

Combined Section Meeting 2019 Washington, DC, January 23-26, 2019

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#### Disclosure

None of the speakers have any conflicts of interest related to the content of this presentation.

#### **Learning Objectives**

 Discuss how basic science serves as the foundation of forming a plan of care for traumatic bone and soft tissue injury.

 Identify key elements of a sound collaborative approach between the orthopaedic surgeon and physical therapist in managing patients with traumatic injury in the outpatient setting.

### Learning Objectives

- Recognize the limitations of protocols and existing evidence in the management of orthopaedic trauma patients, and why therapists must rely on the basic science of tissue healing and clinical reasoning to implement a patient-centered approach.
- Summarize the clinical reasoning needed to manage multiple injuries simultaneously while optimizing function and quality of life.

## **Course Outline**

- Basic science background of bone and soft tissue injury and healing.
- An orthopaedic surgeons view of traumatic bone and soft tissue injury, and what the PT/MD relationship should look like in the best-case scenario.

#### **Course Outline**

 Real trauma case presentations of orthopaedic patients managed at LSU, noting the limitations of current literature in guiding the treatment, and how basic science, clinical reasoning, and the patients' needs informed their unique management of each case.

• Q&A

#### Basic Science of Healing: Bone and Soft Tissue

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| Bone  |  |
|---|--|
| "Every change in the function of a<br>bone is followed by certain definite<br>changes in its internal architecture<br>and its external conformation." |  |
| German anatomist and<br>surgeon Julius Wolff (1836–<br>1902)  |  |

**Bone: Primary and Secondary Healing** 

**Primary Bone Repair** 

**Secondary Bone Repair** 







**Dense Fibrous Tissue** 

## Orthopaedic Trauma: One Surgeon's Perspective on Team-Based Practice and Patient-Centered Care

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#### **Key Themes to Patient-Centered Care**

- Communication "Knowing the person who has the disease..."
  - Patient's pre-injury health status and co-morbidities
     Patient's injuries
  - Patient's goals
- 5 Core Competencies: biopsychosocial, patient as a person, sharing power and responsibility, therapeutic alliance, doctor as a person (self-aware) (Draeger, *Hand Clinic*, 2014)

#### Key Themes to Patient-Centered Care

- Shared management and treatment plan
- Willingness to be flexible according to patient's progress and patient's needs
- It's a TEAM approach with the patient at the center.

### **Patient-Centered Teams**

- "Value" to the patient is related to the patient's experience, not necessarily the surgical or technical outcome.
- Complicated by today's payment and delivery models that do not account for the value of comprehensive and collaborative efforts.

### **Patient-Centered Teams**

- Providers sacrifice payment when time is the only metric that is valued by payers. (Harwood, JBJS, Orthopaedic Forum, 2016)
- Our LSU experience with efficiencies gained through teams.

## **Creating the Culture**

 Interdisciplinary practice defined as:
 "a partnership between a team of health professionals and the patient in a participatory, collaborative, and coordinated approach to shared decision making around health issues."

#### Importance of Co-Location of Multi-Disciplines for Learning and Practice

- Pre-Clinic Meetings Murray, *Swiss Med Wkly*, 2012
  - Others we utilize
  - Bedside rounds
  - Conferences
  - Journal Clubs
  - Clinical Settings
  - Social Events

#### The Pros and Cons of Electronic Health Records

| Communication: Happens<br>Once the Culture is Est | Organically<br>ablished |
|---|-------------------------|
|   |                         |
| Social Settings                                   | Truth to Power          |

Academic Settings

#### Benefits of a Collaborative Approach; We have some work to do on

**attitudes**..... Attitudes of surgeons vary on the benefit of PT following trauma

- "32% of post-surgical patients do fine with surgeon pracribed HEP"
- 27% of post-surgical patients have incorrect medical information delivered by a PT"

- Residents and surgeons with >20 years of experience are least likely to value PT contributions.
- Surgeons between residency and 20 years rank the importance much higher (Archer, *PTJ*, 2009; Dusik, *Arch Orthop Trauma Surg*, 2013.)

#### Benefits of a Collaborative Approach; We have some work to do on attitudes.....

# Functional outcomes are important to patient's emotional health.

- Engaging the biopsychosocial contruct in the management pain is equally important to the technical skills of the surgeon. (Ayers, *JBJS*, 2013)
- Return to function = return to community participation = return to self-efficacy, dignity, and joy.

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**Conservative Management of a Patient** with a Knee Dislocation & Sarcoidosis

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#### Background

- 30 yo AAF sustained a knee dislocation when stepping up a curb.
- MRI revealed: ACL, PCL, and LCL tears, with partial MCL disruption. The posterolateral corner, popliteal tendon, and peroneal nerve were also injured.

#### Background

- · PMHX includes Sarcoidosis, with subsequent prolonged corticosteroid use, and HTN.
- Placed into external fixation 5 days post-injury since surgical reconstruction was not deemed appropriate.
- What is Sarcoidosis???

#### **Existing Evidence**

- Knee dislocations are rare<sup>1,2</sup> and controversial<sup>3</sup>
- Defined as a tear in <sup>3</sup>⁄<sub>4</sub> of the cruciates (ACL & PCL)/collaterals (MCL & LCL)<sup>1,4,5</sup> In the past (mid 1980's mid 1990's), non-operative management was advocated for uncomplicated cases,<sup>4,5</sup> but surgical repair/reconstruction is now favored.2-6

### **Existing Evidence**

- · Surgical outcomes are better - IKDC,3 Lysholm,4,6 ROM,6 return to sport/work5
- There are indications for non-operative management, including comorbidities and associated trauma7
- Clinical Commentary7 and Case Report8 detail postoperative management, but we were unaware of any non-operative treatment guidelines.

#### **Initial Presentation**

- Knee ROM: FLEX = 32/40; EXT = 2/0
- Quad = 3-/5
- Ankle DF = 1/5
- · Ambulated NWB with SW and AFO.
- LEFS score = 11/80
- · Unable to (and previously did not) drive
- · Unable to bathe independently.

#### **Intervention Principles**

- ROM progression based upon soft tissue healing times (8-12 weeks) Caution with progressing too fast to allow some fibrosis in order to achieve some stability
- Hinge Knee Compass removed in third month of PT, with MUA
- Progressed WBing incrementally, paired with OKC strengthening

#### **Intervention Principles**

- Once pt was WBAT, CKC strengthening and stability training
  - Stabilization included balance and perturbation techniques
    - Technique used by Fitzgerald, et al.9

| Month | Exercises   | Ambulation   | ADLs   |
|-------|---|--|--|
| 0-1   | <ul> <li>Heel slides</li> <li>Towel calf stretch</li> <li>Patellofemoral joint<br/>mobilization</li> <li>Low-load, long-duration<br/>flexion stretch</li> <li>Short-arc knee<br/>extension</li> <li>SLRs</li> <li>Side-lving hip abduction</li> </ul> | <ul> <li>Gait training:<br/>mod I with SW</li> <li>Progression to<br/>partial weight-<br/>bearing</li> </ul> | Education on<br>HEP and portal<br>site hygiene |

|             | Month |   | Exercises                   |   | Ambulation          |   | ADLs            |
|-------------|-------|---|-----------------------------|---|---------------------|---|-----------------|
| IT          |       | • | Prone hamstring curls       | • | Progression to full | • | Education on    |
|             | 1-5   | • | Long-arc knee extension     |   | weight bearing      |   | shower safety   |
|             |       | • | NMES assisted SLRs          |   | with SW             | • | HEP progression |
|             |       | • | NMES assisted DF            | • | Gradual increase    |   |                 |
|             |       | • | Half-moon on recumbent bike |   | in ambulation       |   |                 |
| 1           |       | • | Calf stretch with incline   |   | distance            |   |                 |
| the reser   |       | • | Mini-squats                 | • | SW replaced with    |   |                 |
| o M rio     |       | • | Tibiofemoral joint          |   | quad cane           |   |                 |
| societio    |       |   | mobilizations               | • | Quad Cane           |   |                 |
| COD V M     |       | • | Heel raises                 |   | discontinued        |   |                 |
| citical III |       | • | Forward lunges              | • | HKB unlocked        |   |                 |
| doan Br     |       | • | Off-loaded squats           | • | HKB discontinued    |   |                 |
| 019 Arm     |       |   | -bilateral                  | • | Step-ups on stairs  |   |                 |
| a           |       |   | -single leg affected        |   |                     |   |                 |
|             |       |   |                             |   |                     |   |                 |

| Month | Exercises  | Ambulation                                    | ADLs   |
|-------|--|---|--|
| 5-D/C | Single -leg perturbations<br>on roller board:<br>-Sagittal plane<br>-Frontal plane<br>-Transverse plane<br>Bridge with hip<br>abduction and<br>resistance band | Stair<br>management<br>-4 inches<br>-6 inches | <ul> <li>Patient starts<br/>school</li> <li>Transportation<br/>service ends</li> <li>Pt begins driving</li> <li>Pt graduates and<br/>seeks work</li> </ul> |

#### Outcomes

- Knee ROM: 4/0 EXT; 120 FLEX
- Quad = 3-/5
- Ankle DF = 5/5
- Able to ambulate without knee brace, AFO, AD, or A; could manage stairs I.
- LEFS = 43/80
- Negative anterior drawer, Lachman, valgus and varus at 0 and 30 degrees.
- · Patient started technical school and started driving.

#### Conclusions

- It's important to note this patient did not participate in high-impact activities. - Skendzel, et al.note that non-operative management
- was appropriate for patients without high demands.<sup>7</sup>
  Post-operative use of hinged external fixation has been shown to improve joint stability,<sup>10</sup> and to allow ROM progression while protecting healing soft tissue structures.<sup>11</sup>
- Despite surgical intervention being preferred currently, hinged fixation with conservative management with PT and MD cooperation can lead to good functional outcomes.

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#### POST-SURGICAL MANAGEMENT: PRE-ADOLESCENT PATIENT WITH SALTER-HARRIS FRACTURE WITH ANTERIOR CRUCIATE LIGAMENT AVULSION

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#### Background

- 12 year old
- Motor vehicle vs pedestrian 10/27/17
- LOC at scene
- PMHx:
  - Asthma

## Background

#### Diagnoses:

- CT Scan: intraventricular hemorrhage of left posterior horn, no other acute abnormality on c-spine, chest, abdomen, pelvis X Ray/CT scan; Salter Harris III fracture of distal femur with intercondylar split, 3 mm displacement; Left Closed Supracondylar Femur fracture with Intracondylar Extension
- MRI: Left ACL Avulsion Rupture off the Femur

#### **Salter-Harris Classification**

- Type I
  - Separation of the epiphysis from metaphysis
- Type II
  - Fracture separation of physis through metaphysis
- Type III
  - Fracture in plane of physis and epiphysis

#### Salter-Harris Classification (cont'd)

- Type IV
  - Fracture through epiphysis and metaphysis
  - Risk of premature closing of growth plate
- Type V
  - Crushing of epiphyseal plate
  - Risk of premature closing of growth plate

#### **Surgical Fixation**

- Percutaneous cannulated screw fixation of Salter-Harris III distal femur fracture
- Fixation of avulsion fracture of femoral attachment of ACL
- Split noted starting from patellofemoral joint and the physis down to the articular surface.
- Noted articular step-off

#### **Existing Evidence**

- Distal femur fastest growing epiphysis 1,2,7,10 - SH III fractures: 49 %
- Growth disturbance: 63% • High impact injury 1,5,7,9
- Associated with valgus force at knee
- Plain radiographs not effective in determining severity<sup>10-12</sup>
- CT, MRI indicated • Fixation recommended 4,9-12, 14
- Complications associated with fracture 1-14

| Rehabilitation    | SH III Fracture   | ACL Avulsion Fracture   |
|-------------------|---|---|
| Weight<br>bearing | <ul> <li>NWB post-operatively <sup>2,7,11</sup></li> <li>WB c HKB 8 weeks <sup>4</sup></li> <li>HKB c TTWB <sup>5</sup></li> <li>NWB 2 weeks → TTWB <sup>9</sup></li> </ul> | Knee immobilizer 4-6 weeks     Advanced to HKB c WBAT     Progression of FWB following     quadriceps muscle control     achieved               |
| Interventions     | ROM (0-90 deg)     Quadriceps/hamstring     strengthening     Patellofemoral joint     mobilizations     Modalities     Closed chain exercises     Proprioception exercises | Knee ROM     Isometric quadriceps activation     Aquatic therapy     Patellofemoral joint mobilization     Cycling     Proprioception exercises |

|  | Rehabilitation                          | SH III Fracture   | ACL Avulsion Fracture   |
|--|---|---|---|
| rapy Association. All rights reserved. | Return to<br>Recreational<br>Activities | <ul> <li>Jogging at 2 months <sup>11</sup></li> <li>6 -8 months <sup>5,7,9</sup></li> </ul> | <ul> <li>Full ROM isokinetic<br/>strengthening</li> <li>Sport-specific training (4-6<br/>months)</li> <li>Decrease risk of re-injury</li> </ul> |
| 0 2019 Arrentican Physical The         |   |   |   |

#### **Initial Presentation**

- Lower Extremity Functional Scale
   13/80
- Patient Specific Functional Scale
  - Play football with friends 0/10
  - Play basketball with friends 0/10
  - Ride his bike 0/10
  - Return to school 0/10

### **Initial Presentation (Cont'd)**

- Knee ROM
  - Flexion: 50/63 deg (AROM/PROM)
  - Extension: -2 deg AROM

#### Strength

- Quad: 2-/5
- Hips 3-/5



| INTERVENTIONS |   | Month: 2-3   |       | Month: 3-5   |   | Month: 6-12                                 |
|---------------|---|--|-------|--|---|---|
|               | • | Progressed<br>based on bone<br>and soft tissue<br>healing<br>principles<br>Patellar<br>mobilizations | • • • | mobilizations<br>mobilizations<br>Prone hangs<br>Heel slides<br>Quadriceps flexibility<br>Gastrocnemius<br>flexibility | • | flexibility<br>Gastrocnemius<br>flexibility |

| INTERVENTIONS     | Plar<br>Month: 2-3  | n of Care<br>Month: 3-5  | Month: 6-12  |
|-------------------|---|--|--|
|                   | Quad sets     NMES     Hip abduction     Hip extension     Hip ER | <ul> <li>SLR without lag</li> <li>Begin CKC exercises</li> <li>Feedback</li> <li>Squat</li> <li>Step up</li> <li>Single leg balance</li> </ul> | Squats     Multi-plane     lunges     Hip     strengthening in     multiple planes     Balance     unstable surface     with distraction |
| All washing of 20 |   |  |  |



| Plan of Care             |  |   |  |  |  |  |
|--------------------------|--|---|--|--|--|--|
| INTERVENTIONS            | Month: 2-3   | Month: 3-5                              | Month: 6-12  |  |  |  |
| ADL'S/<br>PARTICIPA-TION | <ul> <li>Decrease fall<br/>risk</li> <li>Frequent<br/>transfers out<br/>of WC</li> <li>Education on<br/>use of AD</li> </ul> | Stair navigation     Education for WBAT | Pt returned to<br>school     Stair navigation     Age-appropriate<br>activities     Bike     Football     Jogging –<br>aquatic |  |  |  |
| 0.2019 Алек              |  |   |  |  |  |  |

#### Outcomes – 7 months post-op

- Riding bike, playing frisbee, football, and basketball with • friends
- LEFS: 70/80
- PSFS:
  - Playing football with friends 10/10
  - Playing basketball with friends 10/10
  - Riding bike 9/10
  - Return to school 10/10

#### **Outcomes Cont'd**

- Knee ROM: 0 → 135 degrees B
- Hip strength: 4+/5
- Knee extension: 5/5
  - Functional quadriceps strength with forward step down
- · Y balance test:
  - Deficits >4cm in involved LE

#### Conclusions

Barriers - Age, compliance

•

- Physeal closing occurs between 16-18 years old in males 1
- Potential for future complications
- Initial immobilization did not have detrimental effects to **ROM** 13
- Personal and environmental factors the most limiting aspect of rehabilitation

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#### **Complex Decision Making in a Complex Trauma Case**

Erin McCallister, PT, DPT Board-Certified Clinical Specialist in Orthopaedic Physical Therapy Instructor of Physical Therapy LSU Health-Shreveport

#### Background

- 33 yo female was in an ATV accident 2/14/16
- Admit: gross deformity of b/I LE's
  - no palpable or Dopplerable pulses LLE
  - large open wound L popliteal area
  - motor and sensory intact RLE

#### Surgical Interventions: LLE

- LLE: Open midshaft femoral fracture
- Femoral artery and semitendinosus laceration
- Trauma to tibial nerve
- Immediate: ex-fix with wound exploration, saphenous vein harvest for repair of femoral artery

#### Surgical Interventions: LLE

#### LLE: Open midshaft

#### femoral fracture

- 2.22.16: retrograde IMN with wound I&D, vac placement
- Skin graft to popliteal area

## Surgical Interventions: RLE

- RLE: Closed
- comminuted
- segmental femoral
- shaft fracture
- Initial treatment: external fixation stabilization
- 2/17/16: retrograde IMN fixation

## Initial Presentation

- August 2016: transferred care from outgoing therapist
- Chief complaint:
  - pain in L and R knees
  - no active motion at L ankle except PF + Inversion
  - giving away and swelling at L>R knee
- · Goals: walk without AD and work full-time

#### **Initial Presentation**

- Range of Motion
- Hip and knee
- Strength
- Proximal limitations
- Lower Extremity Functional Scale
  - 30/80 (37.5%)

| 5.5 months post-<br>injury | MMT (L) * | MMT (R) |
|----------------------------|-----------|---------|
| Hip Extension              | 3+/5      | 4/5     |
| Hip Abduction              | 3-/5      | 4/5     |
| Hip Flexion                | 4-/5      | 4+/5    |
| Knee Flexion               | 3+/5      | 4+/5    |
| Knee Extension             | 4/5       | 4+/5    |

## **Initial Presentation**

- Patient Specific Functional Scale
  - Walk with 1 crutch: 1/10
  - Stand >30 minutes: 1/10
  - Squat: 1/10
  - Wash client's hair: 1/10

#### 6 Minute Walk Test

 373 feet c bilateral axillary crutches and AFO



## **Existing Evidence**

#### Bony Healing: Rehab after IMN

- Cannada, et al. 20081
  - Retrograde IMN acceptable fixation for bilateral femur fracture
  - Patients with this injury have high mortality rate
- Paterno and Archdeacon, 2009<sup>2</sup>
  - Further progressions limited by neural injury

#### Intervention

- BSF: bone (months 6-10)
  - Wolff's Law
    - Progress weightbearing?
  - May
  - September
  - Considerations
    - Bone mass adjustment vs. strain<sup>3,4</sup>
  - Orthopaedic consult





#### Intervention

- Dosing of soft tissue tension for ROM and mobility
  Strengthening + cardiovascular conditioning for
- functional goals
- Transition to WB strengthening and proprioception
   Advance proprioception and remove AD support

   Patient specific
- Discharge goals set based on patient activity/participation limitations

## BSF limitations

- Pain: 5/10 worst, 1/10 average
- Activity limitations
- 6-min walk: 545' no AD
- Participation limitations
- LEFS: 45%
  - PSFS: 8/10 average

| Outcomes |                       |                     |         |  |  |  |  |
|----------|-----------------------|---------------------|---------|--|--|--|--|
| /10      | 10 months post-injury | MMT (L) *           | MMT (R) |  |  |  |  |
|          | Hip Extension         | 3+→ 4-/5            | 4→ 5/5  |  |  |  |  |
|          | Hip Abduction         | 3-→ 4/5             | 4→ 5/5  |  |  |  |  |
|          | Hip Flexion           | 4-→ 4+/5            | 4+/5    |  |  |  |  |
| 15       | Knee Flexion          | $3+\rightarrow 4/5$ | 4+→ 5/5 |  |  |  |  |
|          | Knee Extension        | 4/5                 | 4+→ 5/5 |  |  |  |  |
| 20       |                       |                     |         |  |  |  |  |

#### Conclusions

- Address and respect soft tissue healing and maturation
- Utilize the patient's goals to guide your interventions
- Use your orthopaedic team to help manage the whole patient

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#### What to Expect When You See "Polytrauma" on the Referral

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#### M.M.

- 59 year old female involved in a MVC on 1/16/2014
- Reason for Referral: s/p polytrauma; Please start weightbearing 50-75% left lower extremity to as tolerated gait training. Also work on left shoulder ROM and capsular stretching, and elbow extension
- · Patient's goals
- Initial Evaluation: 8/15/14
- · 62 visits, 28 cancellations

## **Orthopaedic Injuries**

#### **Upper Extremity**

- · Left closed proximal humerus fracture
- Left open capitellar and • olecranon fracture and supraintracondylar humerus
- - fracture
- Left closed distal radius fracture
- Lower Extremity
- Left open distal tibia / fibular fracture
- Left open distal femur

## **Other Complicating Factors**

· Commute to PT

LOSS

#### Significant Past Medical History Psychosocial Factors

- Hypertension
- Peripheral artery disease
- Resultant neuropathy
- Former smoker •
- Atrial fibrillation
- Subarachnoid hemorrhage •

## **Initial Presentation**

Elbow AROM

- DASH: 60
  - Shoulder AROM - Flexion: 108
  - Flexion: 110 - Extension: 38
  - Abduction: 90 Supination: 5
  - External
    - Rotation: 10
  - Internal
  - Rotation: 78

Left Knee AROM

• LEFS: 9

- Extension: 15
- Flexion: 35
- · Leg Length
  - Right: 90.5 cm
  - Left: 86.5 cm

## Initial Presentation

- In wheelchair
- · Moderate Assistance for sit to stand
- · Unable to complete stand pivot transfer
- · CGA for sliding board transfers
- · Small wound at distal lateral thigh

## **Existing Evidence**

- Evidence for IMN of a femur fracture(Brumback et al., 1999; Larsen, et al. 2015)
  - Early WB indicated after stabilization with IMN in comminuted femur fractures
  - Decreased muscle strength
  - Decreased long term functional outcomes
- What is the evidence for physical therapy after removal . of an IMN after infection?



## What Did Treatment Look Like?

- Sit to stand and acceptance of WB
- Progression of WB to full
  Modification of shoe for LLE
- Modification of shoe for L LEJoint mobilization for L
- shoulder, L elbow, L knee
- LLLD for elbow extension, knee extension
- Ambulation around trackTotal Gym for increased
- flexion stretch and
- strengtheningAquatics once sh
- Aquatics once she had wound closure
- Stair climbing

#### **Progress at Discharge** Internal Rotation: Left Knee AROM DASH: 60 →21 $78 \rightarrow 78$ Shoulder AROM • Extension: $15 \rightarrow 0$ Elbow AROM Flexion: 110 $\rightarrow$ • Flexion: $35 \rightarrow 50$ 130 Flexion: 108 → Leg Length Abduction: 90 $\rightarrow$ 114 • Right: 90.5 cm 110 Extension: 38 → • Left: 86.5 cm External Rotation: 20 $10 \rightarrow 30$ • Supination: $5 \rightarrow 5$ LEFS: $9 \rightarrow 35$

#### **Discharge Status**

- Driving
- Ambulation
- Stairs
- Transfers

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