



PG Residency Subtrochanteric Fractures

Smart Notes. Better Scores.



Principles of External Fixation

Rapid-Revision Deck for PG Residency Orthopedics

- **Definition:** Fracture hematoma communicates with the external environment
- Open fractures risk severe contamination and hardware infection
- Ex-fix stabilizes by placing pins proximally and distally, completely bypassing the contaminated zone
- Utilizes indirect reduction to maintain length, alignment, and rotation

EXAM PEARL: Never place internal implants in a contaminated open fracture zone; external fixation prevents hardware infection by bypassing the compromised soft tissue envelope.



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Primary Indications & Contraindications



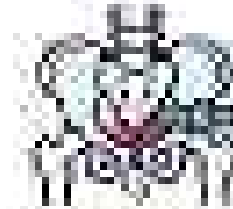
Open Fractures

- Most common indication.
- Bypasses contamination.



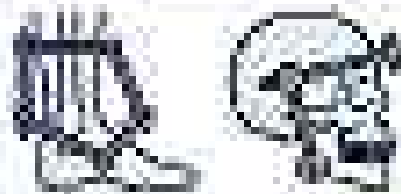
Polytrauma / DCO

- Damage Control Orthopedics.
- Life-saving stabilization required in **15–20 minutes**.



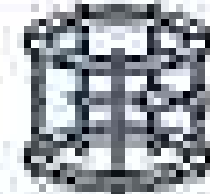
Pelvic Shock

- Compression made to stop tense bleeding and prevent **hypovolemic shock**.



Specialty Cases

- Delta frames for supra malleolus fractures. Ex-fix + fasciotomy for skull fractures with compartment syndrome.



Ilizarov Uses

- Infected/gap non-union, bone transport, limb lengthening, deformity correction.



Contraindications

- Patient non-compliance
- **Morbid obesity** (170–200 kg): Fat layer obscures thin bone; difficult to position Shanz pins.

EXAM PEARL: In polytrauma, the primary goal of external fixation is life-saving damage control (**done in under 20 mins**) before addressing definitive fracture management.



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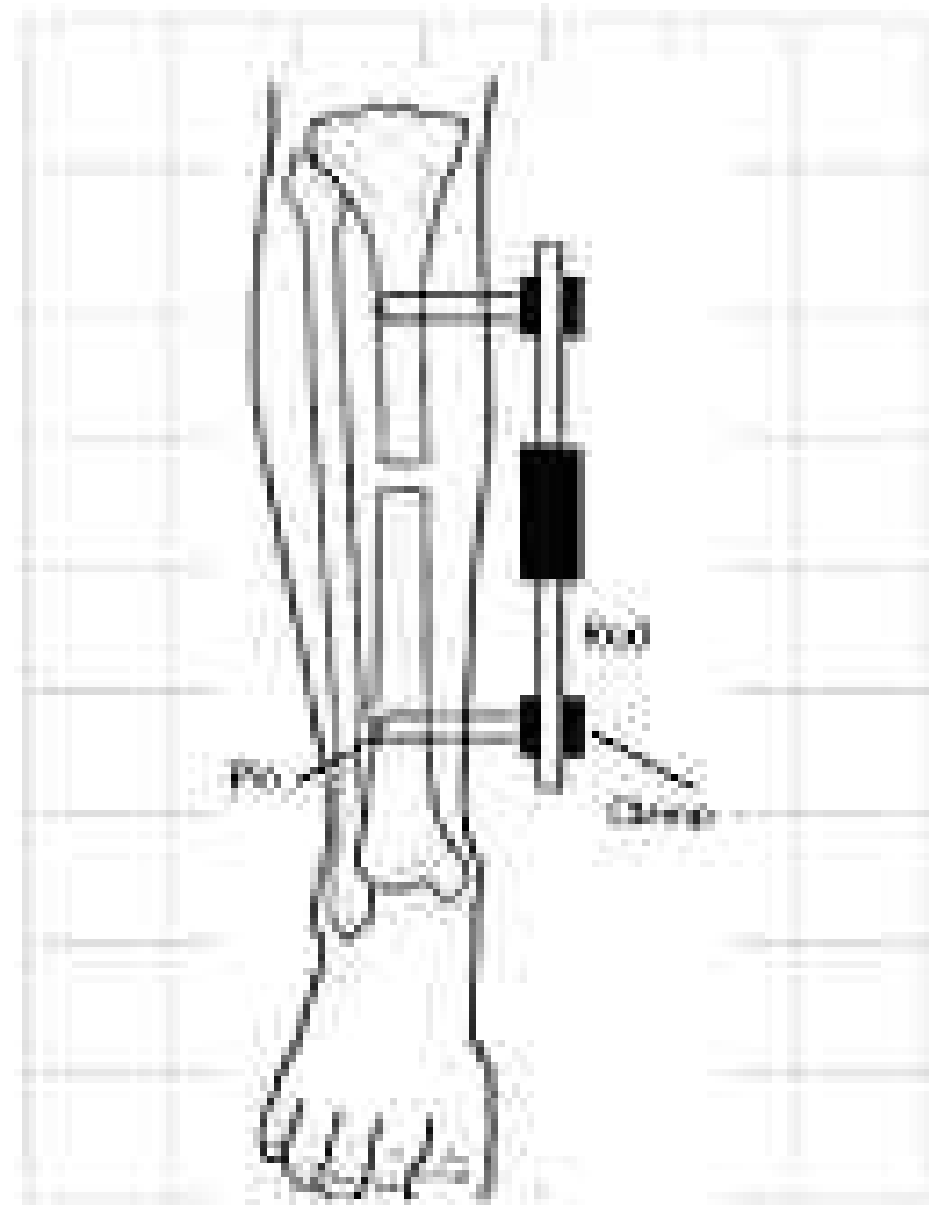
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Basic Anatomy & Pin Materials



- Schanz pin: Partially threaded at tip



- Steinmann pin: Smooth, for traction/delta frames



- Conical pin: Self-drilling tapering threads (LRS)

Pin Materials		
Stainless Steel	Titanium	Hydroxyapatite (HA)
Standard, most common material	Lower modulus of elasticity matches bone stress/strain index. Reduces infection risk.	Superior osseointegration. Ideal for osteoporotic or cancerous bone.

EXAM PEARL: Titanium pins reduce pin-bone stress and infection risk due to a modulus of elasticity that closely mimics host bone.

Dr. Mohamed Elmaghrabi



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Pin Insertion Biomechanics: Pre-Drilled vs. Self-Drilling

 Pre-Drilled Pins	 Self-Drilling Pins
• Requires a pilot hole • Lowest peak insertion temperature • Minimizes thermal necrosis • Reduces risk of premature loosening • Preferred for definitive fixation	• Faster, but generates dangerous heat • High risk of thermal necrosis • Causes micro-fractures on cortices • Lower pull-out strength • Risk of breaking bone when engaging far cortex • Strictly reserved for emergent DCO or pelvic fixation

EXAM PEARL: Always prioritize pre-drilled pins with continuous cold saline irrigation for definitive fixation to prevent thermal necrosis and premature implant loosening.



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Construct Biomechanics: Maximizing Stability

Stiffness $\propto R^4$

(Doubling pin thickness = 16x rigidity)

Pin Rules

- **Max Pin Diameter:** Must never exceed 1/3 of the bone shaft diameter
- **Proximity:** Place pins close to the fracture (outside contamination zone)
- **Span:** Maximize distance between pins within the same fragment



- **Rod Biomechanics:** Carbon fiber rods provide inherently stiffer construction and essential radiolucency.

EXAM PEARL: Never exceed a pin diameter greater than one-third of the bone's diameter, or you create a severe stress-riser leading to refracture upon removal.



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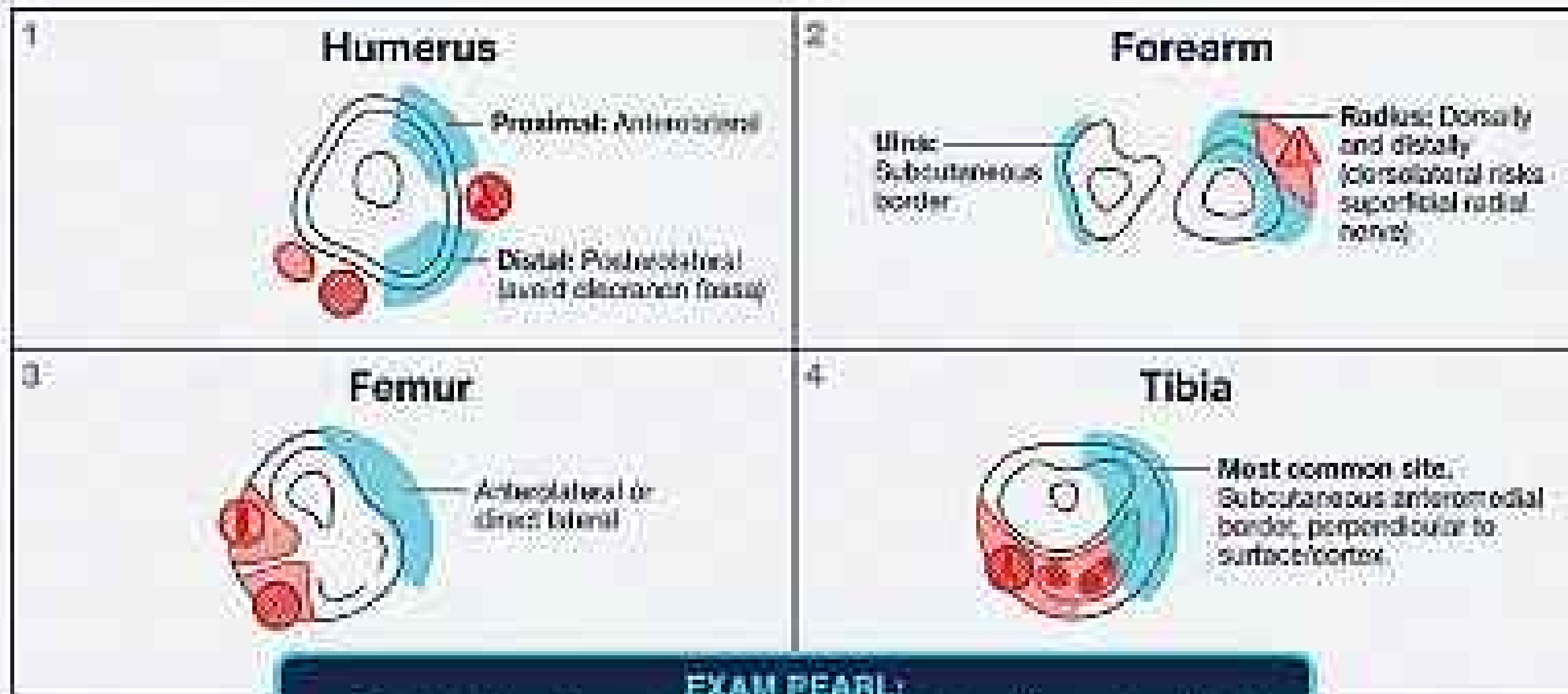


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Anatomical Safe Zones for Pin Placement



EXAM PEARL:
 Distal radius pins must be placed directly dorsally; a dorsolateral trajectory risks iatrogenic injury to the superficial radial nerve.



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Surgical Application Technique

- 1 • Wound debridement and thorough wash (Most important initial step)
- 2 • Reduce the fracture and apply temporary stabilization
- 3 • Make a 1 cm skin incision exactly in the safe zone
- 4 • Bluntly dissect with artery forceps to bone; insert protection sleeve
- 5 • Drill pilot hole using continuous cold saline irrigation
- 6 • Insert Schanz pins using manual T-handle (ideal: 3 proximal, 3 distal)
- 7 • Connect pins to rods with clamps; verify reduction; final tightening



RULE:
Dead bone is not buried.
All small, dead pieces of bone
must be removed during initial
debridement to prevent
sequestrum formation.

EXAM PEARL: Continuous cold saline irrigation during drilling is mandatory to prevent thermal necrosis.



Fixator Ecosystem: Device Types



Monotube Systems & Unilateral

- Standard rod-based trauma frames.
- Telescopic tubes allow axial compression/distraction (useful for lengthening).
- Circular Fixators (Ilizarov): Ring-based frames essential for distraction osteogenesis.



Hexapod & Hybrid Frames

- Hexapod (Taylor Spatial Frame): Corrects in 5 planes using complex computer software. Ideal for stiff/gap non-unions.
- Hybrid Fixators: Ring (periarticular) + Rod (diaphyseal).

EXAM PEARL: Despite theoretical appeal for periarticular fractures, hybrid frames lack sufficient axial and bending stiffness compared to true circular Ilizarov frames.



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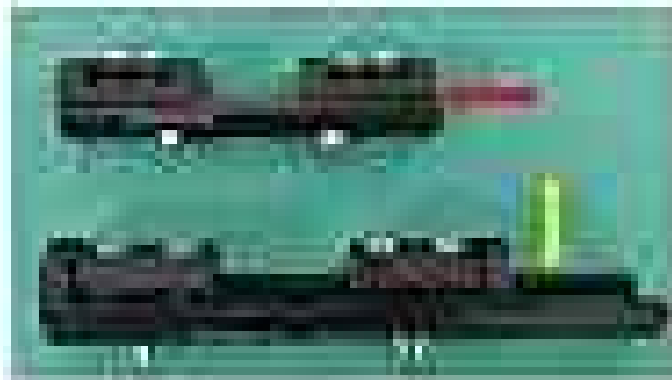
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Specialty Devices & Crucial Application Errors



LRS (Limb Reconstruction System)

- Uses a rigid rail and bogies (like a train) for precise compression/distraction via sliding Schanz pins.



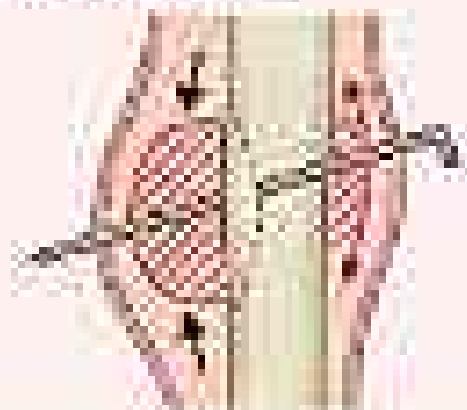
External LCP (Locking Compression Plate)

- Low profile, high torsional stiffness, used for complex cases like type VI skull fractures.

Crucial Application Errors

Crucial Error 1: Eccentric Pin Placement

- Causes tissue strangulation and pin site infection.
- Management: Extend the skin incision immediately to release tension.



Crucial Error 2: Proud Pins

- Leaving pins excessively proud beyond far cortex.
- Only 1-2 turns should pass.



EXAM PEARL: An excessively long (proud) pin protruding past the far cortex in the femur risks lacerating the femoral artery or causing a pseudoaneurysm.



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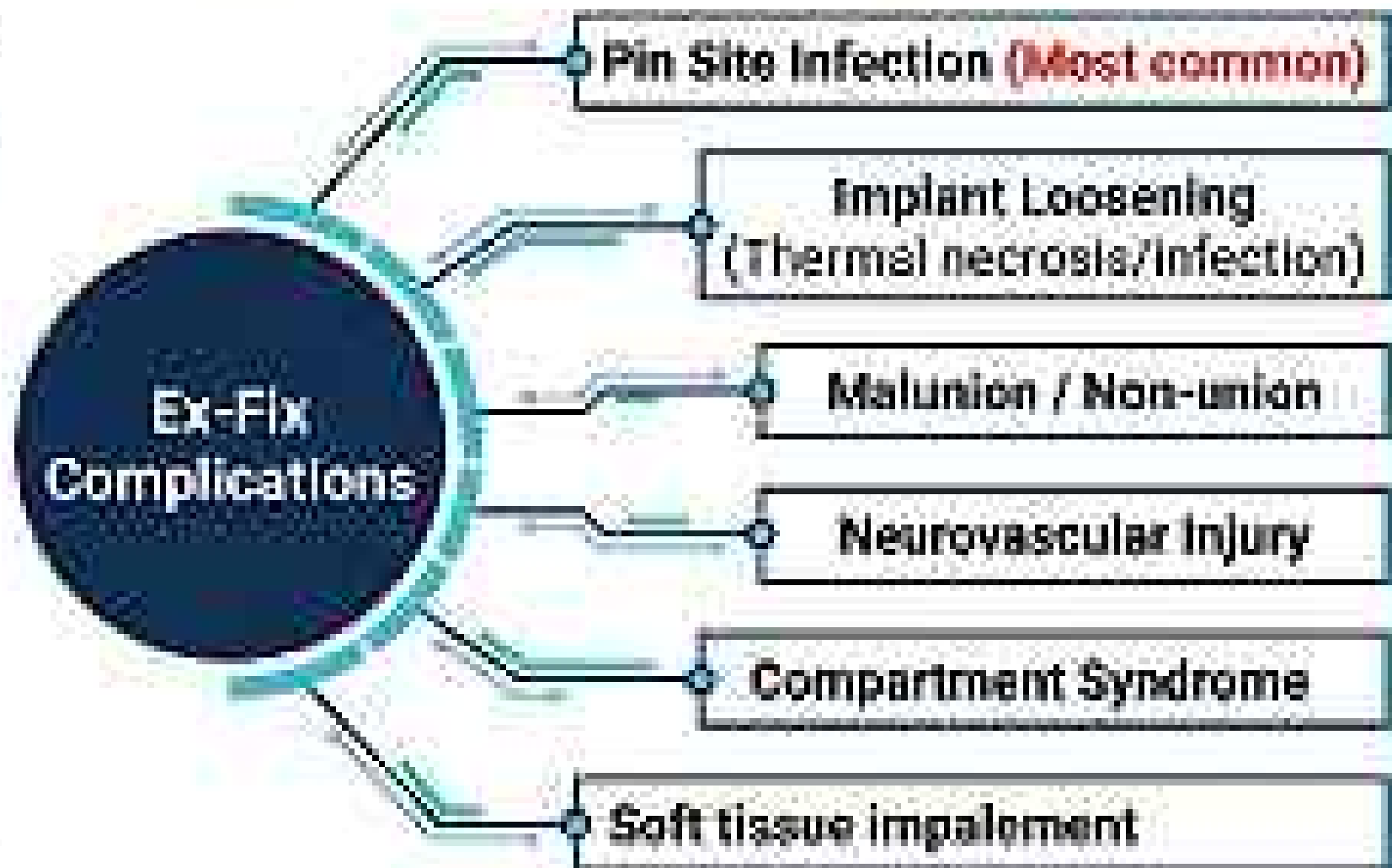
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Pin Site Care & Complication Spectrum

Daily Care Routine

- 1. Strict hygiene and gloves.
- 2. Saline swabs.
- 3. Clean pins upwards away from the wound.
- 4. Aggressively remove dried exudates (nidus for infection, not a scab).



EXAM PEARL: Pin tract infection is the single most common complication of external fixation, frequently leading to loosening and ring sequestrum formation.



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Pin-Tract Infection Classification

Grade	Appearance	Treatment
1	Slight erythema, little discharge	Improved pin care
2	Erythema, discharge, and pain in soft tissue	Topical and/or oral antibiotics
3	Grade 2 but no improvement with antibiotics	Remove pin and change antibiotic regimen
4	Soft-tissue infection involving several pins	Remove any loose pins
5	Grade 4 and radiographic evidence of bone involvement	Remove entire fixator construct and curettage pin tract
6	Infection after fixator removal (clinical and radiographic)	Débridement, irrigation, and systemic antibiotics

EXAM PEARL: Radiographic evidence of bone involvement (Grade 5) mandates the complete removal of the external fixator construct and formal curettage.



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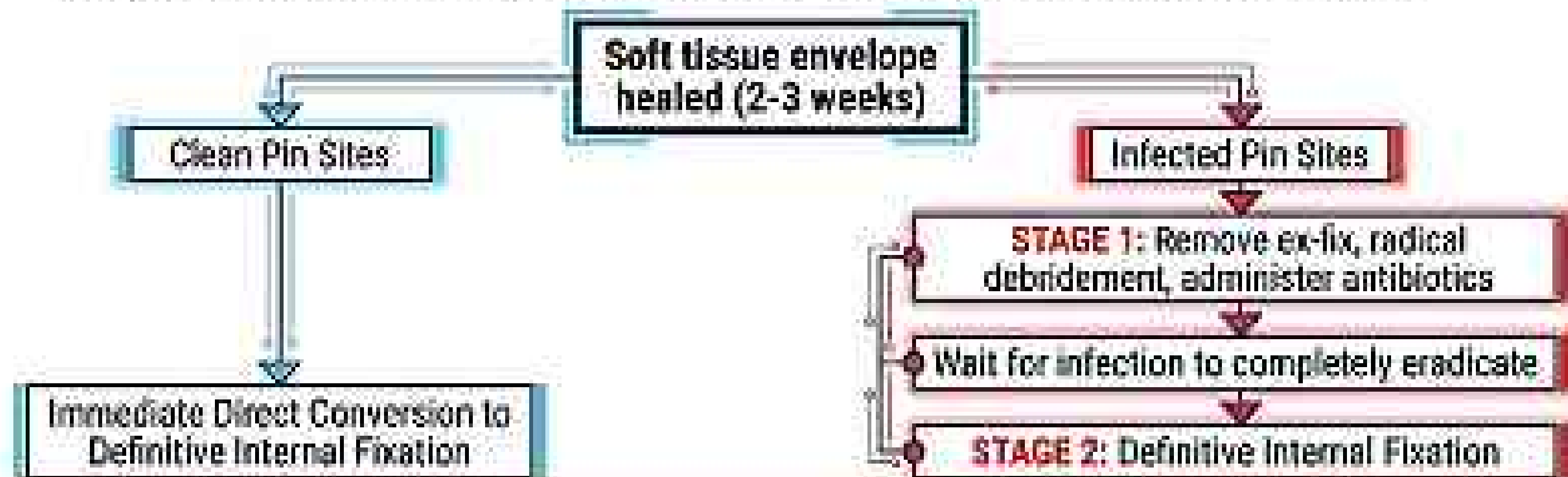
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Conversion to Internal Fixation

- Adult fractures rarely achieve definitive union in standard rod fixators. Ex-fix acts as a temporary bridge (2 to 3 weeks) until soft tissue heals.



EXAM PEARL: Never convert directly to an intramedullary nail or plate if there is active pin tract infection; mandatory staging and debridement are required.



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Must-Remember Values & Angles

< 1/3

Maximum Pin Diameter compared to bone shaft to prevent refracture.

16x

Stiffness $\propto R^4$.
Doubling pin size makes it 16x stiffer.

2 cm

Exact gap required from skin to rod to accommodate edema.

15-20 min

Time window to apply provisional DCO frame in polytrauma.

170-200 kg

Morbid obesity weight threshold acting as a relative contraindication.

Grades 3 & 5

Infection triggers:
Gr 3 = Remove pin.
Gr 5 = Remove construct.

EXAM PEARL: Always recall the 'Rule of 3rds' for pins: A pin diameter > 1/3 of the bone diameter acts as a severe stress riser causing refracture.



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Common Exam Traps

 **Trap:** Using self-drilling pins for definitive long-term fixation.
 **Fact:** They cause thermal necrosis and loosening. Always use pre-drilled.

 **Trap:** Direct conversion to IM nail when pin tracts show Grade 2 infection.
 **Fact:** Must use the 2-stage debridement protocol.

 **Trap:** Placing distal radius pins dorsolaterally.
 **Fact:** Injures superficial radial nerve. Place straight dorsally.

 **Trap:** Believing hybrid fixators offer superior periarticular stability.
 **Fact:** They lack axial/bending stability compared to circular Ilizarov frames.

 **Trap:** Leaving dried exudate on pin sites as a biological 'barrier'.
 **Fact:** Must be meticulously removed to prevent nidus formation.

EXAM PEARL: Examiners frequently test anatomical safe zones: The distal humerus requires posterolateral placement specifically to avoid the olecranon fossa.



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One-Page Management Algorithm & Take-Home Messages

Management Algorithm

Open Fx / Polytrauma



Radical Debridement (Step 1)



External Fixation (Pre-drill, Safe zones, 2cm gap)



Pin tract care monitoring (Grades 1-6)



2-3 Weeks Later



Convert to Internal Fixation (Staged if infected)



1. **Respect the Anatomy:** Strictly utilize **safe zones**; correct eccentric skin tension immediately.
2. **Respect the Biology:** '**Dead bone is not buried**'; continuously irrigate to prevent thermal necrosis.
3. **Plan for the End:** Ex-fix is a temporary bridge in trauma; definitive union requires internal conversion.

EXAM PEARL: Mastery of external fixation requires equal respect for the rigid laws of biomechanics ($\text{Stiffness} \propto R^4$) and the delicate demands of the soft tissue envelope (2 cm clearance).



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