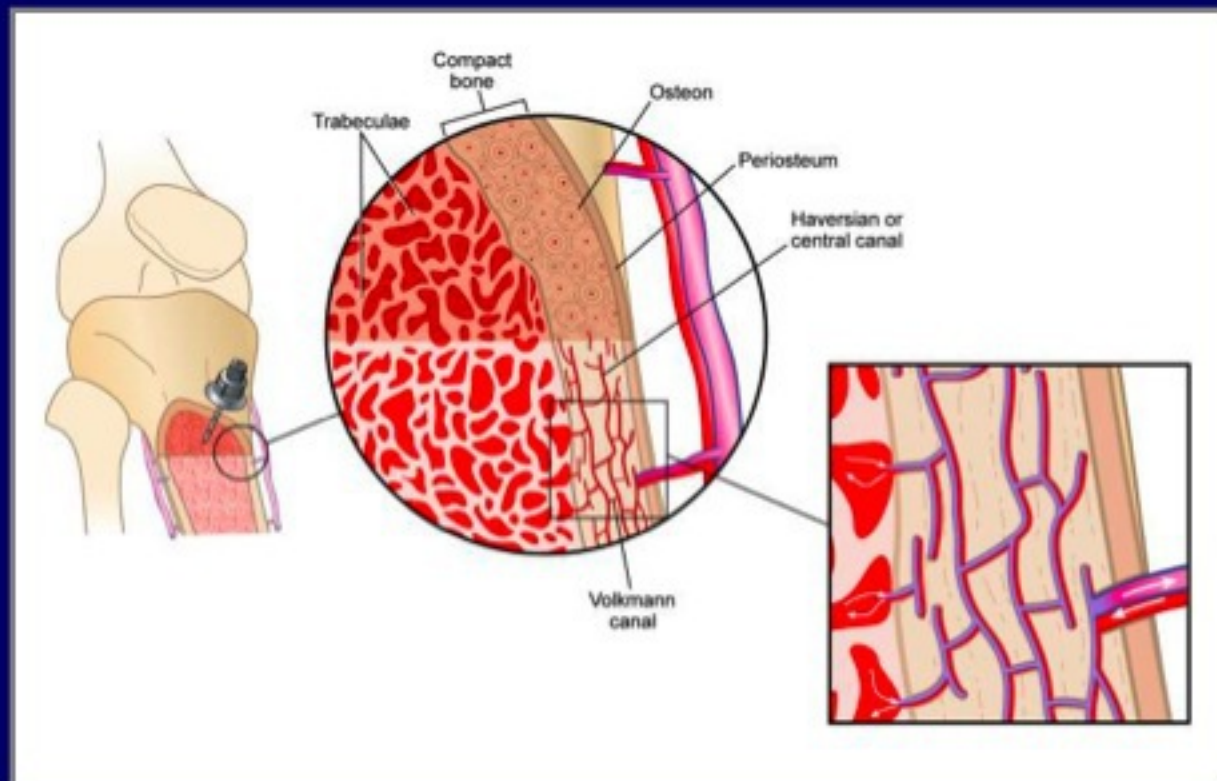
Intra-osseous needle and trauma

- Gaining vascular access can be difficult in trauma
 - Patients may be hypovolaemic and vasoconstricted
 - Not all limbs and sites may be suitable for access



Intra-osseous needle and trauma

- Bone marrow remains 'wide open' despite hypovolaemia
- Fluids and medicines are rapidly absorbed from marrow
 - Almost as rapidly as intravenous administration
 - Intra-osseous access just another form of vascular access
- Significant interest in the role of intra-osseous access in trauma



Intra-osseous needle (ION) and trauma

- Discuss the history of ION
- Briefly summarise the literature
- Discuss the evolution of ION within our own service
- Discuss why we have moved to a powered drill device
- Discuss the potential role of the ION in trauma
- Present a few cases
- Questions and discussion



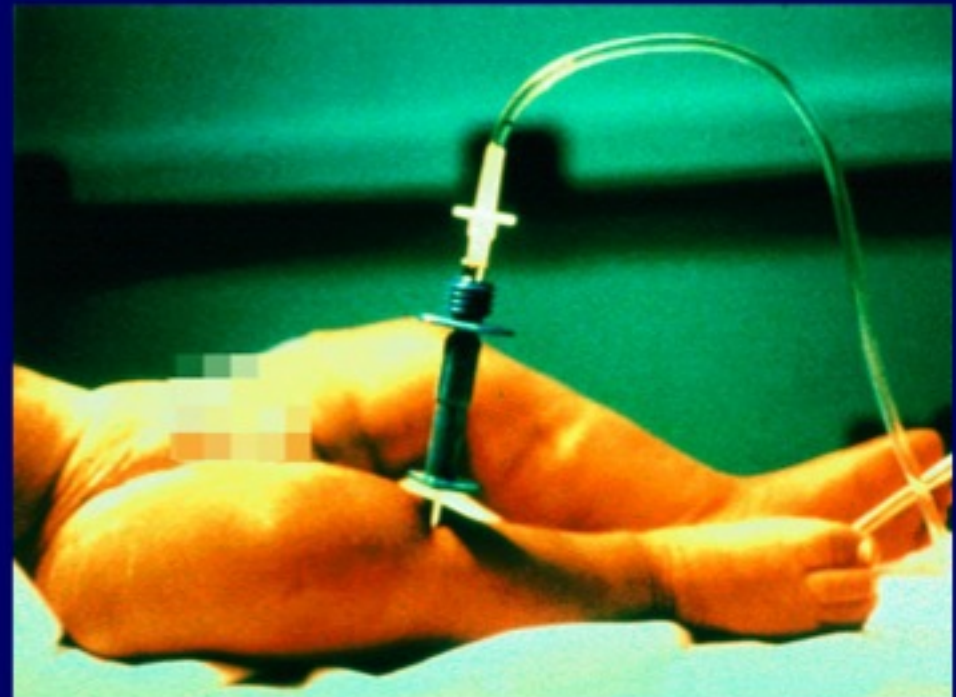
Conflict of interest

- I do not have a financial interest in any of the products
 - I wish I did
- I have not received money from any of the companies
 - I have gratefully received coffee
 - I have gratefully received training



History

- ION have long been used as an alternative to veinous access
- Common in the 1930s and 1940s
- Originally in both adults and children
- Became less common in adults over time
- Resurgence recently



Resurgence recently

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Ann Emerg Med. 1994 Jan;23(1):52-5.
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Comparison of two intraosseous infusion systems for adult emergency medical use.

[Brenner T](#), [Bernhard M](#), [Helm M](#), [Doll S](#), [Völkl A](#), [Ganion N](#), [Friedmann C](#), [Sikinger M](#), [Knapp J](#), [Martin E](#), [Gries A](#).

Department of Anaesthesiology and Emergency Medicine, University of Heidelberg, D-69120 Heidelberg, Germany.

INTRODUCTION: The current guidelines of the European Resuscitation Council (ERC) stipulate that an intraosseous access should be placed if establishing a peripheral venous access for cardiopulmonary resuscitation (CPR) would involve delays. The aim of this study was therefore to compare a manual intraosseous infusion technique (MAN-IO) and a semi-automatic intraosseous infusion system (EZ-IO) using adult human cadavers as a model. **MATERIALS AND METHODS:** After receiving verbal instruction and giving their written informed consent, the participants of the study were randomized into two groups (group I: MAN-IO, and group II: EZ-IO). In addition to the demographic data, the following were evaluated: (1) Number of attempts required to successfully place the infusion, (2) Insertion time, (3) Occurrence of technical complications and (4) User friendliness. **RESULTS:** Evaluation protocols from 84 study participants could be evaluated (MAN-IO: n=39 vs. EZ-IO: n=45). No significant differences were seen in the study participants' characteristics. Insertion times (MW+/-S.D.) of the respective successful attempts were comparable (MAN-IO: 33+/-28s vs. EZ-IO: 32+/-11s). When using the EZ-IO, the access was successfully established significantly more often on the first attempt (MAN-IO: 79.5% vs. EZ-IO: 97.8%; p<0.01). The EZ-IO was also found to have more advantages in terms of technical complications (MAN-IO: 15.4% vs. EZ-IO: 0.0%; p<0.01) and user friendliness (school grading system: MAN-IO: 1.9+/-0.7 vs. EZ-IO: 1.2+/-0.4; p<0.01). **CONCLUSIONS:** In an adult human cadaver model, the semi-automatic system was proven to be more effective. The EZ-IO gave more successful results, was associated with fewer technical complications, and is user friendlier.

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Consecutive field trials using two different intraosseous devices.

[Frascone RJ](#), [Jensen JP](#), [Kave K](#), [Salzman JG](#).

Regions Hospital Emergency Medical Services, Regions Hospital, St. Paul, MN 55101, USA.

OBJECTIVE: Establishing traditional intravenous (IV) access in adult trauma and medical patients can be difficult. We evaluated provider performance for obtaining intraosseous access with two FDA-approved intraosseous devices (F.A.S.T.1 and EZ-IO) in two sequential field trials. **METHODS:** One hundred twenty-four providers consented to participate in the first field trial evaluating the use of the F.A.S.T.1 system. Three hundred eighty-nine providers consented to participate in the second field trial, evaluating the use of the EZ-IO. Following each insertion attempt, a telephone data collection process with a member of the research team was completed. Insertion success rate and measures of provider comfort and satisfaction with each device were collected and analyzed. **RESULTS:** One hundred seventy-eight insertions (89 F.A.S.T.1; 89 EZ-IO) were completed between February 2000 and December 2005. Sixty-four of the 89 insertions of the F.A.S.T.1 were successful, and 78 of the 89 insertions of the EZ-IO were successful (72% vs. 87%; $\chi^2 = 6.8$; $p = 0.009$). Providers using the F.A.S.T.1 attempted more IV insertions prior to using the IO device than the providers using the EZ-IO (2.6 vs. 2.0, $p = 0.005$). There were no differences in provider comfort or provider assessed device performance between the two devices ($p = 0.52$; $p = 0.13$, respectively). **CONCLUSION:** In our comparison of two field trials of prehospital provider use of the F.A.S.T.1 and EZ-IO systems, more successful insertions with the EZ-IO were achieved than with the F.A.S.T.1 device. Limitations of our comparison include nonrandomization, the sequential field trial design, the potential for a learning effect, and self-reporting of data points by providers. A prospective, randomized evaluation of these devices is warranted to draw definitive conclusions about provider insertion success rate with these devices.

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- IO versus IV access while wearing personal protective equipment in a HazMat scene [Prehosp Emerg Care. 2007]
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- Comparison of two intraosseous infusion systems for adult emergency medical use. [Resuscitation. 2008]
- Intraosseous infusion: success of a standardized regional training program for prehospital ac [Ann Emerg Med. 1994]
- The use of a powered device for intraosseous drug and fluid administration in a national EMS: a 4- [J Trauma. 2008]

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Intra-osseous access (EZ-IO) for resuscitation: UK... [J R Army Med Corps. 2007] - PubMed Result - Microsoft Internet Explorer p

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1: [J R Army Med Corps](#). 2007 Dec; 153(4):314-6. Links

Intra-osseous access (EZ-IO) for resuscitation: UK military combat experience.

[Cooper BR](#), [Mahoney PE](#), [Hodgetts TJ](#), [Mellor A](#).

212 Field Hospital RAMC(V).

Military trauma produces predominantly blast and fragmentation injury, commonly resulting in haemorrhagic shock. Injury patterns to limbs are such that the conventional sites for venous cannulation may be unsuitable. The EZ-IO (Vidacare, San Antonio) system is one of a number of novel products designed for intraosseous (IO) access in adults or children. In three months of combat casualty care in Helmand Province, Afghanistan, the UK Defence Medical Services used EZ-IO for emergency vascular access on 26 patients (16 adults; 10 children). 23/26 patients had IO access obtained in the emergency department; 3/26 had pre-hospital IO access within a tactically flying helicopter. A total of 32 needles were inserted, with 97% effective function. IO needles were used to administer fluid (crystalloid, packed red cells and fresh frozen plasma) and drugs (analgesics, cardiac arrest drugs, antibiotics, drugs for both rapid sequence induction and maintenance of anaesthesia). No complication of infection was noted, but pain was observed in responsive patients with the pain of infusion exceeding that of the underlying injuries in 3 cases.

PMID: 18619171 [PubMed - in process]

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- Use of intraosseous infusion in the pediatric trauma patient. [J Pediatr Surg. 1993]
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A summary of the literature

- Not a systematic review
- Dominated by pre-hospital use
- Use in adults is increasing
 - Particularly in military setting
- Some randomised trials
 - Comparing ease of placement of one type vs another
 - In general powered devices appear easier and quicker
 - Differences are statistically significant but not always clinically significant
- No meaningful outcome data

ION in St John

- We used a manual screw in ION for many years
- Only used in children, tibial site only
 - Required child to be fairly moribund
 - Used relatively infrequently
 - Took time and force to place
 - Approximate 30% failure rate
 - Tendency to be easy to dislodge



ION in St John

- Moved away from the manual screw in device to a spring loaded device (bone injection gun or BIG)
 - Easier and quicker to insert, more stable in the bone
 - Able to be placed in 'less moribund' patients
 - We carried the paediatric size only
 - All or nothing (unable to be altered)
 - A much higher failure rate than expected
 - We decided to move back to the manual



ION in St John

- We have also looked at the FAST ION
 - Sternal access only
 - Adults only
 - All or nothing
 - Originally required a separate device for removal
- We decided against introducing it



ION in St John

- We then evaluated drill powered devices
 - Relatively expensive
 - Very quick, easy, relatively painless
 - Adults and children
 - Multiple sites
 - Can be altered (not all or nothing)
- We have chosen to introduce the EZ IO

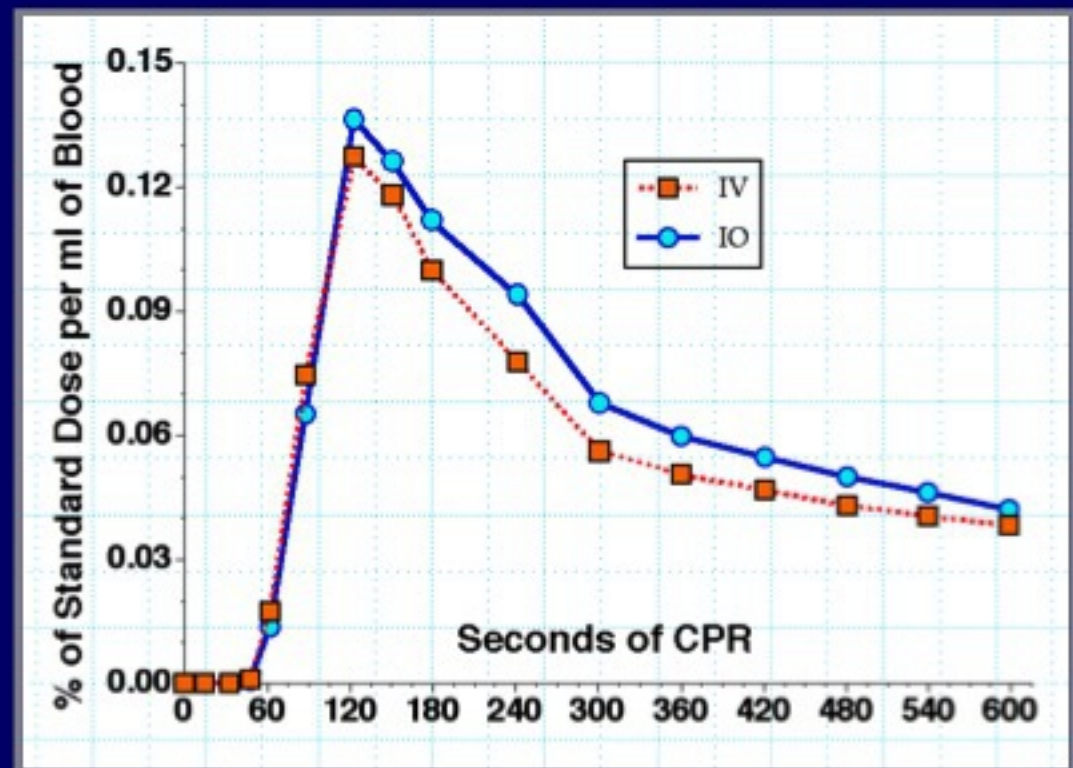


Absorption



How good are they really?

- Medicines and fluids are very quickly absorbed
- Large volumes of fluid require pressure
 - 1 litre crystalloid or one bag of blood crystalloid in 10-15 minutes
 - This may be sore if the patient is awake
 - 1% lignocaine IO for pain



IO drill in St John

- Advanced paramedics (ALS)
- Two sites
 - Anterior tibial (adults and children)
 - Humeral head (adults only)
- Immediate requirement for time critical medicine or fluid and IV access cannot be obtained
- Contraindicated if:
 - Fracture of that bone
 - Known (or strongly suspected) metal in that bone
 - Soft tissue infection at that site

IO drill in St John

- Procedure
 - Identify site
 - Swab with iodine or alcohol and chlorhexidine
 - Drill until loss of resistance (usually into hilt)
 - Remove stylet
 - Aspirate for bone marrow
 - Secure (not crucial immediately)
 - Flush (important for flow)
 - Administer fluid and medicines
- Discourage use in cardiac arrest

IO drill in St John

- What we have learned
 - Awake patients tolerate it remarkably well
 - Not all patients experience pain with fluid under pressure
 - There is an initial level of enthusiasm which then settles down
 - They are remarkably stable
 - We may need to carry a longer needle
 - Don't replace large bore venous access
 - Bridge to large bore venous access when this cannot be achieved quickly

Case example – trauma

- RTC, Truck vs van, van driver trapped
 - A and B OK, tachycardic and constricted, GCS 9 (M5), agitated
 - Trapped by legs, multiple compound limb fractures
 - Several attempts at IV access in one available limb
 - ION placed in humerus
 - Volume loaded via ION during extrication
 - GCS fell to 7 (M5)
 - Intubated and ventilated using RSI via ION following extrication
 - Large bore access gained via EJV

Case example – bleeding

- Woman in her fifties
 - Elective hysterectomy
 - Heparinised post operatively for prosthetic mitral valve
 - Code red for hypotension (clinically bleeding)
 - Restless and agitated, pulled peripheral IVs out
 - Taken rapidly to OR
 - No IV access could be obtained
 - Borrowed ION drill from paediatric ED
 - ION placed in anterior tibia
 - 5 units of blood via ION
 - Anaesthetised via ION
 - Large bore IV access gained in IJ
 - Laparotomy and repair of bleeding vessels

Summary

- The IO drill means that IO access can be gained in both adults and children
 - Quickly and easily
 - In patients who are not moribund
 - In multiple potential sites
 - Ability to rapidly administer medicines and fluids, rapidly absorbed
- Not a panacea
 - Another option for vascular access when it is difficult
- Do not replace large bore veinous access
 - They are a bridge to it
- In my view – they definitely have a role