



GP Orthopedic Surgery Starter Kit

Theory, Nuts & Bolts

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Date



Dem Bones - Considerations

Soft Tissue vs. Orthopedics

Orthopedics	Soft Tissue
Typically non-fatal conditions	Often life-threatening conditions
Expensive equipment & Supplies	Cheap equipment & Supplies
Difficult learning curve	Easier learning curve
Protracted follow-up	Short follow-up
Easy to diagnose	Diagnosis can be challenging

Dem Bones - Considerations

Standard of Care

- Elective vs. life-saving surgery considerations
- Nuanced outcome in orthopedics vs. soft tissue
- How urgently does it need to be done?
 - Who else is going to do it?

Outcome

- Trauma: Broken critter → Normal QOL
- Elective orthopedics:
 - Surgical vs medical treatment
 - Different techniques for the same problem

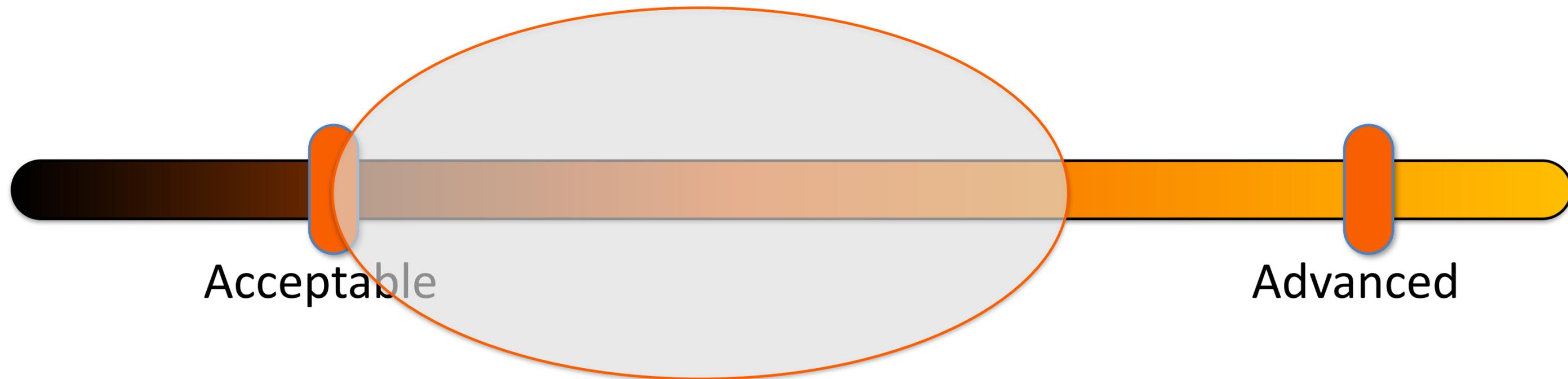


Fracture Management

Standard of Care

- How does Advanced SOC affect GP SOC?

“The standard required of and practiced by the average, reasonably prudent and competent veterinarian”



Fracture Repair – Standard of Care

Pre-Operative Care

- Pain control – full μ -agonist
- Supportive care following trauma – IV fluids, wound care, etc.
- Triage – don't miss the easy stuff
 - Pneumothorax
 - D-hernia
- Not usually emergency surgery – 3-5 day delay is fine

Still Game?

- ER clinic may have taken care of the triage
- Now we are phone shopping for ortho surgery

Fracture Repair – Standard of Care

Principles, Not Systems

- Exact brand, type, etc. matters less than choosing an appropriate system
- Application of system must adhere to principles

Adequate Repair As Standard – 4 A's of radiographic assessment

- 1. Alignment**
- 2. Apposition**
- 3. Apparatus**
- 4. Activity**

Must understand the forces acting on the repair and how to overcome them -
Bending, rotation, compression, tension, shear

Stable at the table is NOT the standard

Fracture Repair – Standard of Care

Alignment – Relative Positioning of Joint Surfaces Proximal & Distal

- Varus & valgus
- Recurvatum & procurvatum
- Rotation
- Translation

Need to Evaluate Over Time



Fracture Repair – Standard of Care

Alignment – Relative Positioning of Joint Surfaces Proximal & Distal

- Varus & valgus
- Recurvatum & procurvatum
- Rotation
- Translation

Need to Evaluate Over Time

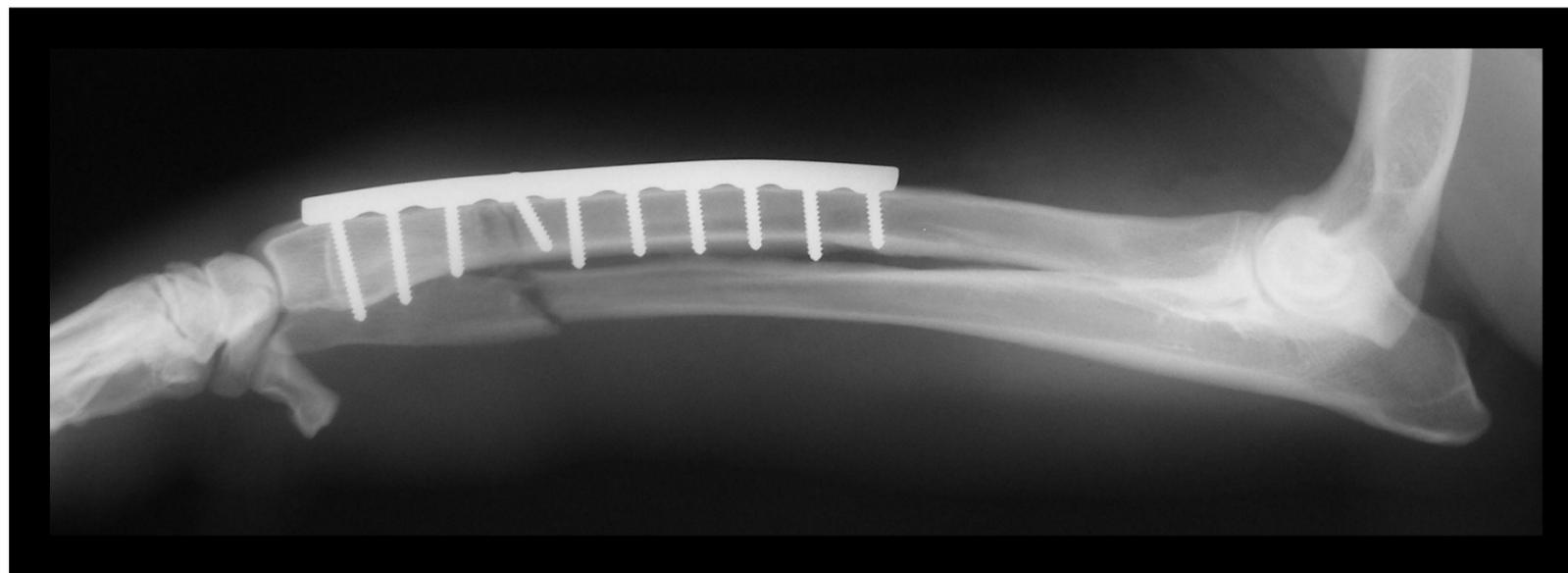


Fracture Repair – Standard of Care

Apposition – Relative Positioning of Fragments to Each Other

- Adequacy depends on repair system
- Gardening vs. carpentry

Need to Evaluate Over Time

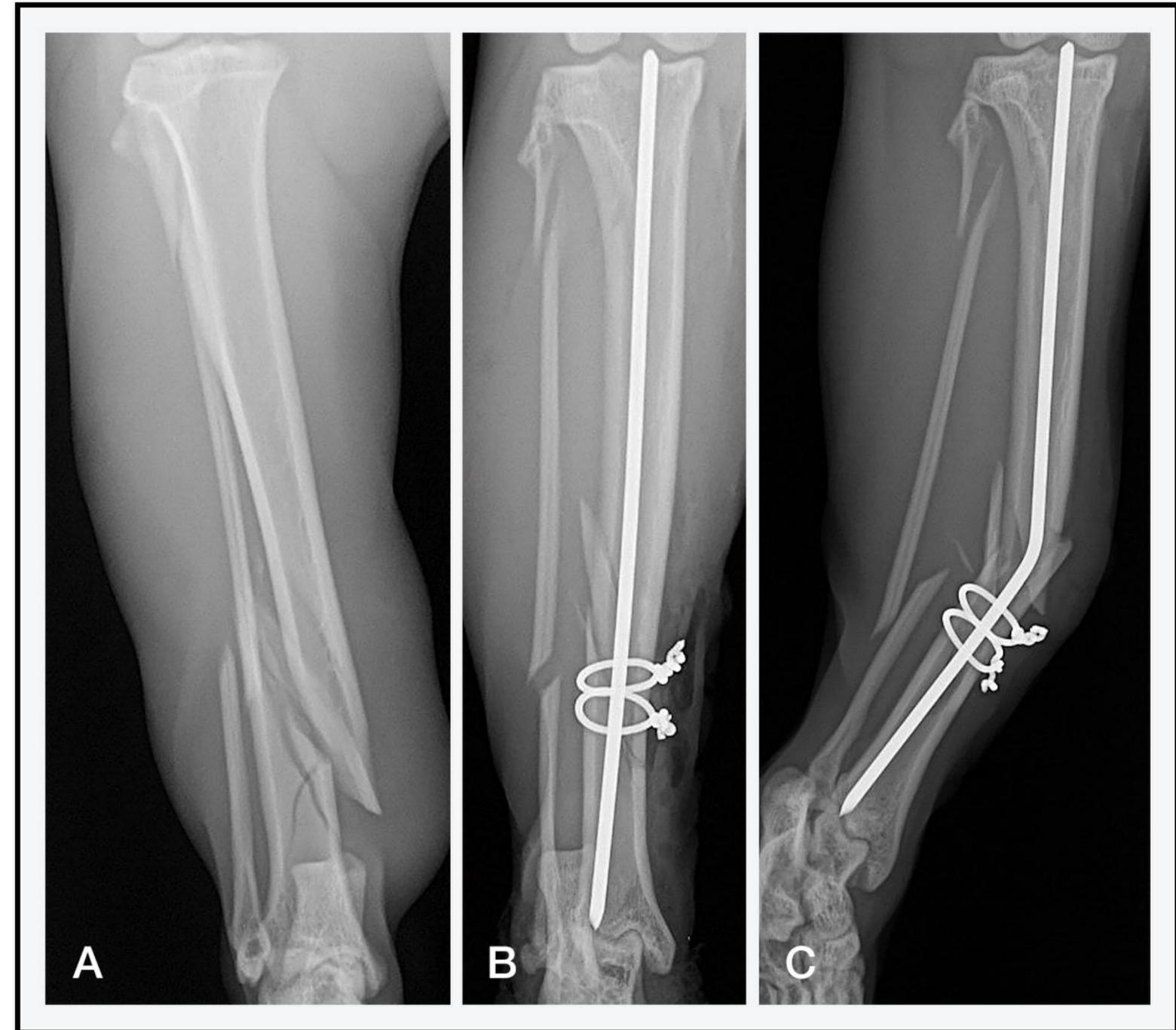


Fracture Repair – Standard of Care

Apparatus

- Must be appropriate for the fracture type and location
- IM pin + Cerclage → Beware!
 - Exceedingly few indications for this repair
 - Long oblique/spiral fracture configuration
 - Mid-diaphyseal
 - Reconstructable (reducible)
 - Usually NOT a good idea
- If you MUST:
 - MUST have > 1 cerclage wire
 - MUST have perfect reduction – load sharing

**Any small fragments?
Step away from the cerclage!**



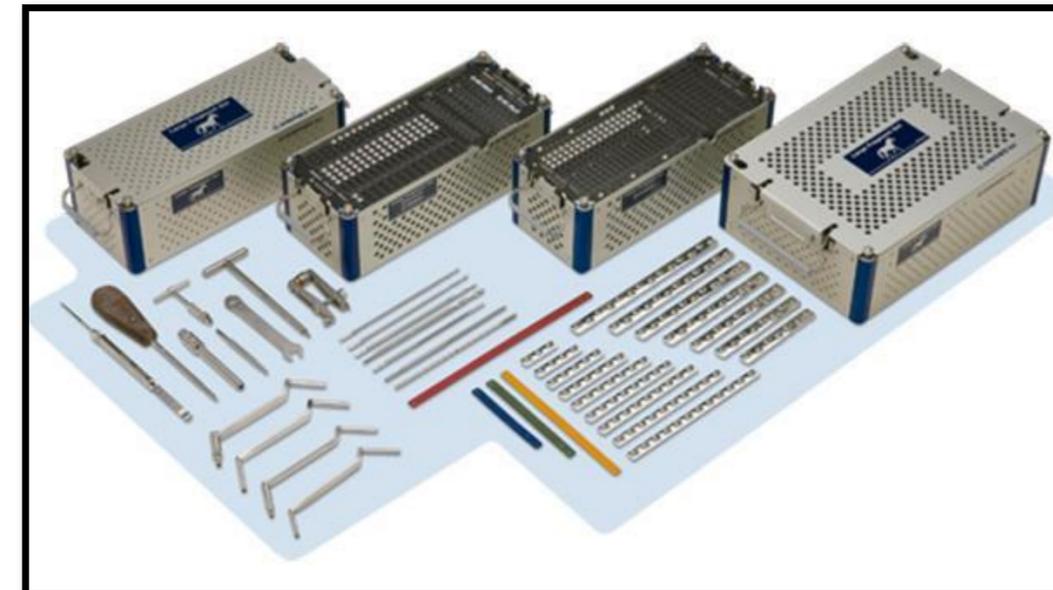
Fracture Repair – Standard of Care

Apparatus

- So many different systems
 - Internal fixation
 - Plates & screws
 - Locking & non-locking
 - Interlocking nails
 - External skeletal fixation
- Appropriate system for fracture location and configuration
- Appropriate application of a given system



Need to Evaluate Over Time



Fracture Repair – Standard of Care

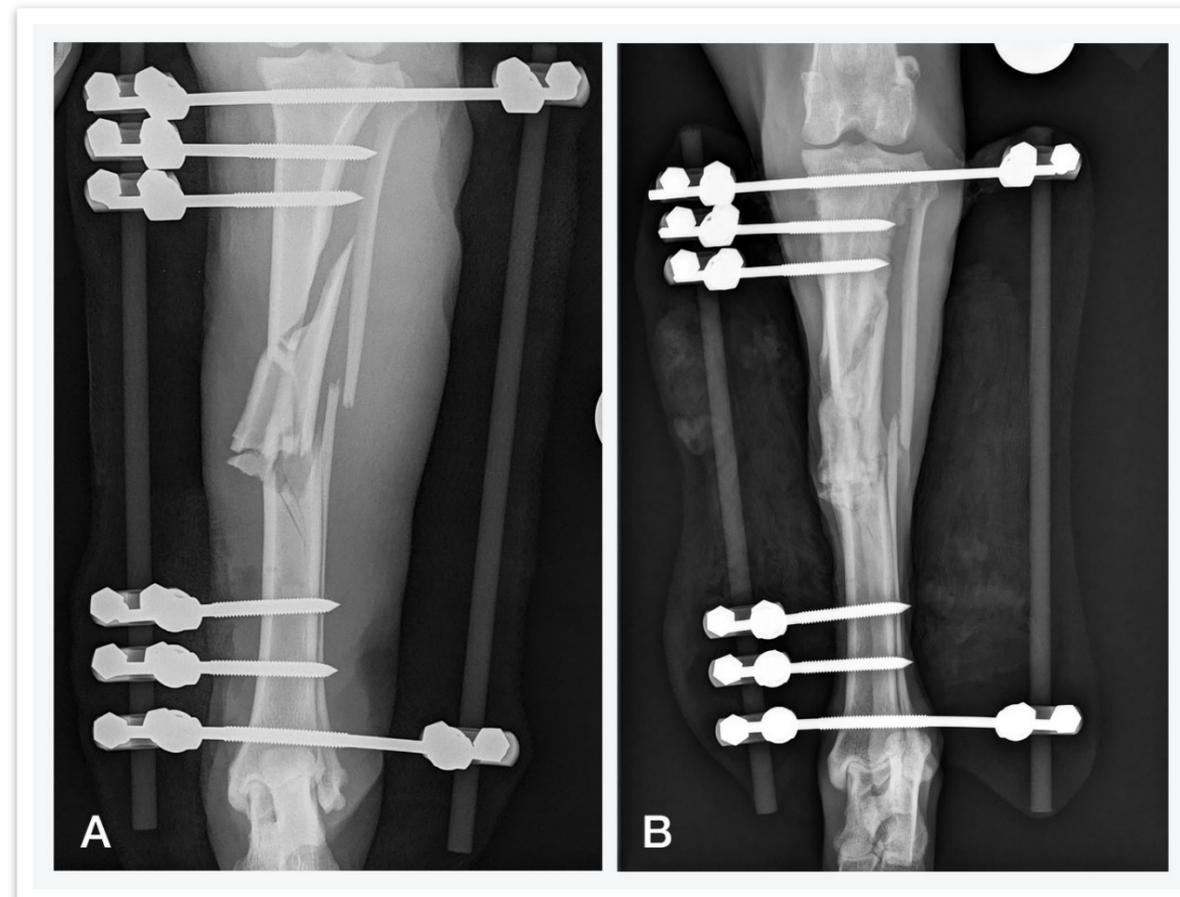
Activity – Evidence of Bone Healing

- Zero at time of surgery
- Changes over time

Expectations for healing vary widely

- System factors
 - Type and application
- Patient factors
 - Fracture configuration
 - Fracture location
 - Patient age
 - Comorbidities

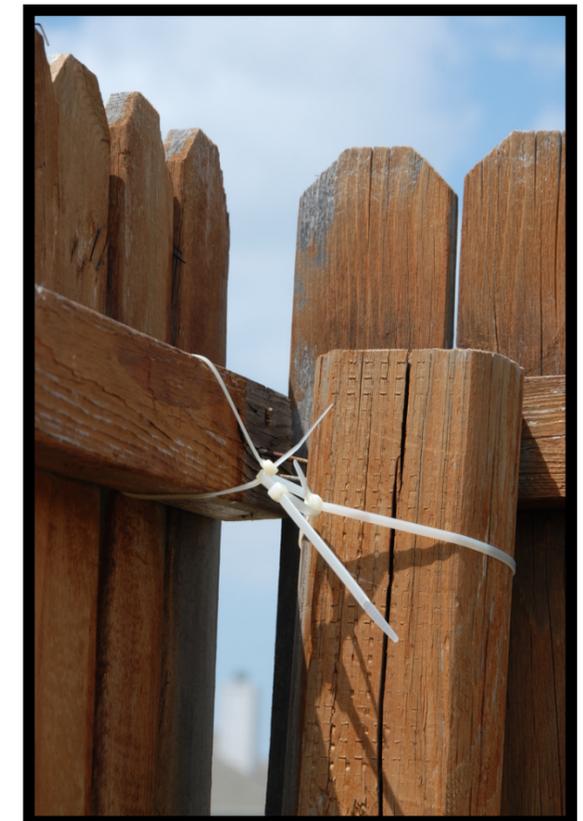
Must See Progression of Healing Over Time



Fracture Repair – Standard of Care

Knowledge - 4 A's

- What is adequate?
 - Alignment - acceptable ranges and clinical ramifications
 - Apposition - context of apparatus, bone biomechanics, fracture healing concepts
 - Apparatus - fundamental concepts, individual system details, physics
 - Activity - fundamental concepts, context of apparatus, imaging interpretation
- Honesty with yourself - Hope is not a strategy



Fracture Repair - Getting Started

Getting Started – KISS principle

- Straightforward cases
- Straightforward system
- Get comfortable with the system and surgical approach
 - CE courses
 - Practice → Saw bones, cadavers
- Support
 - Mentors, friends, colleagues

Progression

- Cases – Use it!
- Straightforward fractures → more complex fractures

The system may limit the kind of cases you can fix



Fracture Repair – Case Selection - Yes

Location – Bone Type

- Tibia/Fibula
- Radius/Ulna
- Femur
- Metacarpals/Metatarsals
- Mandible

Location – Where on the bone?

- Diaphysis
- +/- Metaphysis
- Some growth plate fractures
 - Tibial tuberosity avulsion
 - Distal femoral condylar fracture



Fracture Repair – Case Selection – Maybe Not

Location – Bone Type

- Humerus
- Vertebrae
- Carpus/Tarsus*

Location – Where on the bone?

- Articular
- +/- Metaphysis
- Some growth plate fractures
 - Proximal & distal tibia
 - Proximal humerus & femur



Fracture Repair - Getting Started

Implant System

Pins & Wires

- Cheap
- Limited application
 - Cross-pinning
 - Pin & tension band
 - Dowel-pinning



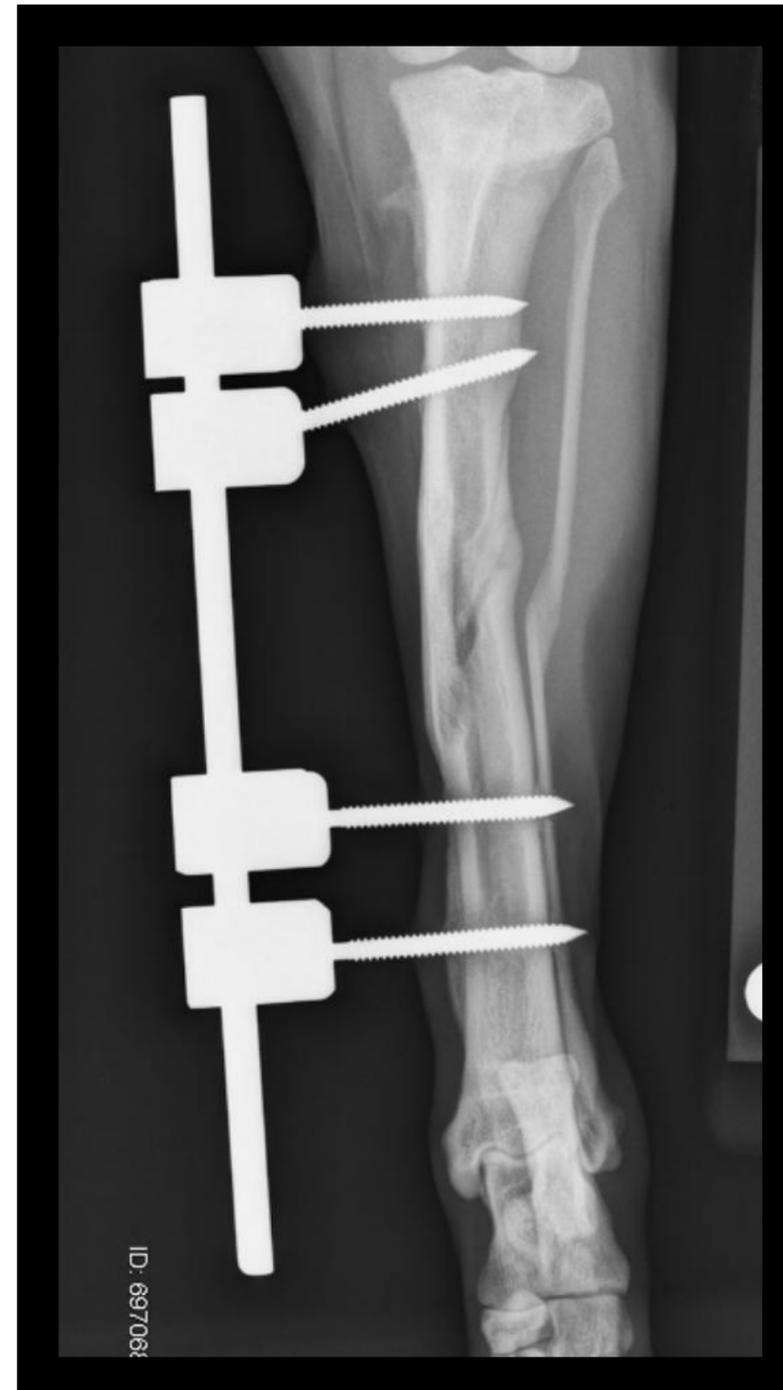
Fracture Repair - Getting Started

Implant System

External Skeletal Fixator (ESF)

- Relatively low overhead cost
- Percutaneous application – implants always come back out
- Good for open fractures
- Versatile, but not great for ALL bones

- Gardening vs. Carpentry approach



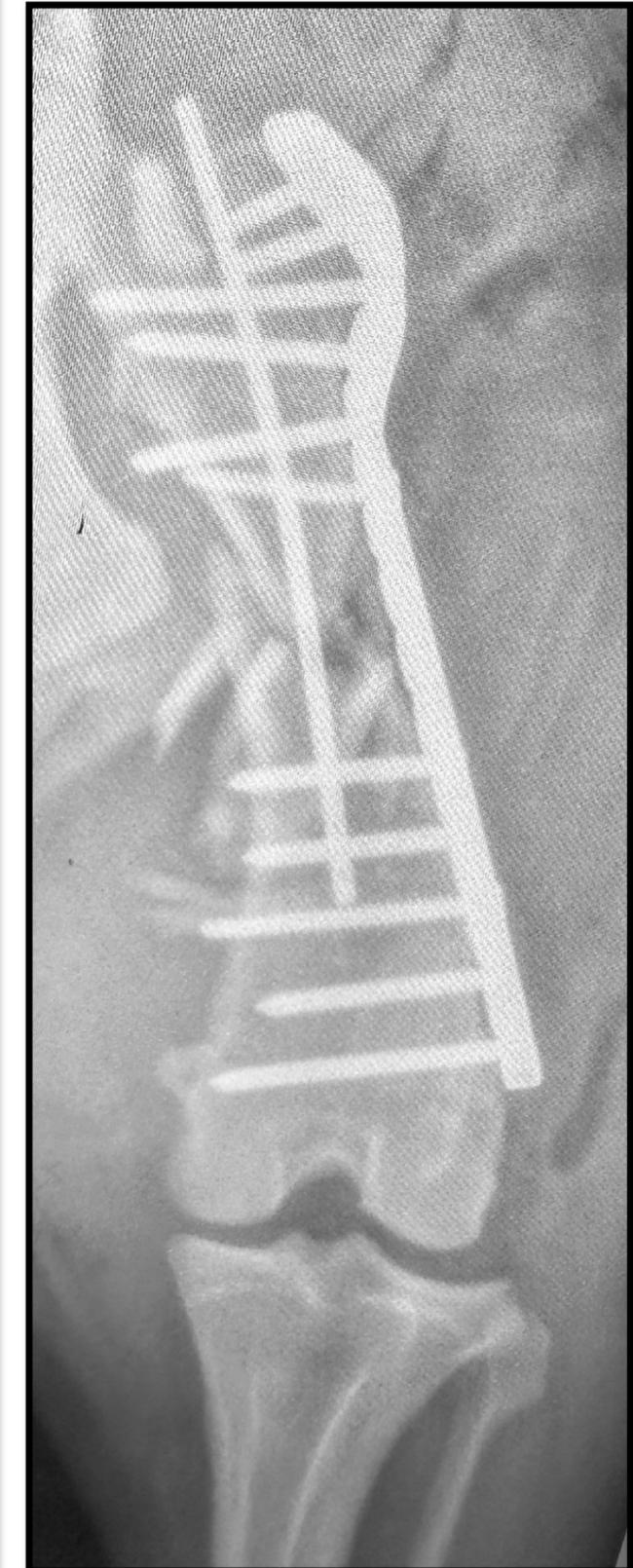
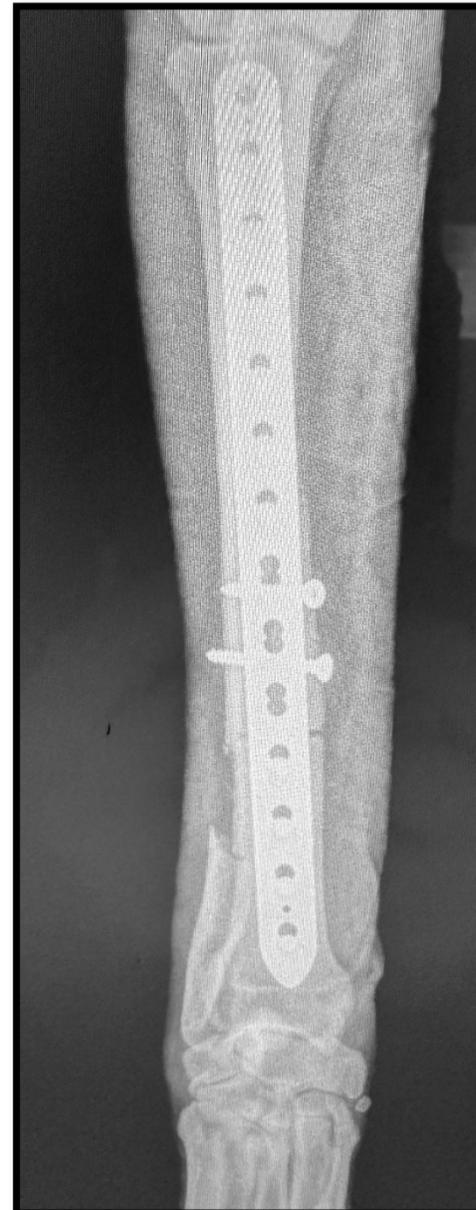
Fracture Repair – All In

Plating Systems

- So many!
- Can be extremely complex – instrumentation, plates & screws
- Requires extensive inventory
 - Plate types & sizes
 - Screw types, sizes, and lengths
- Can fix just about any fracture
- Carpentry approach OR Gardening approach
 - Easy to get focused on carpentry

Interlocking Nail System

- Not the easiest to learn
- Cannot be used for the radius
- Great for metaphyseal fractures
- Great for segmental/highly comminuted fractures



Plating Systems

Considerations

- One to rule them all?
- Versatility!!
 - Locking & non-locking
 - Special plates - trauma, TPLO, etc.
- Cost - instrumentation & supplies
 - Quality matters
 - Most expensive is not always best
 - Goldilocks...

Questions?

What If I Hate Fracture Repair?

There Are Options

External Coaptation

- Splints & Casts
- Slings
- Need to be able to do this anyway

Amputation

Femoral Head & Neck Ostectomy (FHO)

External Coaptation

Splints & Casts

- Many fractures
- Many luxations

Slings

- Luxations

NOT “set it & forget it”

- Low cost ≠ Low maintenance

Bad things can happen

- Pressure – sores → loss of limbs
- Failure to heal
- Improper healing



External Coaptation - Fractures

4 A's of Fracture Repair Still Apply

Alignment – Needs to be straight

Apposition – 50% fragment/cortical overlap

Apparatus – Span joint above and below

Activity – Evidence of healing over time



External Coaptation - Fractures

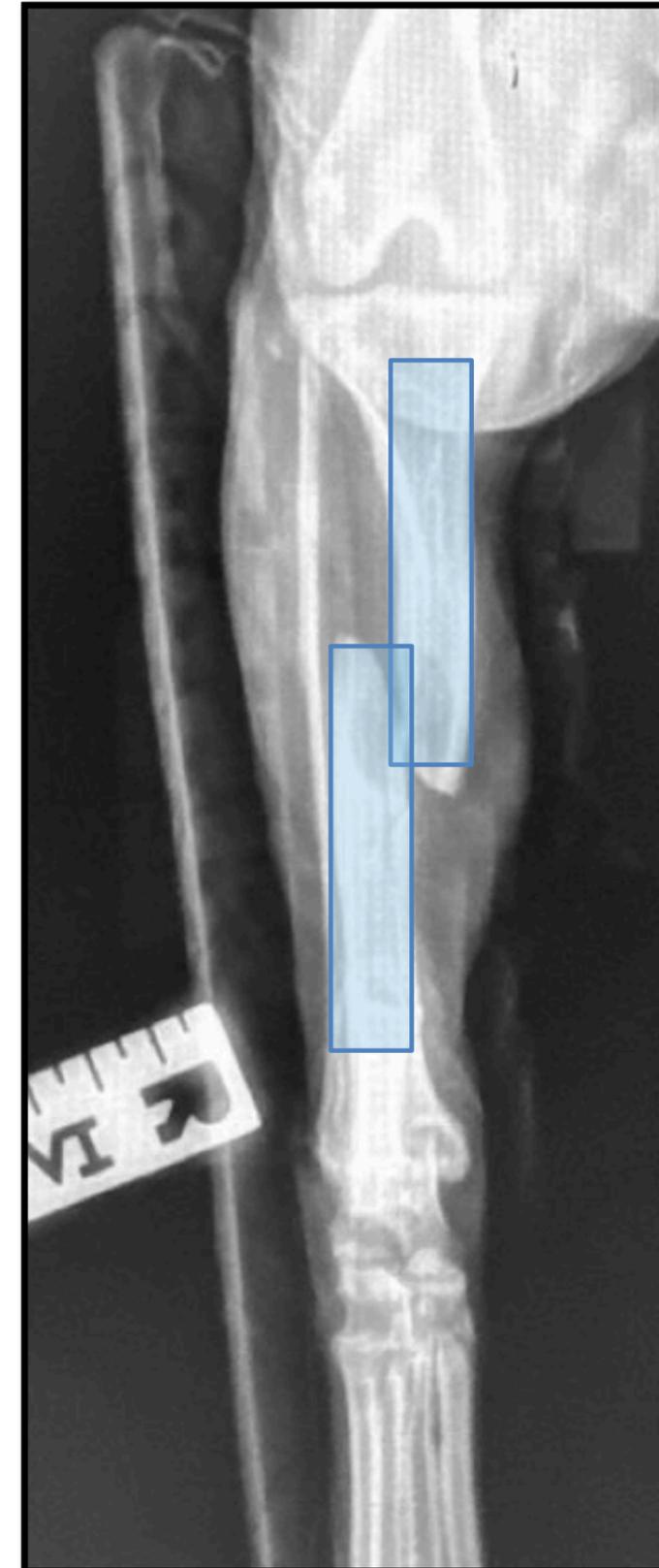
4 A's of Fracture Repair Still Apply

Alignment – Needs to be straight

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Activity – Evidence of healing over time



External Coaptation - Fractures

Case Selection

Rapid healing expected

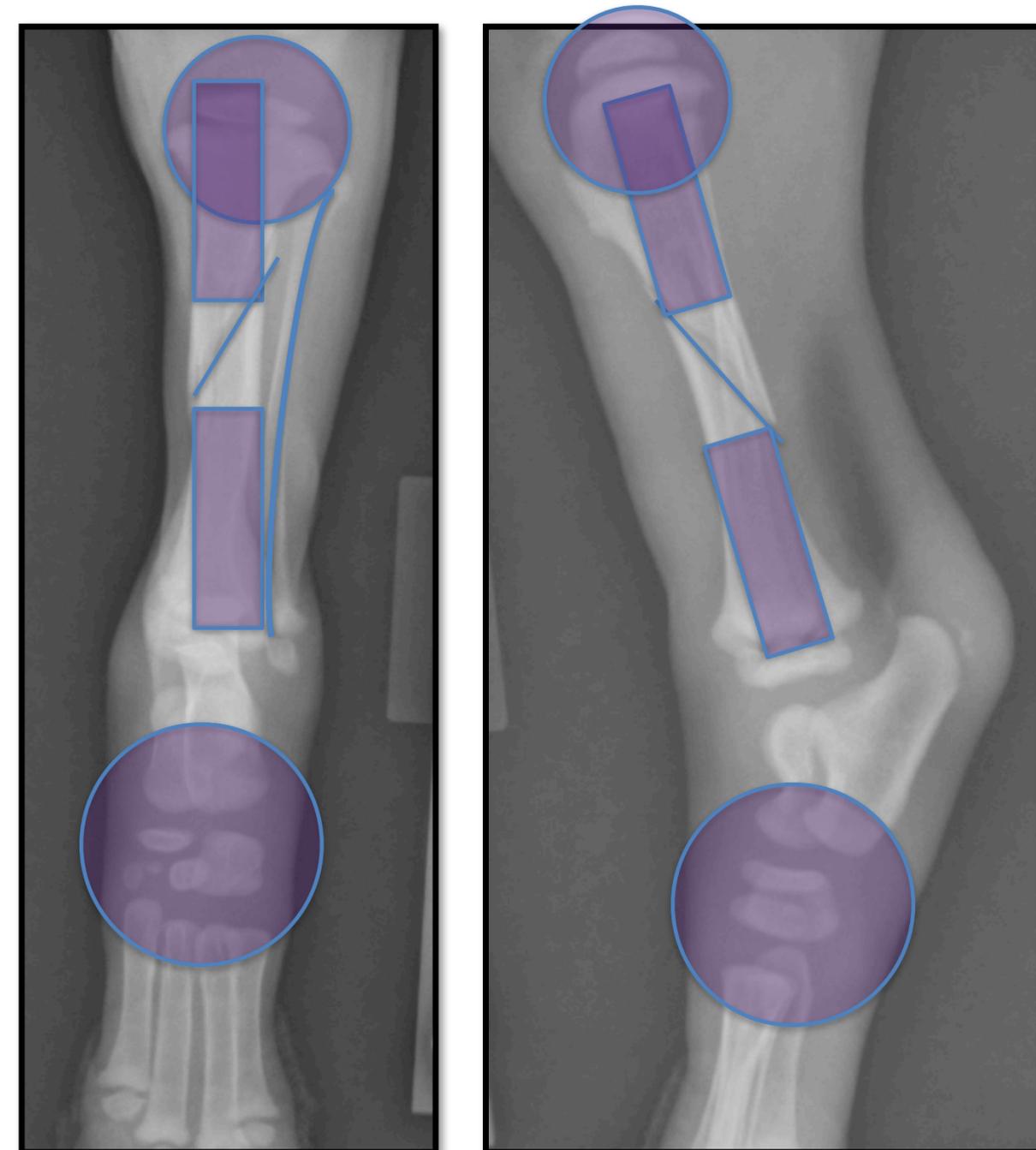
- Immature skeleton = Bone factory
- Excellent blood supply

Good apposition

- Incomplete or greenstick fractures
- Minimally displaced

Stability

- “Internal splint” present → Fibula, ulna
- Splint or cast provides adequate rigidity



External Coaptation - Fractures

Benefits

Cost Effective
Non-invasive

Appropriate Use

- Distal to the elbow
- Distal to the stifle

Risks

Unstable → Poor healing
Soft tissue complications
Maintenance

Beware

- 1) (Distal) R/U fracture in toy breeds
 - Malalignment
 - Non-union
- 2) Open or highly comminuted fractures
 - Stability
 - Healing

External Coaptation - Luxations

Splints, Casts, Slings

- Elbow luxation
- Hip luxation
- Shoulder instability/luxation
- Some tarsal luxations

NOT “set it & forget it”

- Low cost ≠ Low maintenance



External Coaptation - Luxations

Must Monitor for Complications

- Pressure necrosis
- Growth!

- Change at least every 2 weeks
- Expect some bandage sores



Amputation

Always an Option

- Primary treatment option
- Failed healing attempt

Soft Tissue Procedure

- No bone cutting required
 - Forequarter amputation
 - Coxofemoral disarticulation

Salvage Procedure

- Irreversible

Amputation – Case Selection

Patient Factors – Physical Exam

- How much is the affected limb still in use?
- Obvious difficulty rising or walking?

- Neurologic disease present?
- Orthopedic disease present?

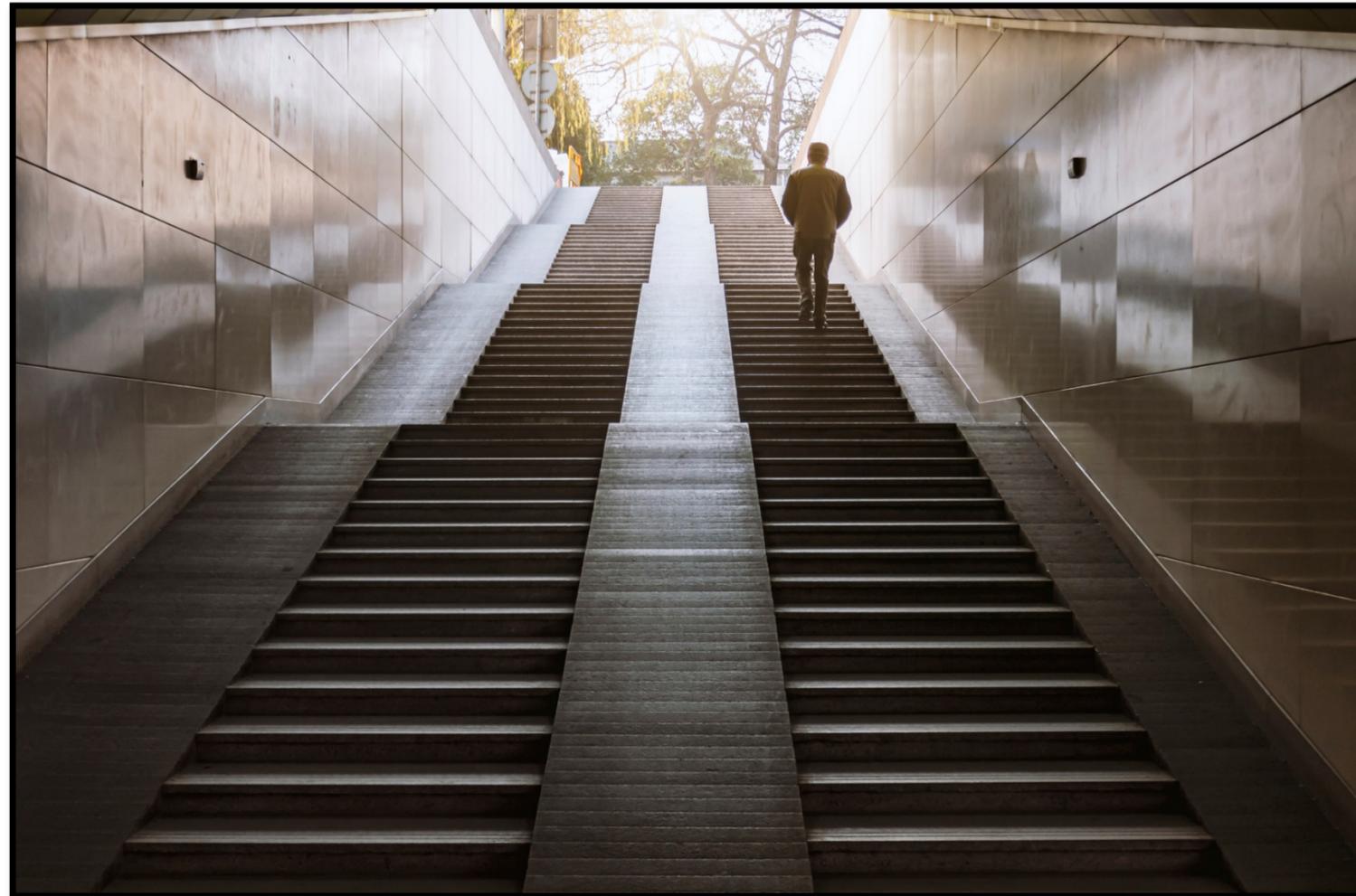
- May be an easy decision
- May involve tough decisions

Able to pop up and walk unassisted on three limbs? Should be fine!

Amputation – Case Selection

Client Factors

- Ability to manage mobility issues
- Physical strength
- Housing
- Transportation



Amputation - Outcome

Expectations

- Changes in biomechanics and gait
- Shift towards contralateral thoracic limb
- More pronounced with thoracic limb amputation

- Pay close attention to that limb on examination
- Context matters



Amputation - Outcome

Client Education

Satisfactory outcome is expected

- Minimal change in attitude
 - Near complete return to normal QOL
 - Clients usually happy with decision to amputate
-
- Quick adaptation – 2-4 weeks

FHO - Indications

Femoral Capital Physeal Fracture

- Cats and dogs
- Can be bilateral
- Traumatic or spontaneous

Coxofemoral Luxation

- Trauma
- Minimal/no trauma

Femoral Neck Fracture

- Trauma

Acetabular Fracture



Feline FHO

Outcome

Good to excellent medium/long-term outcome

- Unilateral or bilateral
- Single session bilateral FHO is well tolerated

Continuum of Care Consideration

- FHO → Repair → Total hip replacement

What's the SOC?

- FHO acceptable across all care settings
- Client communication about other options



J Feline Med Surg. 2024
 Sep;26(9):1098612X24127589
 0.
**Clinical perioperative
 outcomes in 39 cats after
 single session bilateral
 femoral head and neck
 excision**
[Hania Brasali](#)¹, [Sam
 Stewart](#)², [Nicole S Amato](#)¹

<p style="text-align: center;"><u>Slipped Physis – Metaphyseal osteopathy</u></p> <ul style="list-style-type: none"> • No trauma history • Often chronic • <u>FHO is a good option</u> 	<p style="text-align: center;"><u>Osteoarthritis</u></p> <ul style="list-style-type: none"> • Uncommon to require FHO • Often more generalized OA • <u>Medical treatment is usually sufficient</u> • FHO can be considered
<p style="text-align: center;"><u>Capital Physeal Fracture – Traumatic</u></p> <ul style="list-style-type: none"> • Repair is technically difficult & time sensitive • Only need K-wires • <u>FHO is a good option</u> 	<p style="text-align: center;"><u>Coxofemoral Luxation</u></p> <ul style="list-style-type: none"> • Closed reduction → Open reduction & fixation – time sensitive • <u>FHO is a good option</u> • First line or reduction failure

Canine FHO

Outcome

- Not a lot of evidence
- Large dogs can do well
- THA vs. FHO literature imbalance

Continuum of Care Consideration

- FHO → Repair → Total hip replacement

What's the SOC?

- FHO acceptable across all care settings
 - Including large dogs
- Client communication is key



Vet Sci. 2025 May 14;12(5):469.
Force Plate Gait Analysis in Dogs After Femoral Head and Neck Excision
[Pongsatorn](#)
[Tuchpramuk](#)^{1,2}, [Duangdaun](#)
[Kaenkangploo](#)², [Thanikul](#)
[Srithunyarat](#)², [Suvaluk](#)
[Seesupa](#)², [Somphong](#)
[Hoisang](#)³, [Benedict Duncan X](#)
[Lascelles](#)⁴, [Naruepon Kampa](#)²

<h3><u>Avascular Necrosis of the Head & Neck</u></h3> <ul style="list-style-type: none"> • No trauma history • Often chronic • <u>FHO is a good option</u> 	<h3><u>Osteoarthritis</u></h3> <ul style="list-style-type: none"> • Small dogs – great option • Large dogs – good option
<h3><u>Capital Physeal Fracture – Traumatic</u></h3> <ul style="list-style-type: none"> • Repair is technically difficult & time sensitive • K-wires or screw + K-wire • <u>FHO is a good option</u> 	<h3><u>Coxofemoral Luxation</u></h3> <ul style="list-style-type: none"> • • • Closed reduction → Open reduction & fixation – time sensitive • <u>FHO is a good option</u> • First line or reduction failure

FHO

Good Option for a Variety of Conditions

- Straightforward
- Good to excellent clinical outcome

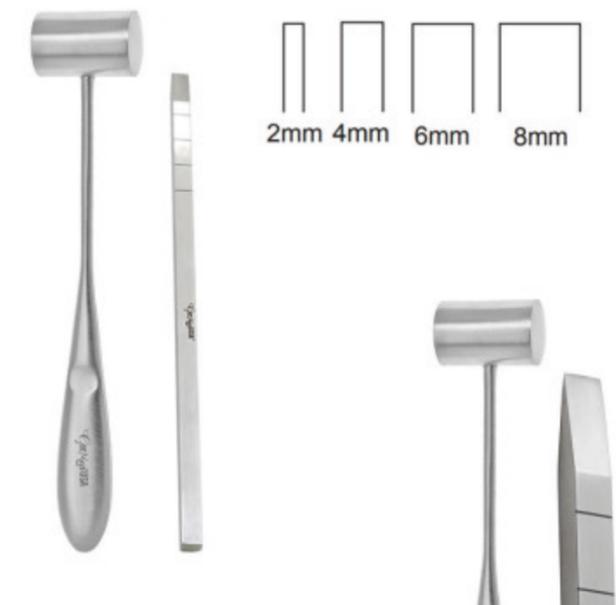
Technique and Progression

- Cats and small dogs are easiest
- Hip luxations make the approach easy
- No-brainer to do this for metaphyseal osteopathy or avascular necrosis of the head & neck

- Power tools are nice but not absolutely necessary
 - Osteotome and mallet are not as clean – need rongeurs
 - Higher incidence of micro cracks and fissures

FHO Must Be Performed Correctly

Total Hip is Better – Until Complications Happen



Questions?



Elective Orthopedics

Standard of Care Considerations

- Does it get trickier?
- Not life-threatening conditions
- QOL and function are measuring sticks
- More nuanced outcomes with potential for difficult learning curves

Ligament Injuries

- CCL rupture - Knees, knees, knees

Developmental Conditions

- OCD – Shoulder, Elbow, stifle, tarsus)
- Dysplasia – Elbow, hips
- Patellar luxation

Ortho - Knees

Standard of Care Considerations

Outcome with surgery is better, but...

- Cats often do great without surgery for isolated CCL tears (deranged stifle/multiple ligament injury cases are different)
- Small dogs do well to great without surgery
- Large dogs do ok to well without surgery

- Surgery is not without risk
 - Anesthetic
 - Healing complications
 - Loss of limb
 - Loss of life

Baseline Assumption: Dogs & Cats Are 3-Legged Creatures With A Spare



J Feline Med Surg. 2020 Apr;22(4):277-284.
Cranial cruciate ligament disease in cats: an epidemiological retrospective study of 50 cats (2011-2016)
[Gudrun S Boge](#)¹, [Karolina Engdahl](#)², [Elena R Moldal](#)¹, [Annika Bergström](#)²

J Am Vet Med Assoc. 2022 Jun 9;260(12):1471-1474.
Conservative nonsurgical treatment for cranial cruciate ligament disease can be an effective management strategy in cats based on validated owner-based subjective assessment in some cases
[Regan M Stoneburner](#)¹, [James Howard](#)¹, [Eva M Gurian](#)², [Stephen C Jones](#)¹, [William M Karlin](#)², [Nina R Kieves](#)¹



Ortho - Knees

Treatment Options

- Wait & See – reasonable
 - When do we change that to: “We really need to think about surgery?”
 - What do we lose?
 - DJD progression to a clinical point of no return is a risk
 - Stabilization procedure doesn’t change
 - Does the success rate change?
 - Risk of contralateral CCL rupture
 - What do we gain?
 - Time to scrape some cash together
 - Clinical improvement eliminates need to operate
- I am comfortable waiting for 6 months to a year
 - Clinical progression and context is important
 - Rechecks/Check-ins!
 - Client communication

Ortho - Knees

Treatment Options

- Which surgery? - Oh boy!
- Dynamic stabilization techniques typically have better outcomes – Acronym soup
 - TPLO
 - TTA
 - CWO, CWBLO...
- Static techniques typically have good outcomes
- What are the marginal gains?

Treatment Options – Krebs approach

- Cats – Lateral suture as default – consider medical treatment
- Small dogs – Lateral suture as default – consider medical treatment
- Medium to large dogs – TPLO as default, but lateral suture is fine – context matters – consider medical treatment

Ortho - Knees

Treatment Options

- **Cats** – Lateral suture as default – consider medical treatment
- **Small dogs** – Lateral suture as default – consider medical treatment
- **Medium to large dogs** – TPLO as default, but lateral suture is fine
 - Context matters – Age, lifestyle, finances, etc.
 - Consider medical treatment
- **Large to giant dogs** – TPLO as default
 - Reluctant to do lateral suture because of high risk of failure – context matters
 - Consider medical treatment

Important Considerations

- Meniscus tear? Medical treatment success rate decreases
- Lateral suture fails? – Can revise (what's the definition of insanity)
 - Perform dynamic stabilization
- Medical treatment ≠ Doing NOTHING
 - Weight loss, physical therapy, joint supplements, NSAIDs, etc.

Ortho - Knees

Getting Started

- **Lateral fabellotibial suture** = step 1
 - Get comfortable exploring the joint
 - Get comfortable treating meniscus tears
 - Failure or infection = easy to deal with
- **Dynamic stabilization technique** = step 2
 - Major investment – plates and screws, instrumentation
 - Need repetition to get good at it
 - A lot more things that can be done wrong or suboptimally
 - Cut the tibia in half and then put it back together again
 - Failure or infection → not so easy to deal with

SOC for surgical treatment of a CCL-deficient stifle

- Evaluation of the meniscus
- Treatment of a torn meniscus
- Procedure performed correctly

Ortho - Knees

Patellar Luxation

- Range of clinical relevance
- Range of surgical difficulty
- Cheap equipment
- Combo with CCL stabilization
- Grade 2 or 3

Case Selection

- Goldilocks principle: not too small (tiny), not too big (giant)
- Grade 2 or 3

Other Considerations

- May not be perfect, but grade usually improved
- Usually deploy a combination of techniques rather than relying on just one
 - Patellar groove
 - Tibial tuberosity
 - Soft tissue tightening

Luxation Grade	Course of Action
I	Ignore
II	Could Fix
III	Should Fix
IV	<u>Really</u> Should Fix – Make sure it’s not you

Ortho - Complications

Range: Minor incisional to failure

- If you are getting into ortho, you need to be able to deal with complications
- Requires in-depth understanding
 - Fracture biology
 - Fracture biomechanics
 - Bone healing
 - Theory & clinical manifestations
 - Radiographic assessment
 - Plan A, B, C when things go wrong
- Requires difficult conversations at times
 - The first time to talk about complications is NOT when they happen!
- Everyone hates to deal with other people's complications...

Perfect Repairs Will Fail

Bad Repairs Will Heal

GP Setting Orthopedics

Summary

- Yes, very much reasonable
- Map out a plan to get better and do cases
 - Find mentorship or other support
- Need repetition to get comfortable and better
- Case selection is key
 - Ok to say “No, thanks.”
 - Need to be able to work through complications
- Life-saving measures – easy decision to try
- Knee-saving measures – maybe less of an easy decision to try

Lack of options → easier to commit to stretching your comfort zone

- Client communication is always key
- Have courage, but don't be irrationally confident

Questions?

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