

Mechanism-based Classification of Pain and Clinical Implications

Mini-course for T32 Musculoskeletal Disorders Training Grant

Nancy Bloom, PT, DPT, MSOT

Professor of Physical Therapy and Orthopaedic Surgery
Washington University



Washington University in St. Louis

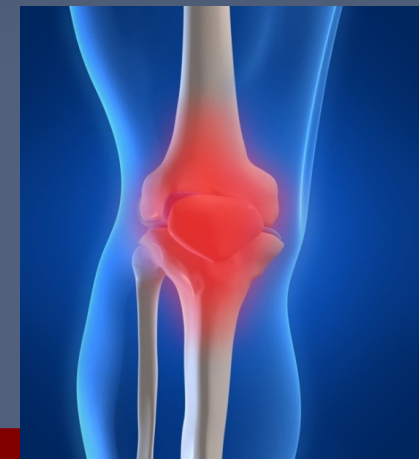
SCHOOL OF MEDICINE

Helpful Readings

- Article by Smart KM et al, 2010:
 - *Clinical indicators of nociceptive, peripheral neuropathic, and central mechanisms of musculoskeletal pain. A Delphi survey of expert clinicians.*
- International Assoc. for Study of Pain (IASP)
 - <http://www.iasp-pain.org/Taxonomy?navItemNumber=576>
- Resources for intervention:
 - Why do I Hurt? By Adriaan Louw
 - Painful Yarns by G. Lorimer.Moseley
 - Explain Pain by David Butler and Lorimer Moseley

A Little Background...

- I am speaking to you as a physical therapist
- The human movement system is the body system for which physical therapists are responsible.
- My expertise is in the examination, diagnosis and treatment of conditions affecting the neuromusculoskeletal system.
- Pain is the most common complaint



Is There an Ideal Way to Move or Is Any Pattern Acceptable?

Impaired shoulder motion



Corrected shoulder motion



Lumbar Extension Pattern with Return from Forward Bending



Role as Movement System Experts

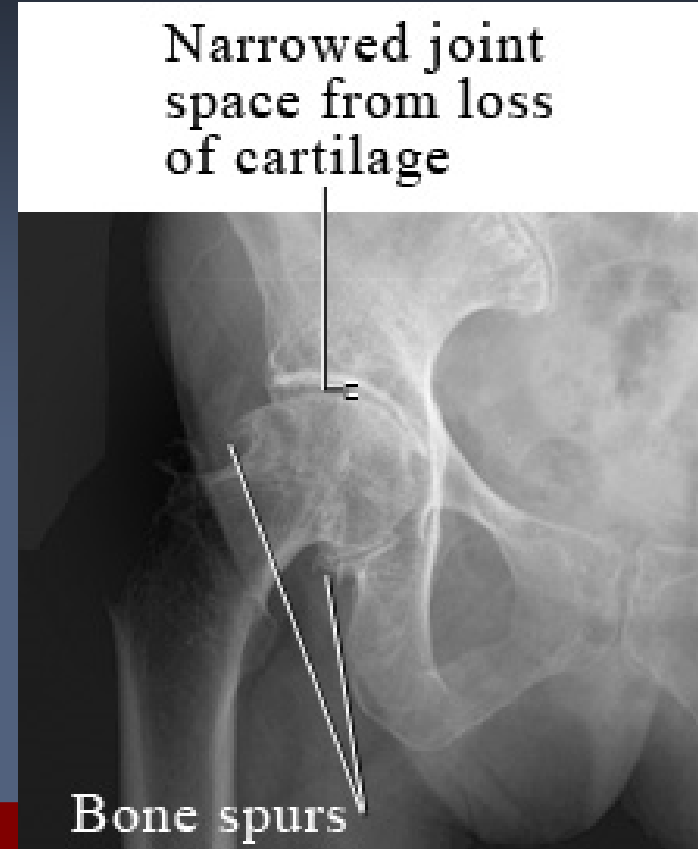
- Collaborate with physicians to identify the region causing pain: sorting diagnostic dilemmas
 - An 84 year old male with knee pain
 - Pain in knee: from back, hip, or knee?
 - Knee replacement without resolution of knee pain
 - Subsequently knee pain associated with lumbar extension
 - Need to match the radiological images with how a person moves within and across body regions – Do the radiological findings match the clinical presentation?
- Collaborate with other exercise providers to direct specificity of programs

A Challenge: Keeping the Acute Problem From Becoming Chronic

- Acute symptoms often subside with
 - time
 - a variety of interventions addressing symptoms
- Recurrence is common
 - Patho-anatomic structures considered the cause
 - The impaired movement not considered as cause
 - Therefore has not been identified & addressed.
- To minimize recurrence –
 - identify the movement cause of pain & contributing factors

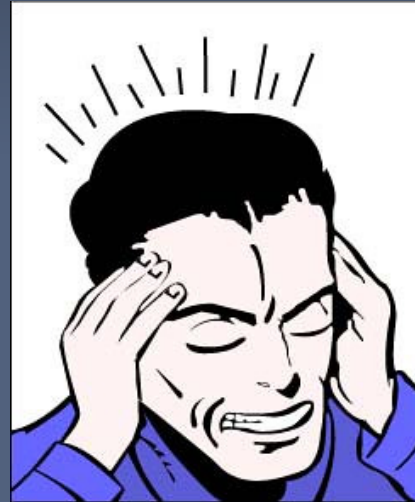
LET'S RETURN TO "PAIN"

Cartesian Model :
An unpleasant sensory
experience associated with
tissue damage



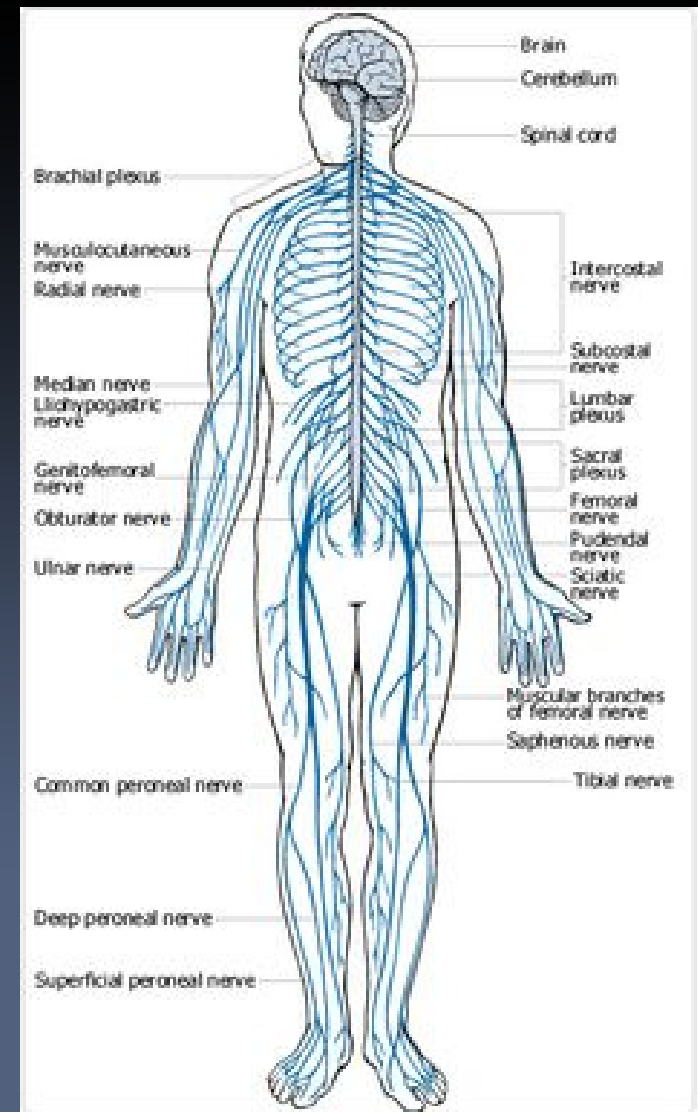
Current Definition of Pain (IASP)

- An unpleasant sensory and **emotional** experience associated with actual or **potential tissue damage**, or described in terms of such damage.



Pain (IASP)

- Pain is always subjective
- Involves both ascending and descending pathways of the nervous system



Types of pain

- Traditional:
 - Mechanical vs. Non-mechanical
 - Acute vs. Chronic (persists beyond normal healing time of tissues)
- More recent:
 - Mechanisms-based classification: classify pain according to the underlying neurophysiological mechanisms for the generation or maintenance of pain

Categories of Pain and Definitions

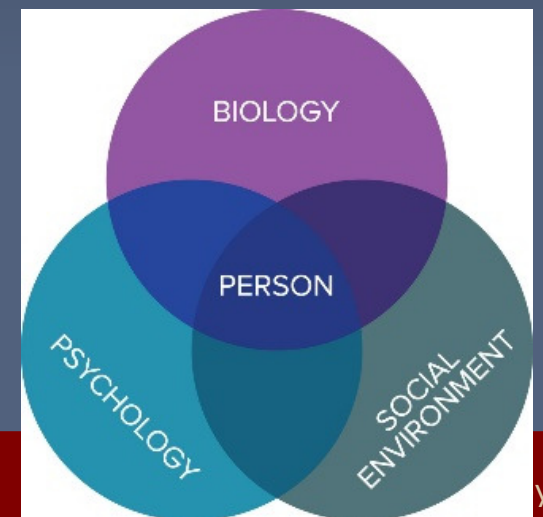


Washington University in St. Louis

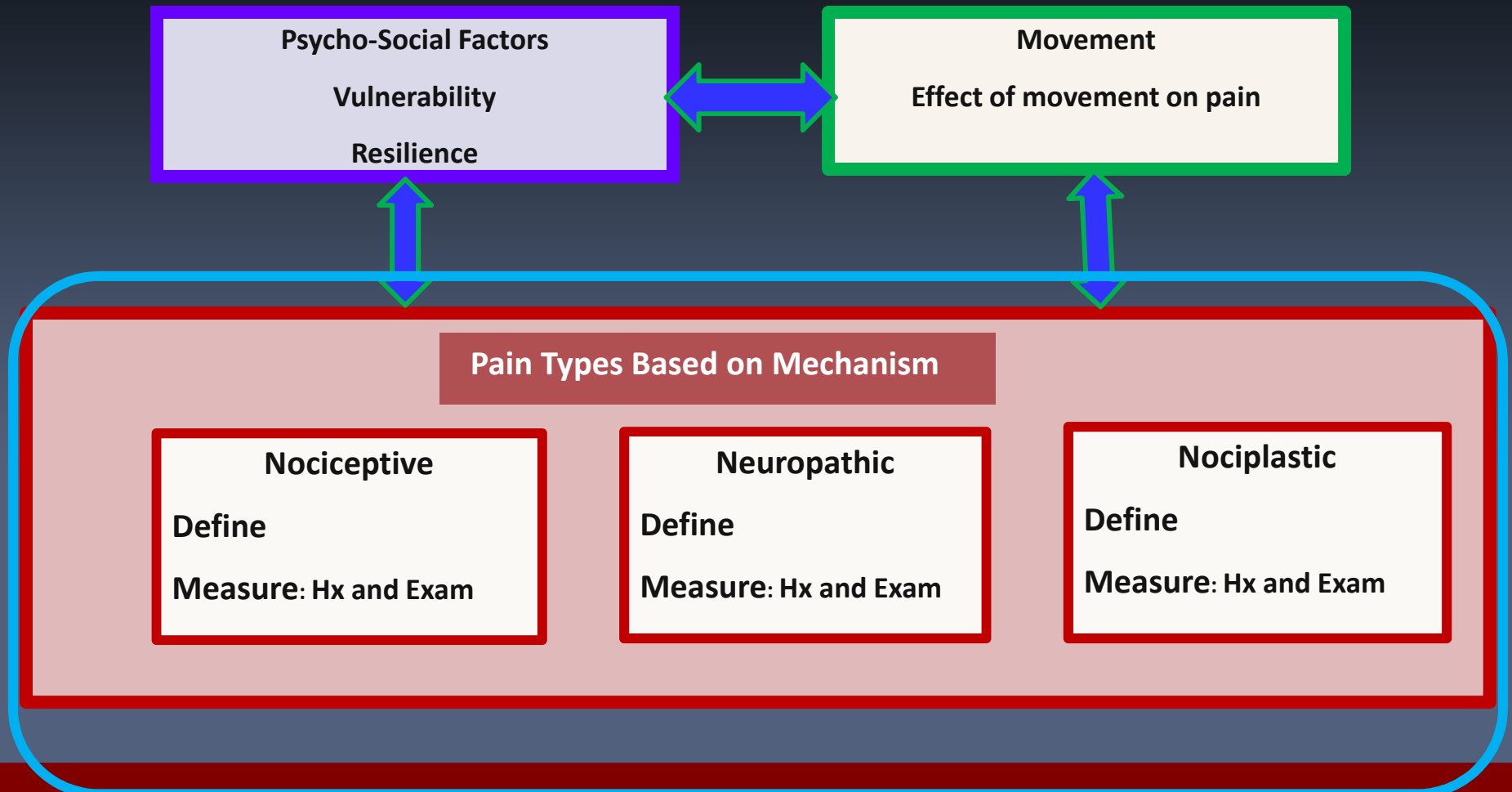
SCHOOL OF MEDICINE

Mechanism-Based Classification

- **Nociceptive** pain (more like traditional def)
 - **Neuropathic** pain
 - **Nociplastic** pain
-
- Importance of understanding the complex biological and psycho-social nature of pain



Model to Consider



Nociceptive Pain (IASP)

- Pain that arises from actual or threatened damage to non-neural tissue and is due to the activation of nociceptors
 - *Chemical (inflammatory), mechanical, or thermal*
 - *Normal function of somatosensory system*



Clinical Indicators of **Nociceptive Pain**

(Smart, 2010)

Table 2: Subjective

- Clear, proportionate mechanical/anatomical nature to aggravating and easing factors
- Pain associated with and in proportion to trauma or a pathological process (inflammatory nociceptive) or movement/postural dysfunction (ischemic nociceptive).

Clinical Indicators of **Nociceptive Pain**

(Smart, 2010)

Table 3: Clinical **Examination**

- Clear, consistent and proportionate mechanical/anatomical pattern of pain reproduction on movement/mechanical testing of target tissues
- Localized pain on palpation.

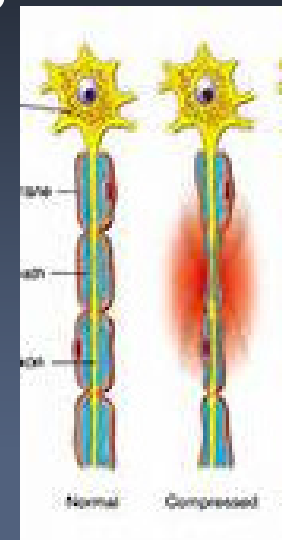
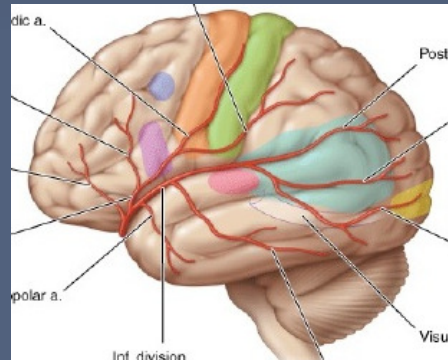
Examples of shoulder pain or LBP from videos

NOTE:

- The **Verbal Numeric Rating Scale (VNRS)** or the **Visual Analog Scale (VAS)** or a **Pain Diagram** are good patient reported outcome measures for pain but are not specific to one type of pain. The patient response is what helps you categorize the pain mechanism

Neuropathic Pain (IASP)

- Pain caused by a lesion or disease of the somatosensory nervous system
 - Peripheral (primary lesion is in PNS)
 - *Carpal tunnel (median n)*
 - Central (distinct lesion or ds in CNS)
 - *CVA or SCI*



Clinical Indicators of **Peripheral Neuropathic Pain** (*Smart, 2010*)

Table 4: **Subjective**

- Pain variously described as burning, shooting, sharp, aching or electric-shock-like.
- History of nerve injury, pathology or mechanical compromise. Pain in association with other neurological symptoms (e.g. pins and needles, numbness, weakness).
- Pain referred in a dermatomal or cutaneous distribution.

Clinical Indicators of **Peripheral Neuropathic Pain** (*Smart, 2010*)

Table 5: Clinical **Examination**

- Pain/symptom provocation with mechanical/movement tests (e.g. Active/Passive, Neurodynamic, i.e. SLR, Brachial plexus tension test, Tinel's) that move/load/compress neural tissue.
- Pain/symptom provocation on palpation of relevant neural tissues. Positive neurological findings (including altered reflexes, sensation and muscle power in a dermatomal/myotomal or cutaneous nerve distribution).

Measure of Neuropathic Pain

Pain Detect

https://www.pain-detect.de/fileadmin/pain-detect.de/media/painDETECT_Q_English.pdf

painDETECT
PAIN QUESTIONNAIRE

Date: _____ Patient: Last name: _____ First name: _____

How would you assess your pain **now**, at this moment?

0	1	2	3	4	5	6	7	8	9	10	
none											max.


How strong was the **strongest** pain during the past 4 weeks?

0	1	2	3	4	5	6	7	8	9	10	
none											max.

How strong was the pain during the past 4 weeks **on average**?





0	1	2	3	4	5	6	7	8	9	10	
none											max.

Please mark your main area of pain



Does your pain radiate to other regions of your body?
 yes no
 If yes, please draw the direction in which the pain radiates.

Mark the picture that best describes the course of your pain:

	Persistent pain with slight fluctuations	<input type="checkbox"/>
	Persistent pain with pain attacks	<input type="checkbox"/>
	Pain attacks without pain between them	<input type="checkbox"/>
	Pain attacks with pain between them	<input type="checkbox"/>

Do you suffer from a burning sensation (e.g., stinging nettles) in the marked areas?

never hardly noticed slightly moderately strongly very strongly

Do you have a tingling or prickling sensation in the area of your pain (like crawling ants or electrical tingling)?

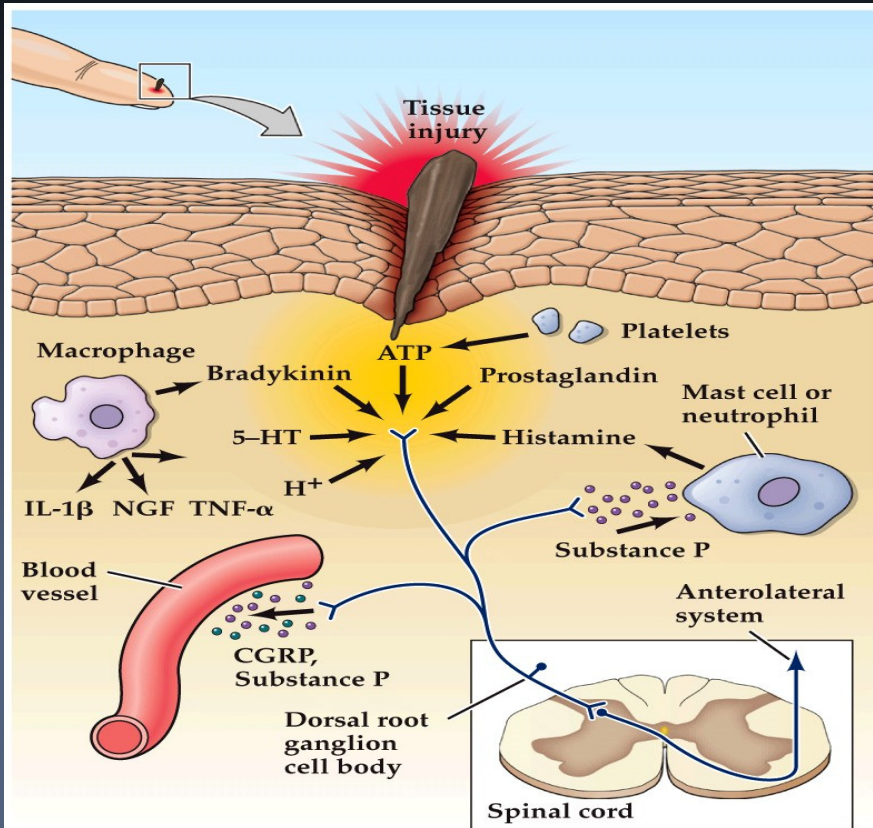
Nociplastic Pain (IASP)

- Pain that arises from altered nociception despite *no clear evidence of actual or threatened tissue damage* causing the activation of peripheral nociceptors or evidence for disease or lesion of the somatosensory system causing the pain.

Sensitization (IASP)

- Increased responsiveness of nociceptive neurons to their normal input and/or recruitment of a response to normally subthreshold inputs
 - Central (in the CNS)
 - Peripheral (receptive fields of peripheral nn)

Peripheral Sensitization



NEUROSCIENCE 5e, Figure 10.7
© 2012 Sinauer Associates, Inc.

Products of tissue damage potentiate nociceptor response

- Extracellular protons
- Arachidonic acid
- Bradykinin
- Histamine
- Serotonin
- Prostaglandins
- Nucleotides
- Nerve growth factor (NGF)

Nociceptors add to inflammatory response:

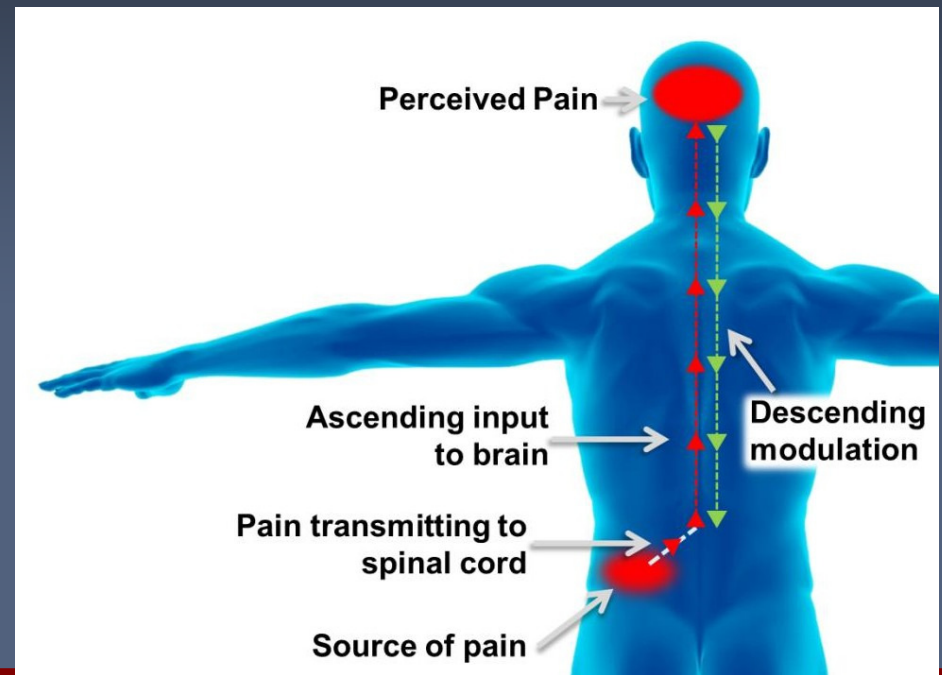
- Substance P
- Calcitonin gene-related peptide (GRP)
- ATP

Central Sensitization

Increased responsiveness of nociceptive neurons **in the CNS** to their normal or subthreshold afferent input (IASP)

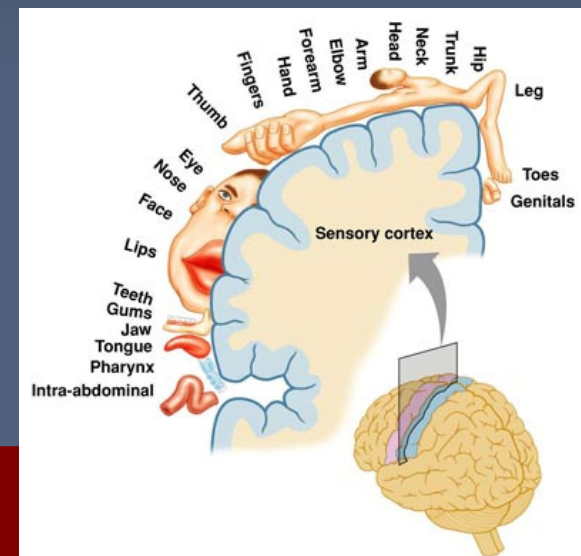
Increased excitability

Decreased inhibition



Central Sensitization

- Response *magnitude* to noxious stimuli *increases*
- Response *threshold* to noxious stimuli *decreases*
- Enhanced response to *non-noxious stimuli*
- Spontaneous activity increases
- Receptive field increases



Clinical Indicators of Central Pain

(Smart, 2010)

Table 6: Central Pain **Subjective**

- Disproportionate, non-mechanical, unpredictable pattern of pain provocation in response to multiple/non-specific aggravating/easing factors.
- Pain persisting beyond expected tissue healing/pathology recovery times.
- Pain disproportionate to the nature and extent of injury or pathology.
- Widespread, non-anatomical distribution of pain.

Clinical Indicators of **Central Pain**

(Smart, 2010)

Table 7: Clinical **Examination**

- Disproportionate, inconsistent, non-mechanical/non-anatomical pattern of pain provocation in response to movement/mechanical testing.
- Diffuse/non-anatomic areas of pain/tenderness on palpation
- Positive findings of hyperalgesia (primary, secondary) and/or allodynia

Clinical Indicators of **Central Pain**

(Smart, 2010)

- Hyperalgesia
 - Increased pain from a stimulus that normally provokes pain
- Allodynia
 - Pain due to a stimulus that does not normally produce pain

Other Measures When You Suspect Nociceptive Pain

- Pressure Pain Threshold (PPT)
 - Use algometer in area of tissue damage and other areas.
- Conditioned Pain Modulation (cold)
- 2 point discrimination
- Laterality (phone app OrientateFree)



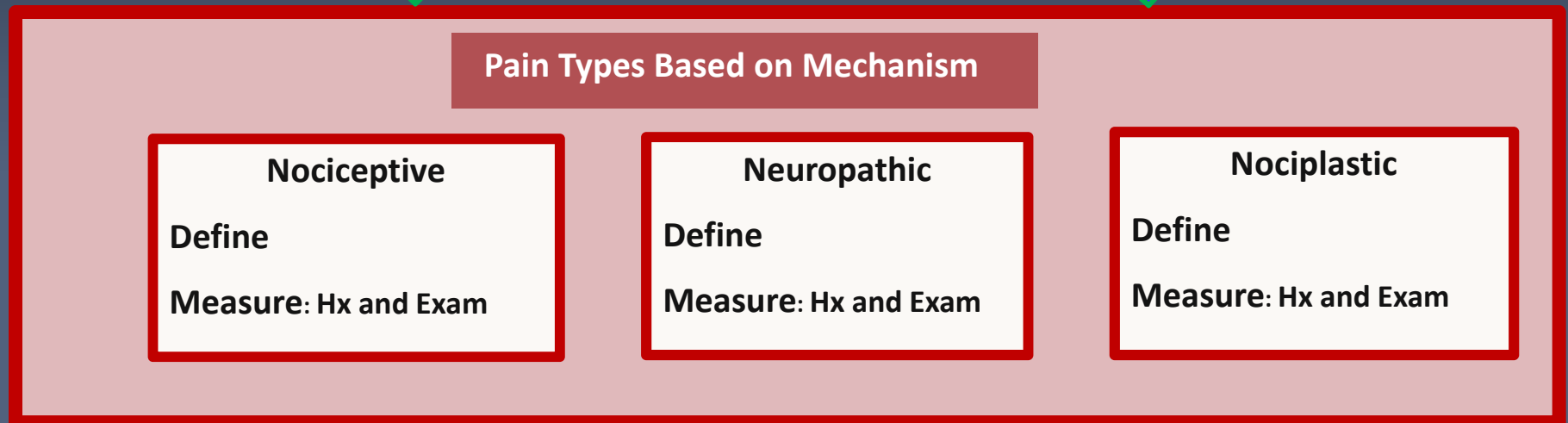
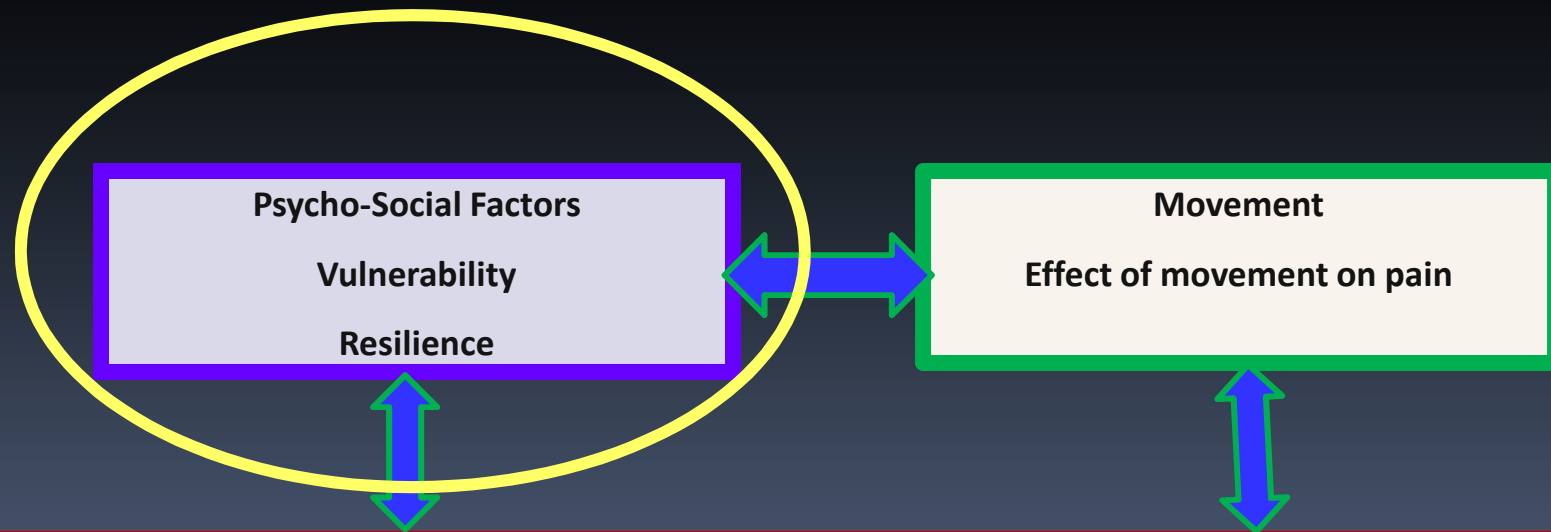
Individuals with Central Sensitization (Magnified Illness Behavior)

- The pain is real and you are treating people, not just joints
- Shouldn't lead to moral judgment or rejection
- Utilize motivational interviewing

Individuals with Central Sensitization (Magnified Illness Behavior)

- Treatment must include education on neuroscience of pain
- Include team of professionals (counseling and pain management)
- Keep program simple – graded activity exposure

Model to Consider



Pain Associated Psychological Distress

- Vulnerability
- Resilience

Lentz T, et al; *JOSPT*, May 2016

Psycho-Social Factors

Vulnerability:

Negative Mood:

Anxiety: 2 questions on Problem Centered History

Depression: 2 questions on Problem Centered History

Fear Avoidance:

FABQ (Fear Avoidance Belief Questionnaire)

TSK – 11 (Tampa Scale of Kinesiophobia)

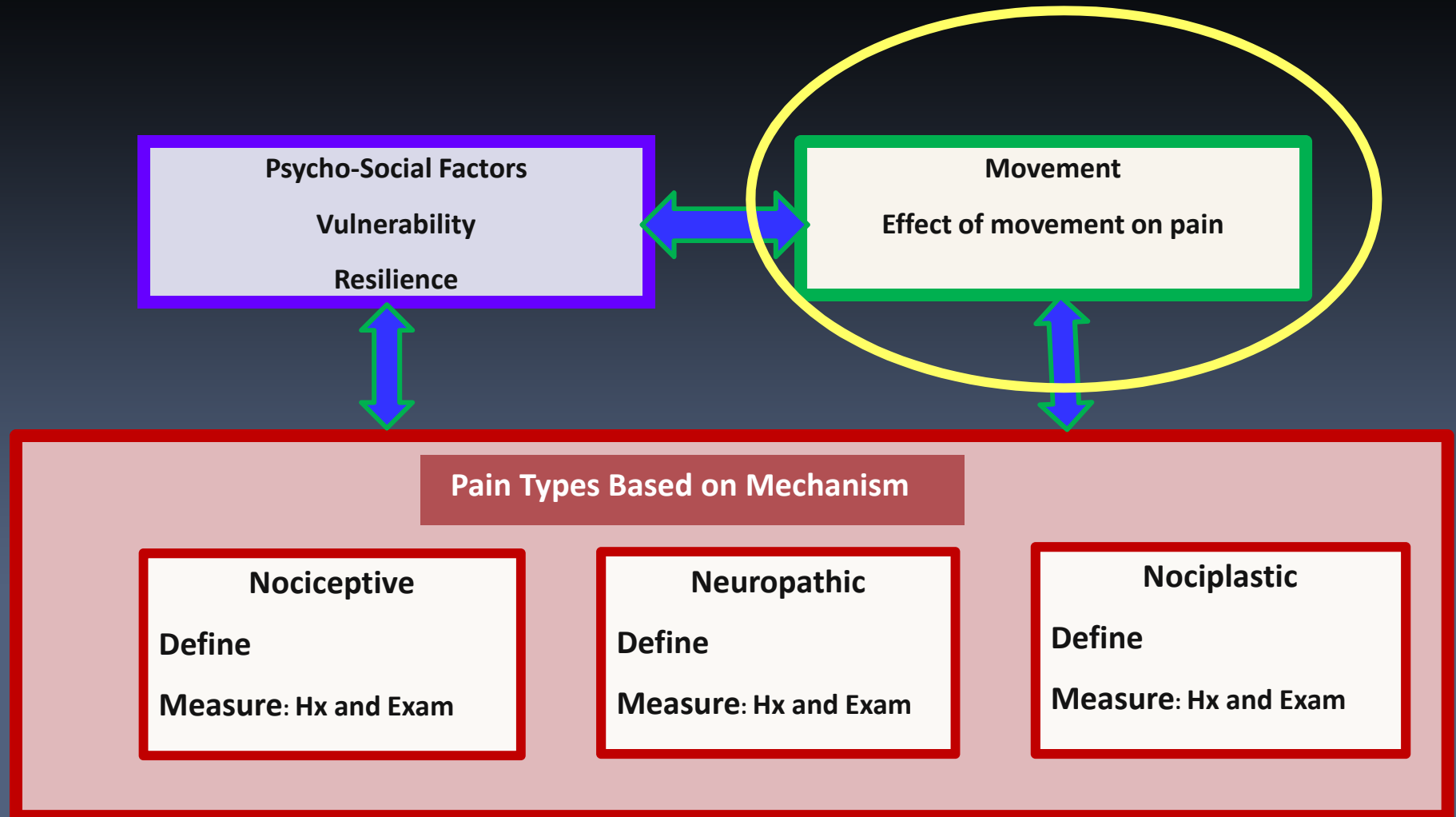
PCS (Pain Catastrophizing Scale)

Resilience:

Self-Efficacy

Pain Self Efficacy Questionnaire

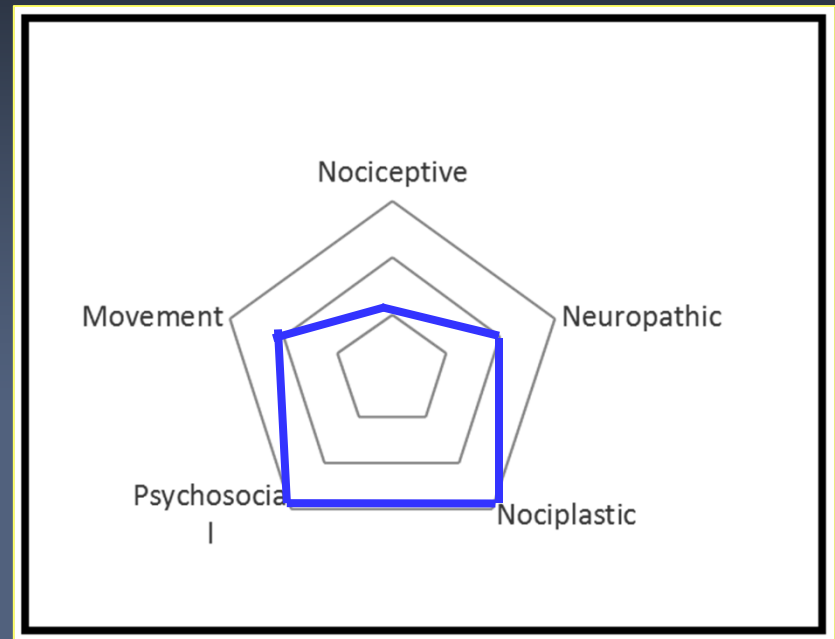
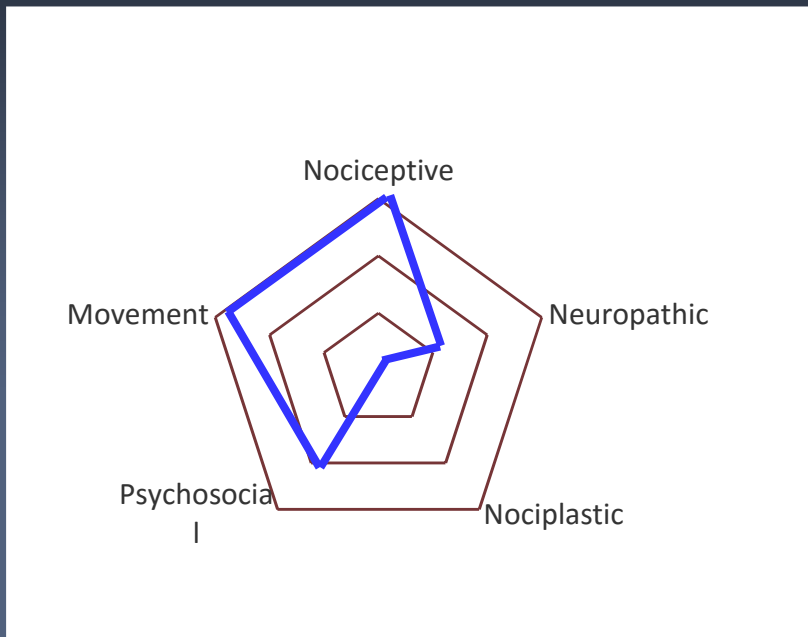
Model to Consider



Movement (includes alignment)

- Determine the effect of movement on pain
- Rank the results from high to low
 - High - predictable/very modifiable
 - Medium - partially
 - Low – pain not modifiable by movement

Radar Plot: Mapping Clinical Presentation



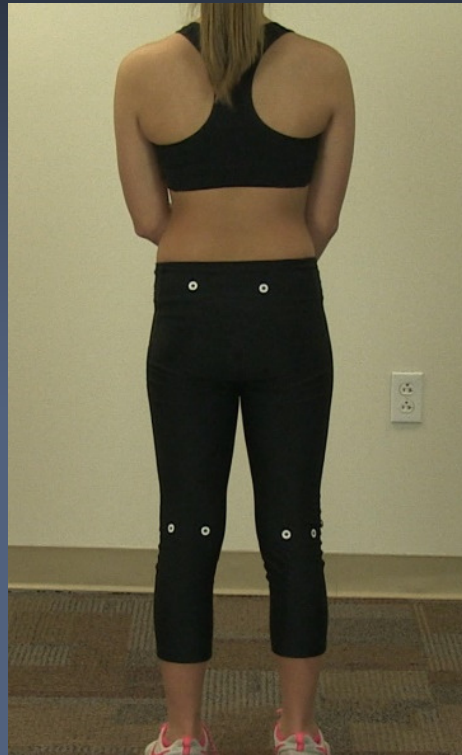
Introduction: Treatment

- Pain is a critical protective device
- Pain does not provide an accurate MEASURE of the state of the tissues
- Pain is a conscious process that combines actual tissue damage with your PAST, PRESENT, and FUTURE experiences

Introduction: Treatment

- Pain is a complex process that can be outside your awareness and control
- Pain hurts where your brain “THINKS” the problem is, not necessarily where the problem really is
- Nociception is neither sufficient or necessary for pain
- Neural networks that produce pain become more sensitive when pain persists

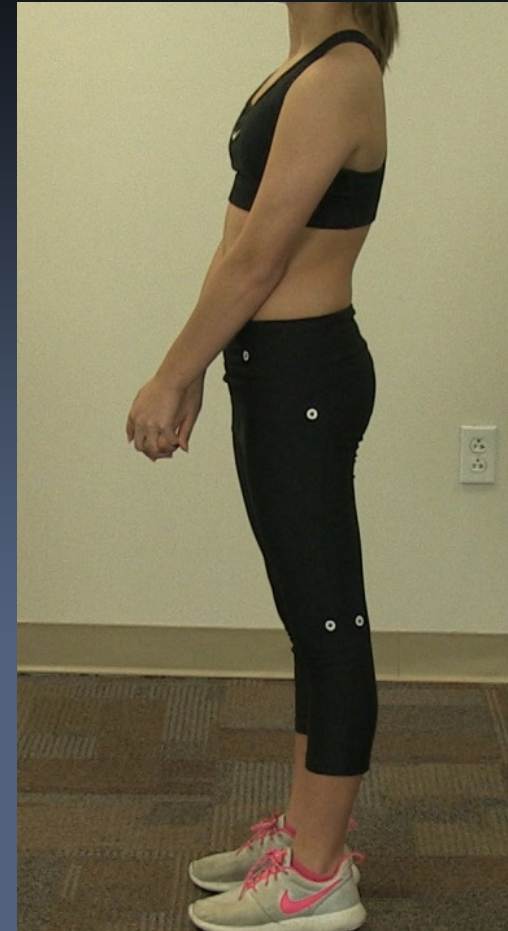
Case Example: Pediatric Hip Pain



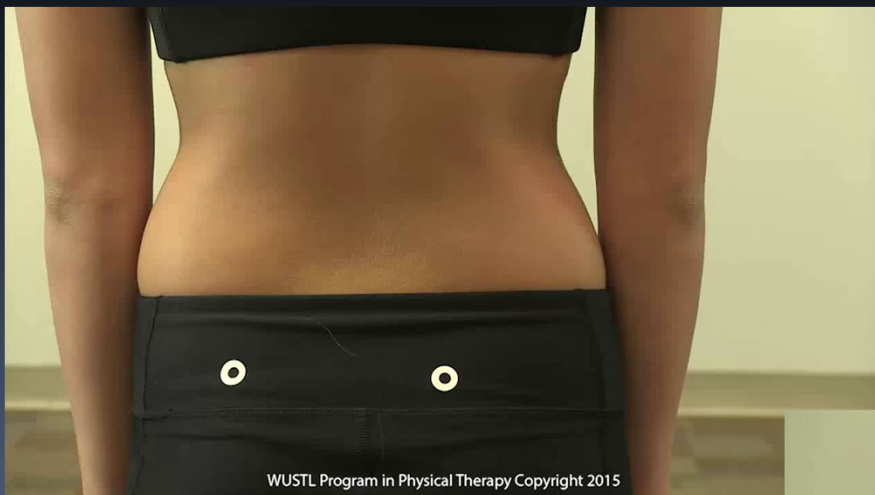
- 12 y/o female
- Pain: 5-9/10 (B) deep, anterior hips
- Present for last several months
- Got better with PT elsewhere but then she fell out of bed and the pain severely worsened
- C/O popping, clicking and snapping

Case #1: Pediatric Hip Pain

- Activities: gymnastics (level 5) and volleyball, wants to run
- Significant psychosocial history: Father died earlier this year after a year of terminal cancer treated at home



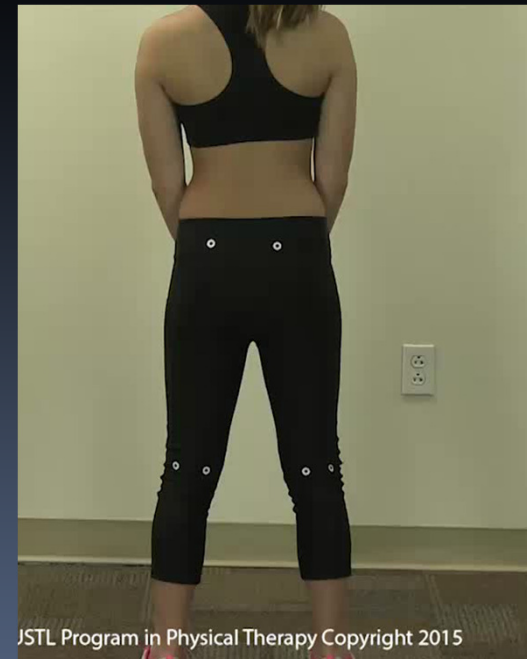
Initial presentation: Case #1



Initial presentation: Case #1

Treatment:

- Exercises
- Tape behind knees to prevent hyperextension
- Gait training
 - Walking with a rollator walker or crutches
 - Forward/backward weight shifting in the treadmill



Case Example

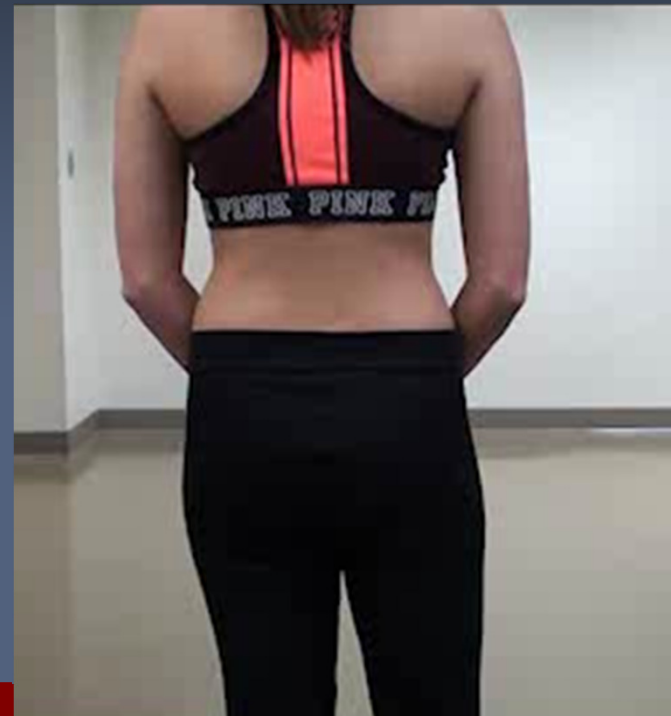
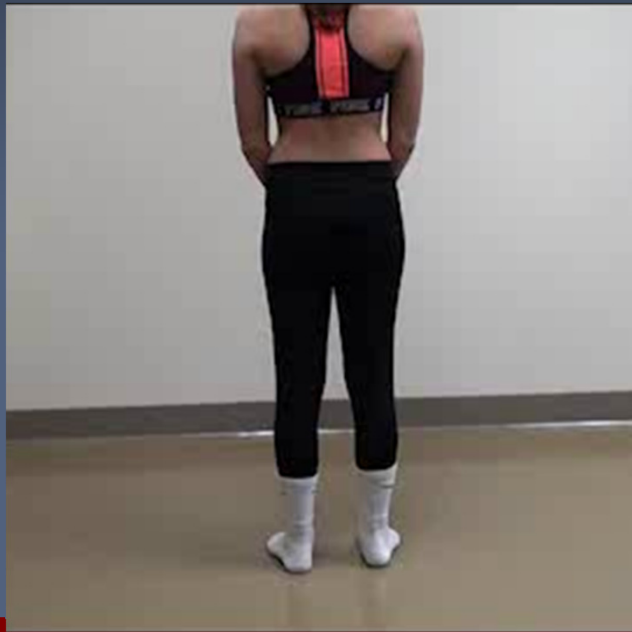
- Seen for 3 visits and did GREAT!
 - Nearly pain free
 - About to start running
- 4th visit: Suddenly worse than before
 - Unable to bear weight on right leg
 - Numbness/tingling
 - No longer going to school
 - MRI on lumbar spine and hip: negative
- Now what?

Regroup: This Doesn't Make Sense

- What did we do?
 - Pain science education using age appropriate metaphors
 - Answered patient and her mother's questions calmly
 - Re-affirm plan of care; include counseling

Regroup: This Doesn't Make Sense

- What could we have done to improve our care?
 - Administered a self report measure
 - Measured PPT
 - More motivational interviewing
 - Provided a list of resources for counseling



Thank You