External Fixation: What's New?

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Disclosures
• Speaker/Consultant
  • Acumed, Citieffe, Carbofix, Synthes
• Royalties
  • Acumed, Citieffe, Synthes
• Development/Design Team
  • Acumed, Synthes
• Committee/Misellaneous
  • ACS/COT-Verification Review
  • ABOS-Examiner

20th Century

Lambotte 1900s  Hoffman 1950s  Ilizarov 1960s  Synthes/AO 1970s
Modern Fixator types

- 1980s: All-in-One
- 1990s: Hybrids
- 2000s: Modulars
- 2010: Cost effective?

Basic Frame Application

- The Stable Base Concept
  - Acknowledgement of J. Hutson MD
- Construct Stiffness Modulation
- Pin Management

Frame Application – Easy Way

- Create a “Stable Base”
  - Two pins in each segment
  - Connect to form “STABLE BASE”
  - Reduce fracture, apply third bar
Construct Stability: Bars

- Bar position and number
- More bars = stiffer
- Bar closer to bone = stiffer
- Modern Fixators
  - *IT DOESN'T REALLY MATTER!*

Femur = Portable Traction

- Simple anterolateral pins
- “stable bases”
  - proximal and distal segment
- Manipulate and connect
- Plan ahead if cross knee

Femur: In ICU
Femur

Lower Extremity Frames

Ankle Frames: Keep it Simple
New Damage Control Ankle Frame


Pin Trajectory

Advantages

- Elevates heel
- Natural dorsiflexion
- Radiographic visualization
Why does posterior pin placement work better?

Micro motion in axis of ankle/pin thread $\rightarrow$ bone erosion
Posterior pins = perpendicular to thread “cut” direction

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Pin Tract Problems:
Why does it happen?
Soft tissue motion $\rightarrow$ Inflammation $\rightarrow$ Bacterial Colonization

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The Solution:
Stabilize Skin, No Chemicals, Soap/H2O

- Cover pins in OR w slight pressure on skin
- Day 3-4: Daily showers with soap and water
  - Alcohol pledget wipe around pin
- Dressing to apply slight pressure on skin
### Checketts-Otterburns Pin Grading

<table>
<thead>
<tr>
<th>Grade</th>
<th>Symptoms</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>Mild inflam, min discharge</td>
<td>Improve care</td>
</tr>
<tr>
<td>Grade II</td>
<td>Moderate inflam &amp; discharge</td>
<td>Improve care, po atb</td>
</tr>
<tr>
<td>Grade III</td>
<td>Grade II, no response to ATB</td>
<td>Keep fixator, dc pin</td>
</tr>
<tr>
<td>Grade IV</td>
<td>Severe inflam, loose pin</td>
<td>dc pin</td>
</tr>
<tr>
<td>Grade V</td>
<td>Bone changes</td>
<td>dc pin &amp; debride tract</td>
</tr>
<tr>
<td>Grade VI</td>
<td>After dc fixator, ongoing inf.</td>
<td>dc pin &amp; debride tract</td>
</tr>
</tbody>
</table>

- >98% of pin problems are Grade I, II and III
- < 2% of pin problems Grade IV and V

### Pin Care: The Evidence

- Egor et al – RCT (JBJS, 2006)
  - Daily vs. weekly vs dry dressing = no difference
- Temple and Santy – Review (Cochrane Database, 2004)
  - Little evidence to support any particular method
  - Saline (daily vs. weekly) = no difference
- Ziran et al – OTA 2010
  - Evaluated over 1000 pin sites
  - Grade 3 or more = 1.8%
  - Grade 1 or 2 = 6%
  - Long term (>6mos)
  - Non-compliant with care

### MRI Safety?
Induced Currents

- Frame construct = closed circuit
- Magnetic field induces electrical current
- Current grounds via pins => heat
  - Large frames = more induced current

MRI safety?

- **MR Safe** = safe in **ANY** environment
- **MR Conditional** = safe in **SPECIFIC** environment
- No Fixator is MRI Safe!
  - Components can be MR safe
  - Assembled in-vivo creates closed circuit
- FDA/ASTM standards = 3 degree increase

It’s not just the CLAMPS

- Non-magnetic clamps (everyone has them)
- Non-insulated rods = induced currents > FDA limits
- Insulated rods = induced currents below FDA limits

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John Nyenhuis, PhD Magnetic Resonance Imaging Testing of External Fixation Frames.
Purdue University. Lit Number LSA55
External Fixator Re-Use

• Classified as Single Use Devices
  • No regulatory (FDA) ruling
• Financially ~ 20-50% savings, but for who?
  • Insurers vs. Hospitals vs. Patients?
• How to charge?
  • A “rental” fee or price averaged?
• Company sponsored reprocessing ⇒ “CPO”
  • Compliance and Issue

The Future:
Single Use Disposable Sets

• Much simpler (No instrument trays)
• Much cheaper (~60-70%) than complex fixators
• Adequate for temporary fixation
• Best MRI conditional status

Ease of Application
Other Configurations: Hip

Other Configurations: Pelvis
Other Configurations: Knee

Upper Extremity: Elbow

Pins Under Local
Soldier May Use Trigger Finger
Thank You