Note to Participants: There are interactive pop-up questions throughout this lecture. If you choose to pause the lecture and return at a later time, a natural break time would be after answering the interactive questions. (You are able to pause at any time and the presentation will “remember” where you were. It’s just a more natural time to pause after the interactive questions.) For your convenience, this outline reflects where/when within the lecture the interactive questions occur.

This lecture has 120 slides and is 108 minutes in duration.

I. Terminology & semantics
   A. CTD – Cumulative trauma disorder
   B. MSD – Musculoskeletal disorder
   C. Repetitive strain injury
   D. Overuse disorder
   E. Soft tissue injury
   F. Micro-Trauma vs Macro-Trauma
   G. Faulty terminology
      1. Ergonomics injury
      2. Repetitive motion injury
      3. Lifting injury

II. Tendinitis at the cellular & molecular level
   A. Tendons
      1. Matrix of cells, collagen, proteoglycans, water, limited nutrient pathway
      2. Force attenuation
      3. Collagen disruption, repair, adaptation
   B. Adaptation
      1. Loading breaks collagen fibers.
      2. Collagen precursors laid down.
      3. These polymerize into collagen fibers.
      4. Collagen fibers align along load.
      5. Form proper weave to accommodate deformation under the ongoing loads.
      6. Quality of healing; quantity of healing; remodel stimuli, nutrient pathway.
      7. Needs rest to initiate healing; needs activity to stimulate quality of healing.
   C. Degeneration
      1. Ongoing stress with reduced nutrient pathway.
      2. Breakdown exceeds repair.
      3. Atrophy; failure.
   D. Tendinitis
      1. Reduced quantity and quality of collagen.
      2. Less able to attenuate internal strain.
3. Increased micro-damage.
4. Chemical changes.
5. Inflammation
6. Nociception
7. Effusion

III. Pain – Nociception
A. Charge-gated ion channels: Open
   1. Positive ions in
   2. Negative ions out
B. Mechanical-thermal-chemical-hypoxia as pain stimuli
C. What enhances this?
D. Systemic effects
E. CNS-PNS effects
F. Injury: release of chemical mediators
G. PNS – CNS changes
   1. Primary hyperalgesia, sensitization locally, upregulation of pain
   2. Secondary hyperalgesia, sensitization at CNS, upregulation of pain
   3. Cortex changes

Interactive Questions – slide 30 @ 18 minutes

IV. Repetitive motion versus sustained posture
A. Nutrient pathway disorder
B. Lack of perfusion to working tissues
C. Muscle contraction, tendon tension, joint compression
   1. Tissue loads exceed perfusion pressure
D. Static muscle work should not exceed 5-7% of MVC over one hour.
E. Repetitive motion not the cause of most MSD; static posture the greater risk.
F. Proximal posture stress easier to manage than distal repetitive motion (good news).
G. Proximal inputs to distal symptoms.

V. Forward Head Posture
A. Flexed upper-thor, compensatory extension at upper-C to level vision
B. Flattened mid-C, disc loading, uncus loading.
C. Scaleni recruited as posture- tonic muscles, fiber change, fatigue-pain-triggers.
D. Paradoxical scaleni breathing further loads them.
E. Elevated rib-1, TOC
F. Tight scalene, TOC
G. Protracted shoulder girdle, tight pectoralis minor, TOC
H. Protracted shoulder, subacromial compression
I. Stretch weakness upper-T extensors, sustained tension across upper-T ligs.
J. Levator scap stress, triggers
K. TMJ shifts, more afferent inputs
L. Flattened lumbar, disc loading
M. TOC, ANT, double crush
VI. How much musculoskeletal MSD is actually neurogenic?
A. Many-most patient with MSD show ++ ANTT findings.

VII. Cervical spine degeneration
A. Static posture, prolonged unchanging WB, nutrient pathway losses.
B. DDD, DJD
C. Reduced water binding sites in cartilage (facet articular and discs).
D. Reduced disc height, increased WB on facets and on uncus.
E. Unco-vertebral joint develops and soon degenerates, spur at IVF, root impingement.
F. Pain, posture change, hyperalgesia, radicular, ANT, nociceptor cycles.
G. Scolenus anticus pulls anterior sheer, levator pulls posterior sheer: fight!
   1. Hand use increases neck loading!
   2. Even good posture is bad, if it is sustained!

Interactive Questions – slide 52 @ 39 minutes

VIII. Repetitive motion injury due to friction?? NO.
A. Repetition is not contract-relax cycling; repetitive contractions do not fully relax.
B. More repetition means progressively less relaxation between cycles.
C. Increasing background tension exceeds perfusion pressure; loss of perfusion.
D. Nutrient pathway interruption

IX. Neuro-Vascular Compression: NVC
A. 20-30mm Hg obstructs intraneural perfusion.
B. Nerve mobility
   1. Peripheral nerves slide & stretch to match limb-trunk movements-postures.
   2. Impingement at one point alters slide-stretch along length of nerve.
   3. Alters blood supply and causes AIGS (automatic impulse generating site).
C. Nerve root, IVF, scaleni, rib 1, pect minor, cubital tunnel, radial tunnel, carpal tunnel, pronator teres, Guyon’s canal
D. CTS; fluid dynamics imbalance, nutrient pathway disorder
E. Other NVC’s

X. Other MSD risks
A. Shoulder girdle protraction.. shoulder, AC, upper-T, costovertebral
B. Shoulder reach: how high, how far, how often, prolonged, load.
C. Elbow flexion: ulnar, cubital tunnel, sleep postures, C7-T1-T2.
D. Supination, med epi, pronator syndrome, CTS risks
E. ECR loading, TE, tendinosis, C-spine inputs-responses, radial tunnel, ANT.
F. Wrist flexion-deviation.
G. Grip-pinch.
H. Thumb lateral pinch with ulnar deviation, deQ, CMC-saddle, ANT.
I. Plantar fasciitis, heel spurs, TTS, LS-sciatic inputs, ANT
J. Posture: position, duration, variety
K. Movement: ROM, repetition, force, variety

Interactive Questions – slide 81 @ 69 minutes

XI. Low Back Workplace MSD
A. LBI as a micro-trauma MSD.
B. Even acute macro-trauma has a component of micro-trauma.
C. Dysfunction leads to degeneration leads to derangement.
D. Dysfunction: altered flexibility, mobility, strength, stability.
E. Degeneration: the effects of time, gravity and reduced nutrient pathway.
F. Derangement: mechanical-structural failure, e.g., HNP.
G. Multiple risk factors, multiple pathomechanics, multiple prevention options.

XII. Zygo-apophyseal joint
A. Synovial joint, articular cartilage, joint capsule, sensitively innervated.
B. Weightbearing, mobile-stable, small surface area.
C. 15% of segment load (per positioning); cyclical loading-unloading.
D. Risks: standing, overhead, twisting, sidebending.
E. Degeneration.

XIII. Intervertebral Disc
A. Hydrated, hydraulic, elastic.
B. Matrix of a few cells (5%), collagen, proteoglycan, water.
C. More water-proteoglycan centrally (nucleus).
D. More collagen peripherally (annulus).
E. Largest avascular structure in body: long nutrient pathway (bony endplate).
F. 85% water: lots of proteoglycan with water binding sites.
G. Requires much cyclical loading-unloading.
H. Static posture work and hypomobility dysfunctions reduce this.
I. Load transfer function.
J. Bending during load distorts this function.
K. HNP
L. Hypomobility and static posture
M. DDD
N. Degenerative effects on sacroiliac joint.

XIV. Ligaments: posterior ligs include SSL, ISL, LF, facet capsules, posterior annulus.

XV. Muscles – Motor Control
A. Strength, stability, endurance, protection.
B. Erector spinae, multifidus, transverses, iliopsoas, quadrates, thoracolumbar fascia.
C. Glut max, hamstrings, quadriceps, calf, glut med and TFL-ITB.
D. Muscle protection of posterior passive soft tissues is position-
specific.

XVI. LB risks
   A. Prolonged sitting, poor sitting habits, poor seating equipment.
   B. Prolonged standing, cement floor, steel surface, vibration surface.
   C. LB flexion.
   D. Torsion-twisting.
   E. Overhead or long reach.
   F. Lifting and all its variables.
   G. Worker’s lack of flexibility and other MS function-dysfunction.

XVII. Lower extremity MSD
   A. Plantar fasciitis
   B. Tarsal tunnel syndrome
   C. Sciatic ANT
   D. Trochanteric bursitis
   E. Piriformis syndrome

Interactive Questions – slide 116 @ 99 minutes

XVIII. Socio-Political Issues
   A. Workplace MSD is more than “injuries.”
   B. Injuries, claims and costs are three separate issues.
   C. MSD is an invisible disorder: no dripping blood or negative x-rays.
   D. Restricted duty.
   E. Delayed access to HCP.
   F. All these will determine if the injury costs $500, $5,000 or $50,000 !!
   G. The PT can favorably affect costs, at least as much as they can affect injury prevention.
Bibliography

Costs & epidemiology


Exercises & rest breaks


**Sit-Stand**


**Back schools**


**Lifting & Lordosis**


**Posture**


UE support


Ergonomics interventions


Pathogenesis


On-site PT


Back belts


**Important journal special issue: JOSPT October 2004**

49. MacDermid J, Doherty T. Clinical and electrodiagnostic testing of carpal tunnel syndrome.

50. Michlovitz S. Conservative interventions for CTS.

51. Lee M, LaStayo P. Pronator syndrome and other nerve compressions that mimic CTS.


**Important texts**
