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DENVER, COLORADO

2017

Musculoskeletal Care and Pain Management in SCI

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SCI Intensive Review Course – September 3, 2017

HYATT REGENCY DENVER & COLORADO CONVENTION CENTER - SEPTEMBER 3-6, 2017

Goals & Objectives

1. Musculoskeletal Care in SCI

- ❑ Upper limb (UL) pain
- ❑ Fractures (location & treatment)

2. Pain Management in SCI

- ❑ Overview
- ❑ Classification
- ❑ Treatment

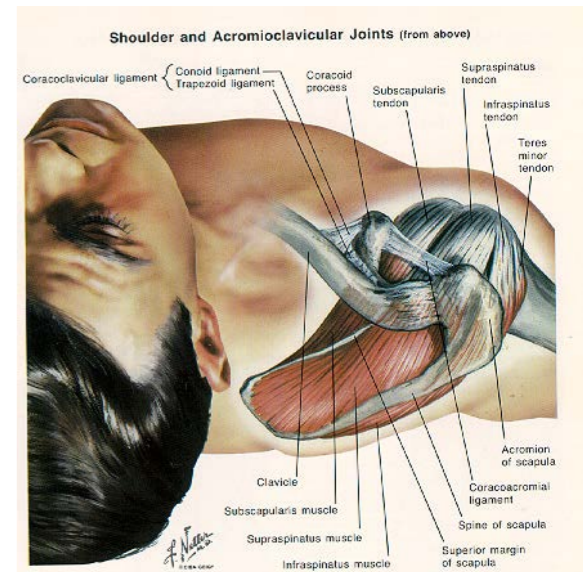
- * *I have no financial interest or conflicts to report.*
- * *Of the drugs discussed in pain treatment section, only pregabalin has been FDA approved for treatment of neuropathic pain after SCI.*



Upper Limb Pain Syndromes

- Caused by overuse, disuse atrophy, or compressive neuropathy
- Complication of the weight-bearing UL, but also associated with UL disuse (↑level tetraplegia)
- Pain may be significant in over one-half the cases
- Most common locations are shoulder and wrist (CTS)
 - tetraplegics: shoulder pain most common
 - paraplegics: CTS, followed closely by shoulder
- CAUTION: pain is a symptom that can be referred from other structures (e.g. acute abdomen pain → shoulder)

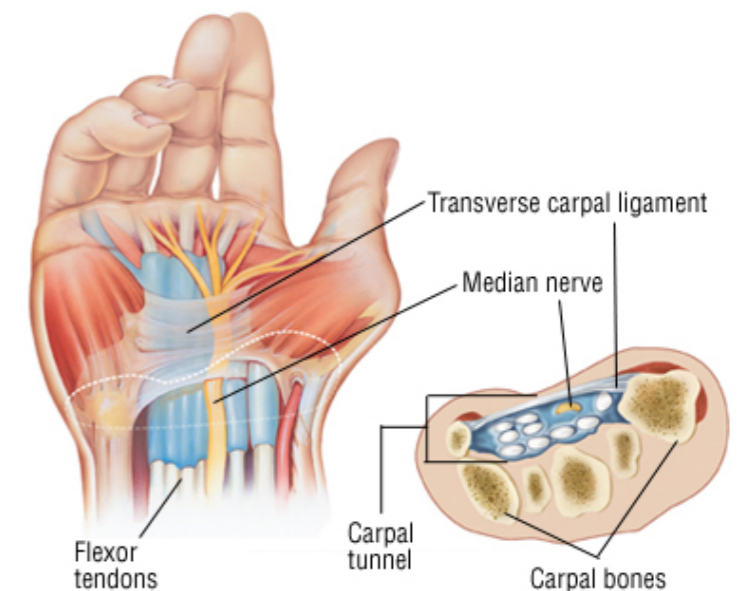
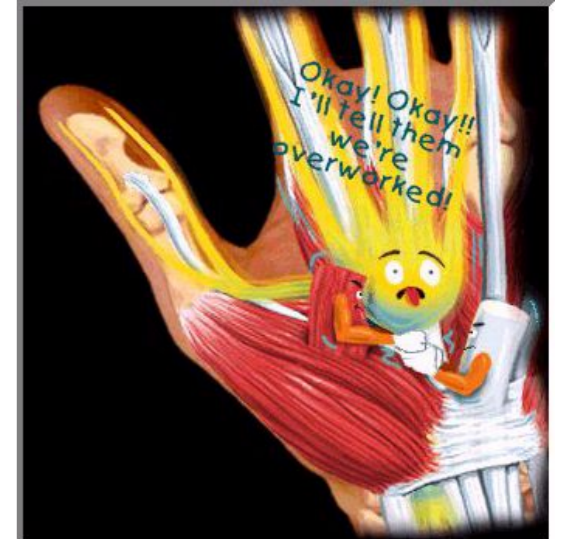
Shoulder Pain



- Most common cause of musculoskeletal pain
- Prevalence 30-73% in chronic SCI (occurs in acute too)
 - “All cause” shoulder pain: Tetraplegia > Paraplegia
 - “Overuse” shoulder pain: Paraplegia > Tetraplegia
- Other risk factors: female gender, BMI, age, duration (?)
- “Wheelchair User’s Shoulder” – weight-bearing UL
- Musculotendinous overuse syndromes – most common
 1. Pain in relation to rotator cuff/surrounding structures
 - Rotator cuff disease (*rotator cuff/bicipital tendinitis, subacromial bursitis, “impingement syndrome”*); “tendin-osis”, not “-itis”
 2. Pain in regional muscles of shoulder (e.g. acute strains, MPS)

Carpal Tunnel Syndrome

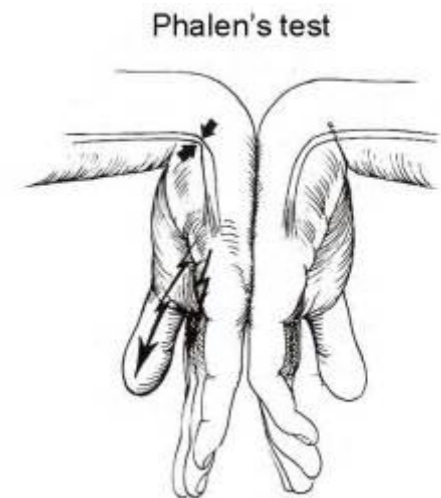
- Most common overuse neuropathy in SCI
- Prevalence = 40% to 66%
 - ↑duration of injury; more common in paraplegia
- “Repetitive contact neuropathy” – median nerve
 - ↑ carpal canal pressure during extreme wrist extension
 - Repetitive trauma to volar aspect of wrist during wheelchair propulsion and transfers



Carpal Tunnel Syndrome

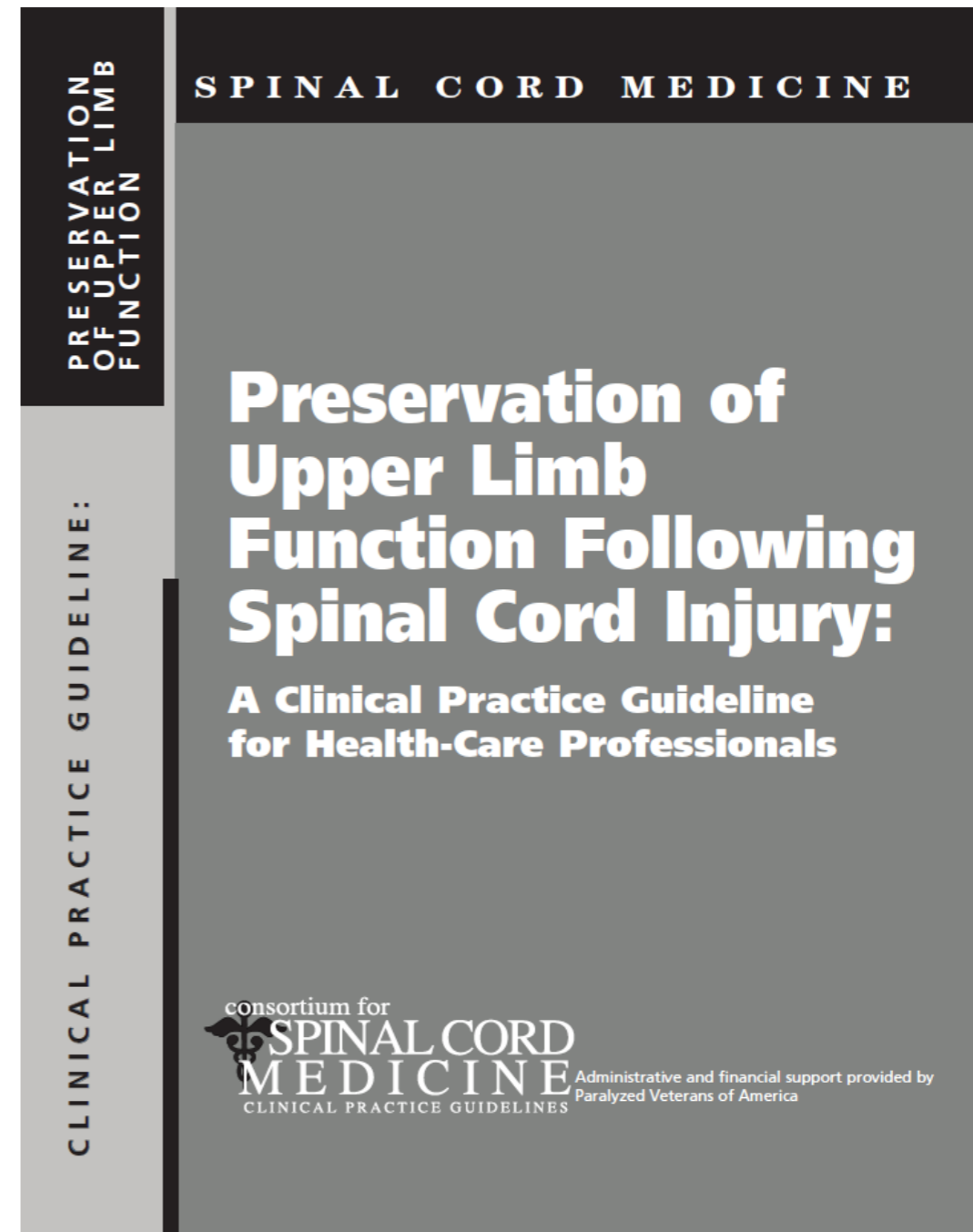


- History:
 - numbness in the hand worsens at night/during wheelchair propulsion; improves with shaking of wrist
- Physical exam:
 - Tinel's sign; Phalen's sign;
 - thenar atrophy and/or weakness
- Electrodiagnostics - confirms diagnosis
- Tx – conservative (padded gloves, limit end-range of motion, wrist splints at night, steroid injections)
- Surgery - carpal tunnel release



Management of Upper Limb Pain

- ↓Acute pain
 - rest (relative)
 - pharmacological interventions (NSAIDs, etc.)
 - amitryptiline (myofascial pain)
 - joint injections
 - modalities (ice/heat, TENS, ultrasound)
 - acupuncture
- Address 2^o disabilities
- Prevention
 - *Consortium Guidelines*
- Avoid surgery if possible



Fractures



- Incidence = 2.5%; up to 70% of all persons with SCI
- SCI-induced bone loss: 1) rapid acute loss (plateaus ~2yrs after injury; and 2) slower ongoing loss .
- No consensus for predicting fracture risk on DEXA BMD values
- Fracture risk: complete>incomplete; paraplegia>tetraplegia
- Majority occur in LE (around the knee [dist. femur & prox. tibia])
 - **Supracondylar** >Tibia (proximal then distal) > Femoral shaft then neck >humerus (more common in tetraplegia)
 - 2^o to falls or minor stress such as ROM, dressing
- Symptoms: erythema, swelling, joint deformity, pain (sensate)
 - Fever, malaise, ↑spasticity, AD in insensate
- Dx: X-ray

Fracture Management

- Ambulatory – management similar to non-SCI population
- Non-ambulatory - usually non-operative with padded splint
 - Minimize complications
 - Allow satisfactory healing
 - Preserve pre-fracture function/alignment
 - Some degree of shortening/angulation acceptable
 - ORIF may be required displaced fractures/rotational deformity
- Well-padded knee immob for femoral supracondylar/shaft fx and proximal tibia fx; ankle immob for distal tibial fx
 - Preferred over circumferential casting
 - if cast, bivalve and pad well; perform skin inspection at least 2x/day



Fracture Management

- Most fx will heal with conservative approach
- Can be mobilized in WC after a few days
- If fx not at the knee, can flex at hip and knee; foot on foot-rest
- If fx at knee, then use knee extension leg rest
- Callous formation usually evident in 3-4 wks
- Immobilize for 6-8 wks, then ROM resumed
 - Weight bearing should be delayed a little longer
- Non-union ~2-10%; not clinically significant if don't weight-bear
- Femoral neck fractures: immobilization (splinting) difficult. If alignment is OK can mobilize



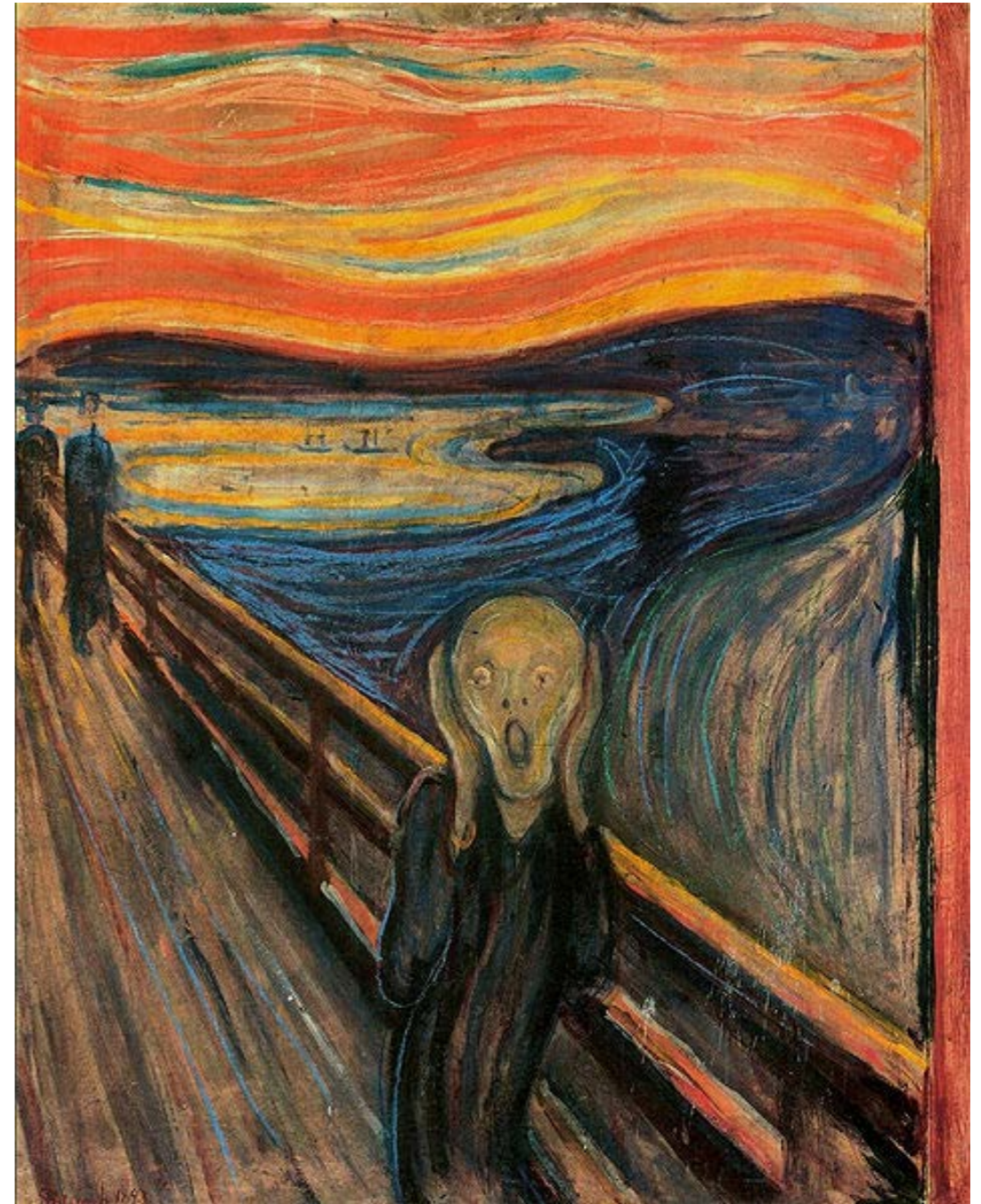
Fracture Prevention

- Modifiable risk factors.
 - Caffeine, Smoking, Alcohol use
- Learn to transfer with proper leg position
- Observe for signs of fracture
 - Localized swelling, hematoma, low grade fever, ↑spasticity, AD
- Interventions are questionable in reversing bone loss
 - Medications:
 - Bisphosphonates: *may* be beneficial in acute injuries and people with motor incomplete who ambulate and weight-bear; no strong evidence for complete injuries
 - Vitamin D (1000 IU) and Calcium (1000mg/day)
 - FES with leg cycling – possible effect
 - Weight-supported ambulation – possible effect
 - E-stim with standing – possible effect



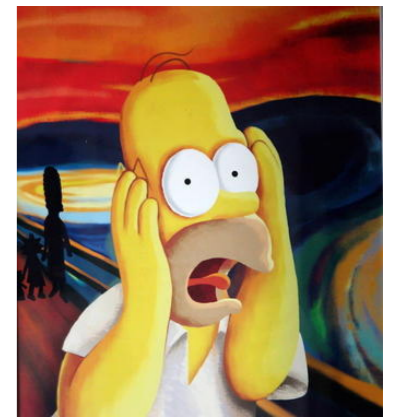
Pain Management

1. Overview
2. Classification
3. Treatment



Munch, *The Scream* 1893-1910

Pain after SCI



- Definition: *An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.*¹
- Highly complex (multiple types of pain simultaneously)
- Overall prevalence = 26 to 96%²
 - Gender *not* associated with pain prevalence
 - Level of injury *not* associated with pain prevalence
 - Completeness *not* associated with pain prevalence
- “Debilitating or disabling pain” = 11 to 34%³
- Causes distress and limitations in ADL (sleep, work)
- Important factor for decreased quality of life

Classification

- Lack of consistent definition
- Over 29 different schemes
 - Bryce/Ragnarsson SCI Pain Taxonomy
 - Cardenas SCI Pain Taxonomy
 - International Association for the Study of Pain (IASP) Taxonomy
- Most classify pain as nociceptive or neuropathic, and based on location in relation to NLI (at-level, below-level)
- International SCI Pain (ISCIP) Classification
 - consensus classification based on international input
 - includes elements from previous taxonomies
 - classifies pain in three tiers according to type of pain and source

Table 3 SCI pain types according to major classification*

Bryce/Ragnarsson	Cardenas	Donovan	ISAP	Tunks
Above level	Neurologic	1) Segmental	Nociceptive	Above level
1) Nociceptive	1) Spinal cord	2) Spinal cord	1) Musculoskeletal	1) Myofascial
2) Neuropathic	2) Transition zone	3) Visceral	2) Visceral	2) Syringomyelia
At level	3) Radicular	4) Mechanical	Neuropathic	3) Non-spinal cord injury
3) Nociceptive	4) Visceral	5) Psychogenic	3) Above level	At level
4) Neuropathic	Musculoskeletal		4) At level	4) Radicular
Below level	5) Mechanical spine		5) Below level	5) Hyperalgesic border reaction
5) Nociceptive	6) Overuse			6) Fracture
6) Neuropathic				7) Myofascial (incomplete)
				Below level
				8) Diffuse burning
				9) Phathom
				10) Visceral
				11) Myofascial (incomplete)

*This article was published in Physical Medicine and Rehabilitation Clinics of North America, 18, Ullrich, Pain Following Spinal Cord Injury, 217-233, Copyright Elsevier (2007).

International SCI Pain (ISCIP) Classification

Three-tier hierarchy:

1. Tier 1: Pain *type*

- Nociceptive
- Neuropathic
- Other
- Unknown

2. Tier 2: Pain *subtypes*

- Nociceptive: Musculoskeletal, Visceral, or Other
- Neuropathic: At-level, Below-level, or Other

3. Tier 3: Pain *source/pathology*

Tier 1: Pain type	Tier 2: Pain subtype	Tier 3: Primary pain source and/or pathology (write or type in)
<input type="checkbox"/> Nociceptive pain	<input type="checkbox"/> Musculoskeletal pain	<input type="checkbox"/> _____ e.g., glenohumeral arthritis, lateral epicondylitis, comminuted femur fracture, quadratus lumborum muscle spasm
	<input type="checkbox"/> Visceral pain	<input type="checkbox"/> _____ e.g., myocardial infarction, abdominal pain due to bowel impaction, cholecystitis
	<input type="checkbox"/> Other nociceptive pain	<input type="checkbox"/> _____ e.g., autonomic dysreflexia headache, migraine headache, surgical skin incision
<input type="checkbox"/> Neuropathic pain	<input type="checkbox"/> At level SCI pain	<input type="checkbox"/> _____ e.g., spinal cord compression, nerve root compression, cauda equina compression
	<input type="checkbox"/> Below level SCI pain	<input type="checkbox"/> _____ e.g., spinal cord ischemia, spinal cord compression
	<input type="checkbox"/> Other neuropathic pain	<input type="checkbox"/> _____ e.g., carpal tunnel syndrome, trigeminal neuralgia, diabetic polyneuropathy
<input type="checkbox"/> Other pain		<input type="checkbox"/> _____ e.g., fibromyalgia, Complex Regional Pain Syndrome type I, interstitial cystitis, irritable bowel syndrome
<input type="checkbox"/> Unknown pain		<input type="checkbox"/> _____

Nociceptive Pain

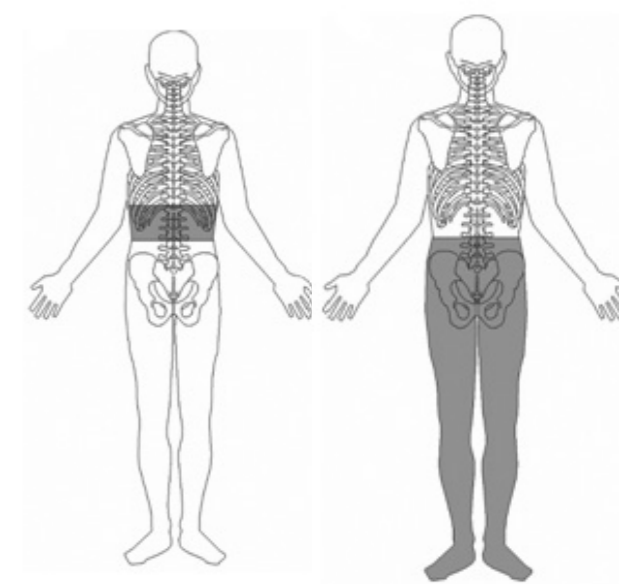
- Type: Nociceptive pain
 - Pain arising from activation of nociceptors*
- Subtypes: Musculoskeletal, Visceral, and Other nociceptive
 - Musculoskeletal – (e.g. arthritis, fractures, tendinopathies)
 - areas of preserved sensation, but can incl. area below NLI
 - ‘dull’ or ‘aching’; related to movement/position; tenderness on palpation
 - Visceral pain (e.g. constipation/impaction, UTI, cholecystitis)
 - visceral structures in thorax, abdomen, or pelvis
 - ‘cramping’, “dull”, “tender”; temporal relationship to visceral fct.; tenderness on palpation; associated nausea/sweating
 - Other (nociceptive) pain (e.g. AD headache, pain from pressure ulcer, migraine)
 - Nociceptive pain that is not musculoskeletal or visceral pain

Tier 1	Tier 2	Tier 3
<input type="checkbox"/> Nociceptive pain	<input type="checkbox"/> Musculoskeletal <input type="checkbox"/> Visceral pain <input type="checkbox"/> Other nociceptive	Musculoskeletal <input type="checkbox"/> _____ e.g., glenohumeral arthritis, lateral epicondylitis, comminuted femur fracture Visceral pain <input type="checkbox"/> _____ e.g., myocardial infarction, abdominal pain due to bowel impaction Other nociceptive <input type="checkbox"/> _____ e.g., migraine headache, surgical skin incision
<input type="checkbox"/> Neuropathic pain	<input type="checkbox"/> At level SCI pain <input type="checkbox"/> Below level SCI pain <input type="checkbox"/> Other neuropathic	At level SCI pain <input type="checkbox"/> _____ e.g., spinal cord compression, nerve root compression, cauda equina compression Below level SCI pain <input type="checkbox"/> _____ e.g., spinal cord ischemia, spinal cord compression Other neuropathic <input type="checkbox"/> _____ e.g., carpal tunnel syndrome, trigeminal neuralgia, diabetic polyneuropathy
<input type="checkbox"/> Other pain		Other <input type="checkbox"/> _____ e.g., fibromyalgia, Complex Regional Pain Syndrome type I
<input type="checkbox"/> Unknown pain		

***Nociceptor** = a peripheral nerve ending or a sensory receptor that is capable of transducing and encoding noxious stimuli.

Neuropathic Pain

Tier 1: Pain type	Tier 2: Pain subtype
<input type="checkbox"/> Neuropathic pain	<input type="checkbox"/> At level SCI pain
	<input type="checkbox"/> Below level SCI pain
	<input type="checkbox"/> Other neuropathic pain



- Type: Neuropathic pain
 - Pain caused by lesion/disease affecting the somatosensory system (central or peripheral).
 - sensory deficits, allodynia/hyperalgesia within pain distribution
 - “hot-burning”, “tingling”, “pins & needles”, “electric”, etc.
- Subtypes: At-Level, Below-level, and Other neuropathic
 - At-level SCI pain
 - Neuropathic pain ≤ 3 dermatomes below NLI; not any lower; (except: damage to cauda equini)
 - must be due to injury of spinal cord/nerve roots (spinal or radicular pain)
 - Below-level SCI pain
 - Neuropathic pain > 3 dermatomes below NLI (may incl. NLI dermatome)
 - must be due to injury/disease of spinal cord; if not, then *other neuropathic pain*
 - pain due to damage of cauda equina is radicular, therefore, considered at-level

Neuropathic Pain (cont.)

Tier 1: Pain type	Tier 2: Pain subtype	Tier 3: Primary pain source and/or pathology (write or type in)
<input type="checkbox"/> Neuropathic pain	<input type="checkbox"/> At level SCI pain	<input type="checkbox"/> _____ e.g., spinal cord compression, nerve root compression, cauda equina compression
	<input type="checkbox"/> Below level SCI pain	<input type="checkbox"/> _____ e.g., spinal cord ischemia, spinal cord compression
	<input type="checkbox"/> Other neuropathic pain	<input type="checkbox"/> _____ e.g., carpal tunnel syndrome, trigeminal neuralgia, diabetic polyneuropathy

- Subtypes (cont.)

- *Other* neuropathic pain

- neuropathic pain present above, at or below the NLI, but is not directly related to the SCI
 - should only be chosen for pains unrelated to the underlying SCI (e.g., compressive mononeuropathy [e.g CTS], postherpetic neuralgia, etc.)
 - pain from lumbar radiculopathy in someone with incomplete tetraplegia is classified as *other neuropathic pain*
 - nerve root avulsion pain is classified as *other neuropathic pain*

Other Pain

- Type: Other pain
 - No identifiable noxious stimulus or damage to the nervous system; unclear what causes the pain to develop or persist
 - Examples: Complex Regional Pain Syndrome type I, irritable bowel syndrome pain, fibromyalgia.
- Type: Unknown pain

Tier 1	Tier 2	Tier 3
<input type="checkbox"/> Nociceptive pain	<input type="checkbox"/> Musculoskeletal <input type="checkbox"/> Visceral pain <input type="checkbox"/> Other nociceptive	Musculoskeletal <input type="checkbox"/> _____ e.g., glenohumeral arthritis, lateral epicondylitis, comminuted femur fracture Visceral pain <input type="checkbox"/> _____ e.g., myocardial infarction, abdominal pain due to bowel impaction Other nociceptive <input type="checkbox"/> _____ e.g., migraine headache, surgical skin incision
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<input type="checkbox"/> Other pain		Other <input type="checkbox"/> _____ e.g., fibromyalgia, Complex Regional Pain Syndrome type I
<input type="checkbox"/> Unknown pain		

Management of Upper Limb Pain

1. Conservative Management

➤ Prevention

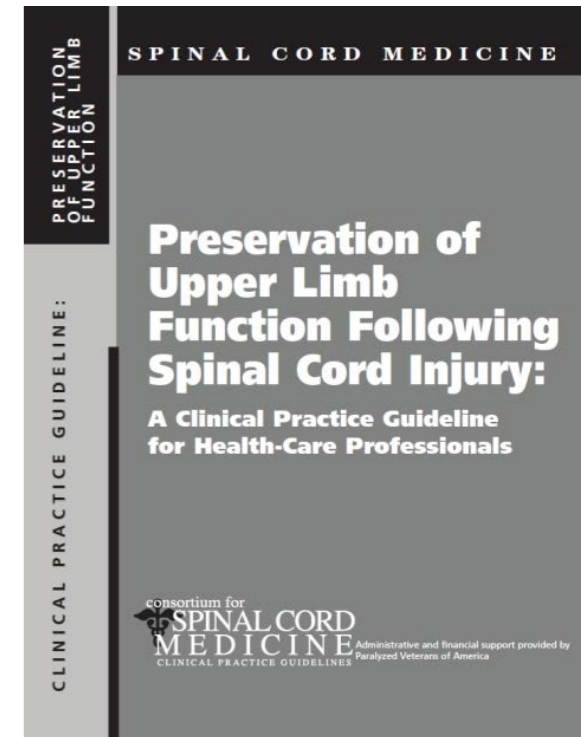
- Ergonomics (minimize frequency & force, avoid extreme positions)
- Equipment Selection, Training, and Environmental Adaptations
- Exercise (stretching/strengthening)

➤ Treatment

- Rest (not always practical in upper limb dependent population)
 - Pharmacological agents (e.g. NSAIDs, corticosteroid injections)
 - Modalities (e.g. ice/heat, TENS, ultrasound)
 - Exercises (stretching/strengthening)
- Consider switch to power wheelchair (or power-assist)

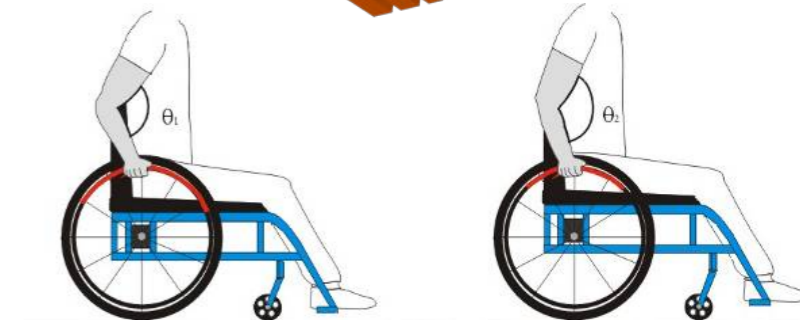
2. Surgical Management

- Treatment of last resort in SCI
- Prolonged immobilization → functional decline/depression
- Risk of poor outcomes, particularly if tasks continue
- Pre-surgery planning & post-surgery transition/care



Management of Upper Limb Pain

- Ergonomics
 - ↓frequency/force UL tasks; ↓extreme/injurious joint positions
- Equipment selection (and set-up)
 - manual WC of lightest possible material
 - WC set-up: rear axle as far forward as possible
 - Position the rear axle so elbow 100-120°
 - Consider power WC or power add-ons
- Education & equipment training
 - Use long, smooth strokes
 - Promote appropriate seated posture
 - Transfer training



Management of Upper Limb Pain

- Exercise

- Flexibility exercises to maintain normal glenohumeral motion & pectoral muscle mobility.

- Anterior shoulder muscles

- Resistance training (balanced program with strengthening of the posterior musculature) that emphasizes 4 main areas.

1. Scapular stabilizers (trapezius and serratus anterior);
2. Rotator cuff muscles (supraspinatus, infraspinatus, teres minor, and subscapularis);
3. Shoulder adductors
4. Primary humeral head movers (deltoid, pectoralis major, & latissimus dorsi)



Treatment of Neuropathic Pain

- Difficult and typically only partially reduces pain
 - Only one-third experience a 50% reduction in pain with treatment
 - Goal is to reduce pain enough to support functional improvement
- Treatment includes pharmacological and non-pharmacological approaches
- Pharmacological approaches: two main groups
 1. Anticonvulsants (suppression of aberrant electrical activity)
 2. Antidepressants (through effects on serotonin & norepinephrine)
- Non-pharmacologic approaches: various stimulation techniques, psychological management, and surgery
- Need to find balance between side effects and pain relief.

CanPain Treatment Recommendations

- First-Line Therapy:
 1. Pregabalin: first choice of first-line medications
 - *Only FDA-approved drug for neuropathic pain associated with SCI*
 - Dose: 150-600 mg/day in two divided doses
 - Starting dose = 75 mg BID; may be increased to 150 mg BID within 1 week
 - 300 mg BID after 2-3 weeks, if 150 mg BID ineffective
 - Adjust dose in cases of reduced renal function
 - Side effects: somnolence and dizziness; additional warnings for angioedema, hypersensitivity reaction, and suicidal ideation
 - If discontinuing, best to taper over 1 week if h/o seizure disorder
 2. Gabapentin: next option if pregabalin not available or ineffective
 - Dose: 1,800-3,600 mg/day; starting dose 100 mg 3-4 times daily
 - Side effects: somnolence and dizziness

CanPain Treatment Recommendations

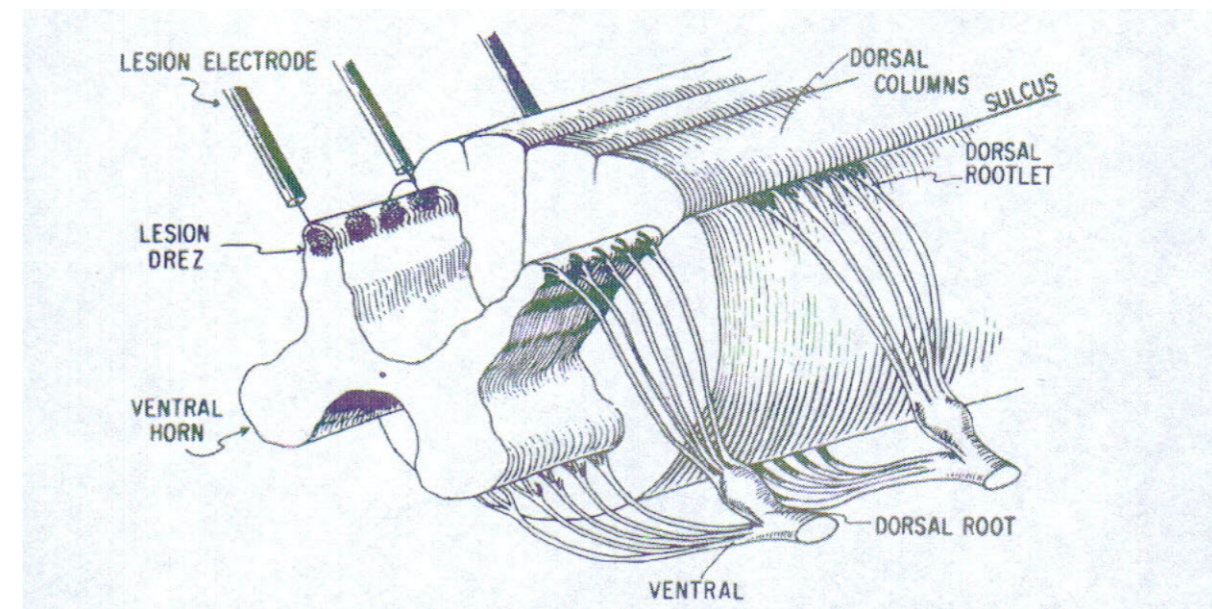
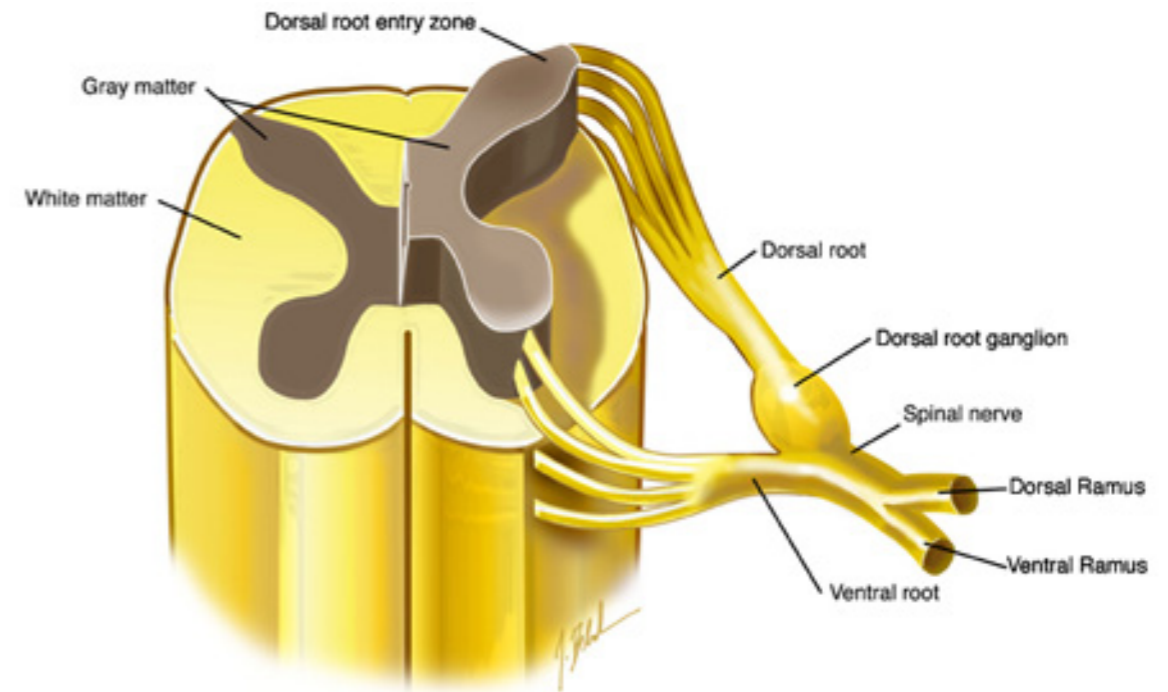
- First-Line Therapy (cont.):
 3. Amitriptyline: can be used if pregabalin & gabapentin ineffective
 - Dose: 25-150mg/day; starting dose 10-25mg daily; target dose 50mg TID
 - Based on studies in SCI, lower doses than 50 mg TID may be ineffective
 - Side effects: anticholinergic side effects (e.g. dry mouth, constipation, somnolence); may lower seizure threshold
- Second-Line Therapy:
 1. Tramadol: can be used for reduction of neuropathic pain in SCI
 - Dose: 400 mg/day; starting dose 50 mg once or twice daily
 - Side effects: sedation, nausea, constipation
 2. Lamotrigine: may be considered in those with incomplete SCI only
 - Dose: titrated to max dose 400 mg/day
 - Side effects: somnolence and dizziness, headache, and rash; “black box” warning by FDA for skin rashes (Stevens-Johnson Syndrome)

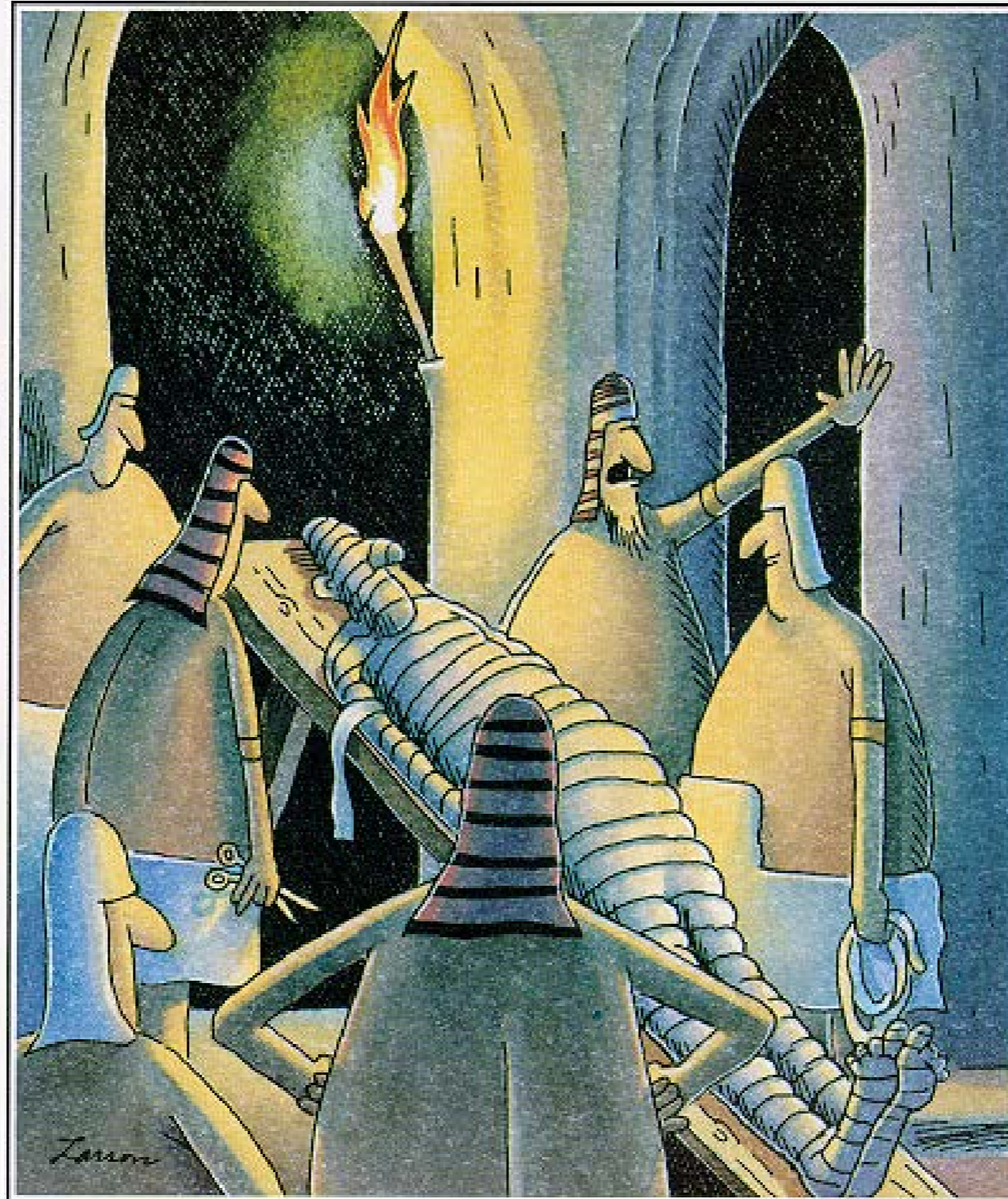
CanPain Treatment Recommendations

- Third-Line Therapy:
 1. Transcranial direct current stimulation (tDCS)
 2. Combined visual illusion with tDCS
- Fourth-Line Therapy:
 1. Oxycodone
 2. Dorsal root entry zone (DREZ) procedure
 - Considered in exceptional circumstances and as a last resort for reducing neuropathic pain in SCI
 3. Levetiracetam should not be used for reducing neuropathic pain in SCI
 4. Mexiletine should not be used for reducing neuropathic pain in SCI

Dorsal Root Entry Zone (DREZ) Procedure

- Evidence of benefit, but treatment of last resort
- Risks: paresis, neuropathy or radiculopathy, ataxia, & surgical complications
- May be more effective in “segmental pain” than “diffuse pain”
- May be more effective in individuals with conus medullaris level injury than cervical, thoracic, or cauda equina injury





"OK, folks! ... It's a wrap!"