How do Injuries Occur?

Acute injuries

- Happen *immediately*
- Can become chronic
- Re-injury possible

Chronic injuries

- Pain or symptoms lasting more than a month

Cumulative exposure to trauma /irritation/ load / energy

- Happens *over time*

Sort of energy loads

- Sound waves
- Thermal
- Electricity
- Radiation – light, ionizing and non ionizing
- Chemicals
- **Mechanical**

Microtrauma Definition

microtrauma

[-trô′mə]

a very slight injury or lesion.

microtrauma

microtrauma Small, often minute injuries caused by repetitive overuse.

microtrauma [mi″kro-traw´mah]
a microscopic lesion or injury.

microtrauma

a microscopic lesion or injury.

microtrauma

Orthopedics Small, usually unnoticed injuries caused by repetitive overuse. See Overuse syndrome.

mi·cro·trau·ma (mī′krō-traw′mă)

A minor or microscopic lesion due to injury, which may become significant if often repeated.
Synonym(s): cumulative trauma disorder.

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Microtrauma

repetitive strain injuries

TITLE: repetitive strain injury (RSI)

Normally, structural tissue damage post-injury activates a cellular cascade to mediate inflammation and to initiate tissue repair. However, repetitive injury results in repeated tissue **microtrauma**, which disrupts the normal repair process. In patients with chronic RSIs, cumulative loading can lead to reduced perfusion (blood supply), reduced function of peripheral nerves, excessive tissue...

Repetitive strain injury

- Cumulative trauma disorder
- Repetitive motion and stress injury
- Work-related musculoskeletal disorder

- Heavy, stressful schedules of repetitive hand use that demand high levels of accuracy and progressive task difficulty. Work or activities involving forceful, rapid, stereotypical, near simultaneous, or alternating movements

Nancy Byl Professor and Chair Emeritus, Department Physical Therapy and Rehab Science, University of California San Francisco School of Medicine

Tissues invoved

Disorder or injury of muscles, nerves, tendons, joints, cartilage, spinal discs

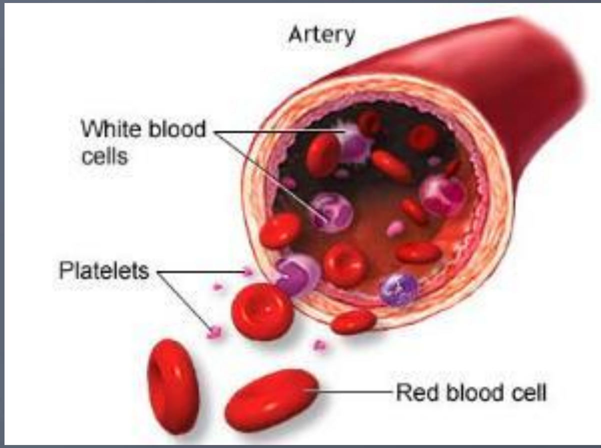
The Bureau of labor statistics

Terminology

- **RSI – repetitivre stress injury**
- **CTD – Cumulative trauma disorder**
- **MSD – musculo skeletal disorder**
- **Microtrauma**
- Work-related Musculoskeletal Disorder (WRMSD)

- Overexertion or Overuse Injury
- Strains and Sprains
- Soft Tissue Injury

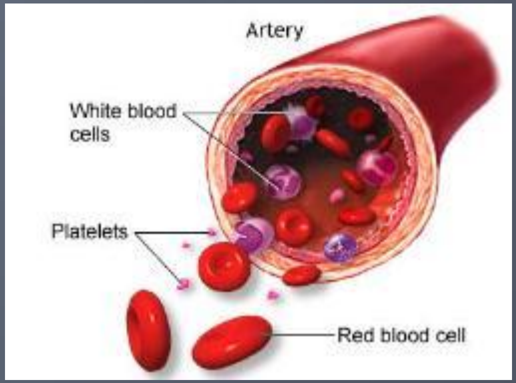
Tissue Repair



Phases of repair of soft tissue:

1. *Acute (<72 hours):* coagulates blood to stop bleeding, brings in WBC to clean up dead tissue and bacteria
2. *Repair (48 hours to 6 weeks):* deposition of new collagen (scar tissue)
3. *Remodeling (3 weeks to 12 months):* collagen remodeled to increase functional capabilities

Tissue Repair (cont'd)



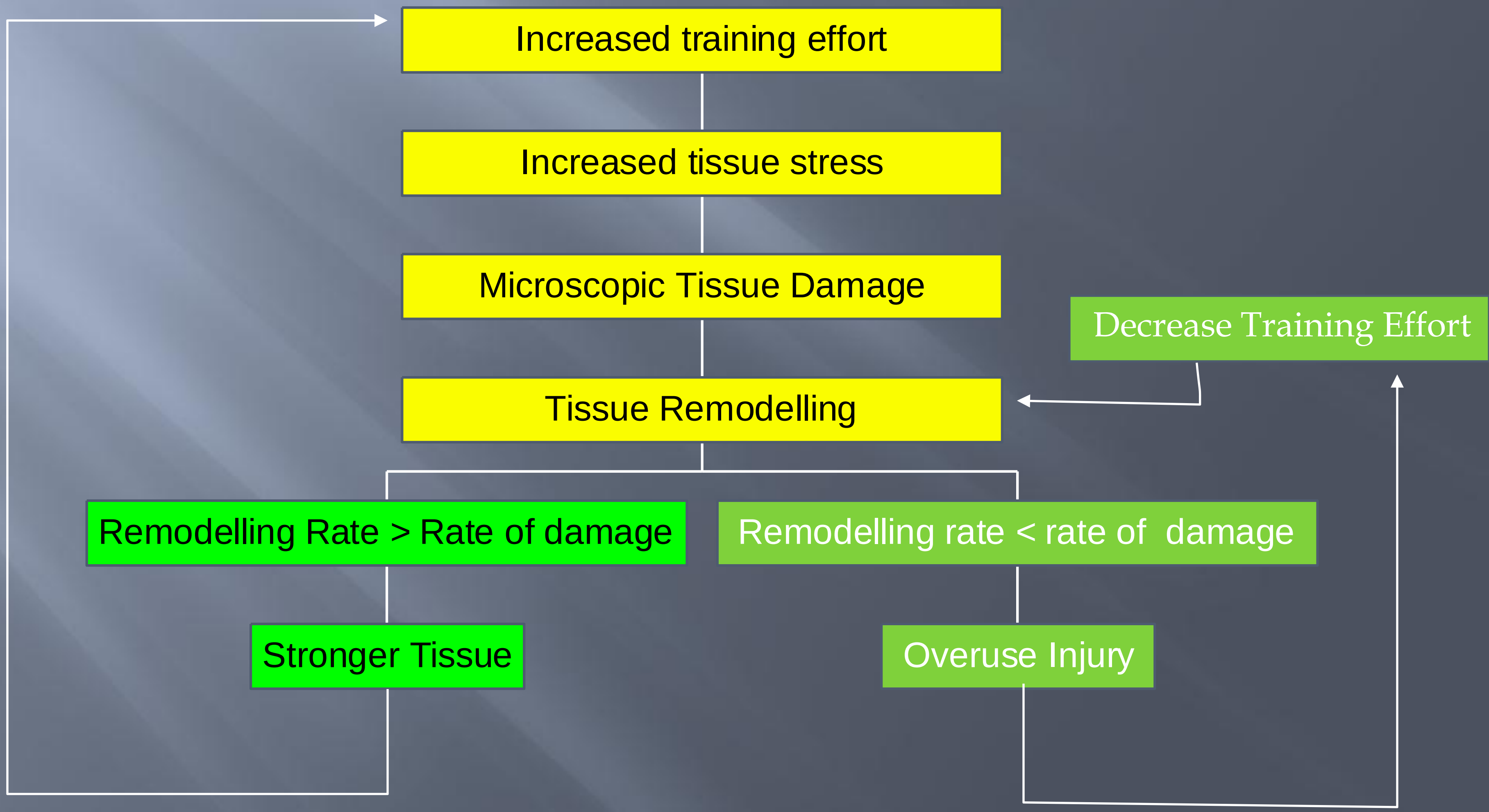
- Body creates a scar internally much like a scar from an external wound
- Scar tissue is **fibrotic** - not the same as the original tissue
  - laid down in chaotic manner to be strong
  - **Reduced elasticity**
- If tissues are continually disrupted due to use repair is never complete
- *Adhesions* form
- **A chronic inflammatory** cycle is created

Stress Continuum

- Distress (Causes malfunction)
  - Pathologic underload zone
  - Pathologic overload zone
- Eustress (Causes positive adaptation)
  - Physiologic loading zone
  - Physiologic overload (training) zone

Distress	Eustress	Eustress	Distress
Path Underload	Phys Load	Phys Overload	Path Overload

Williams' model of overuse injury
(1993)



Cumulative Trauma Cycle

Activity

irritation to tissue

microtrauma (small tears)

produces scar tissue

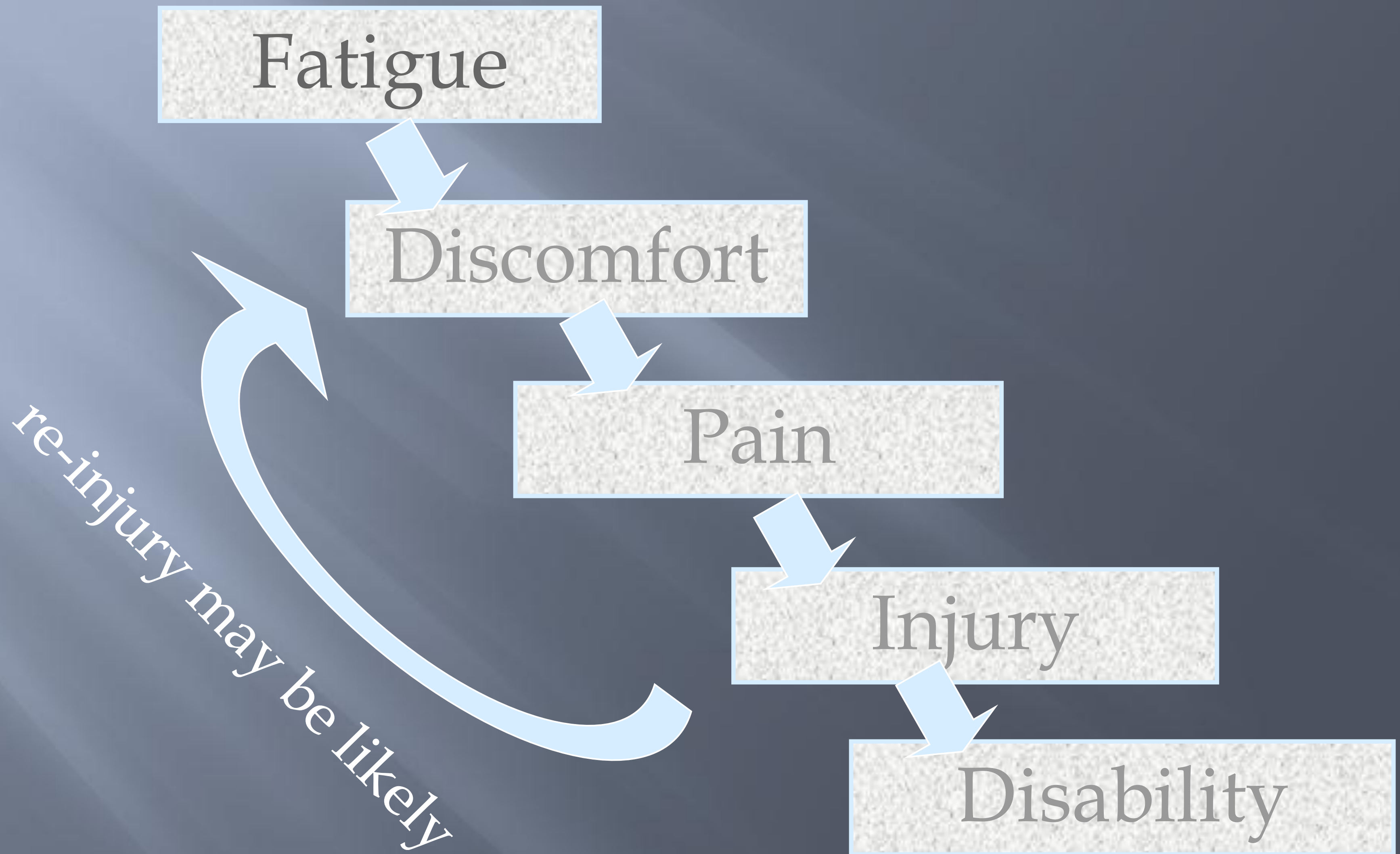
adhesions form

adhesions coalesce

results in:
- ↓ flexibility
- ↓ strength
- ↓ function

Keeps repeating as long as activity continues

Break the Injury Cycle



Mechanism

- Reduced perfusion
- Reduced function of peripheral nerves
- Excessive tissue inflammation
- Scarring, cell compression, extracellular matrix degradation
- Muscle fiber loss
- Cell death

- Tissue discontinuity

Clinical results

- Alters strength, compliance, and flexibility.
- Lose strength and endurance
- Severe pain (with or without inflammation)
- Excessive fatigue
- Poor sensorimotor feedback

and painless loss of fine motor control (e.g., focal hand dystonia)

Risk factors for Overuse Injury: The Usual Culprits

- Intrinsic abnormalities
- Extrinsic abnormalities

Conditions

- Excessive use
- Forceful use
- Strain
- Rapid movement
- Constrained or constricted
- Non physiological posture

Tissues and system

- Tendonitis , tendinosis
- Neuritis ,Carpal tunnel syndrome, thoracic outlet syndrome, cubital tunnel syndrome, focal hand dystonia, and neuropathic pain
- Fascitis
- Myositis
- Degenerative arthritis
- Fibromyalgia
- Herniated disk

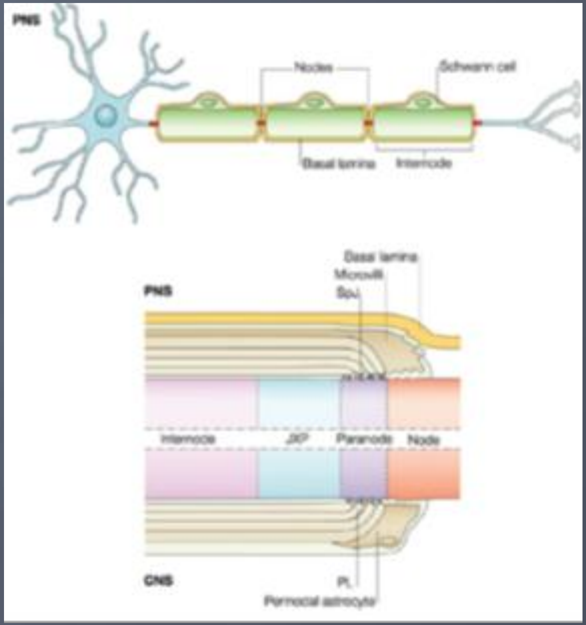
Stages based on the soft tissue response

- Stage one, injury may induce **inflammation**, but not associated with pathological alterations in the tissue.
- Stage two**, pathological alterations**, such as tendinosis & degeneration
- Stage three - **structural failure** (rupture).
- Stage four, **additional changes** are seen, such as osseous (bony) calcification.

Specific tissue changes

- Neural
- Tendinious
- Bony

Microtauma – nerve damage

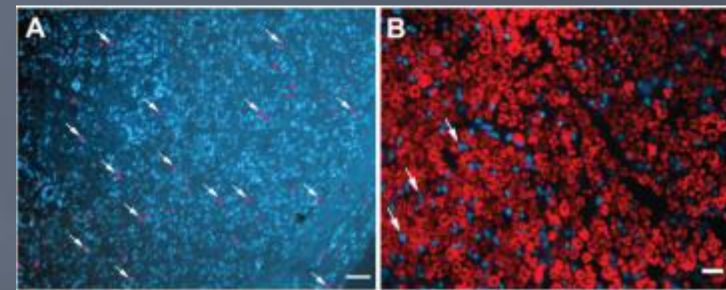


- Chronic nerve compression (CNC)
- A Schwan cell mediated disease.

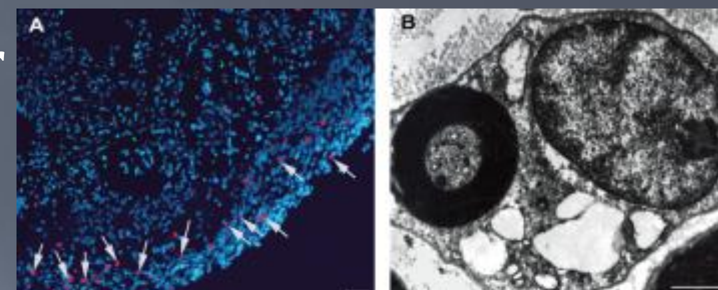
- Limited amount of human nerve tissue
- Animal models
- Understanding the molecular and cellular pathogenesis of CNC injury

Khoa Pham, B.S.,1 and Ranjan Gupta, M.D.1–3
Neurosurg Focus 26 (2):E7, 2009

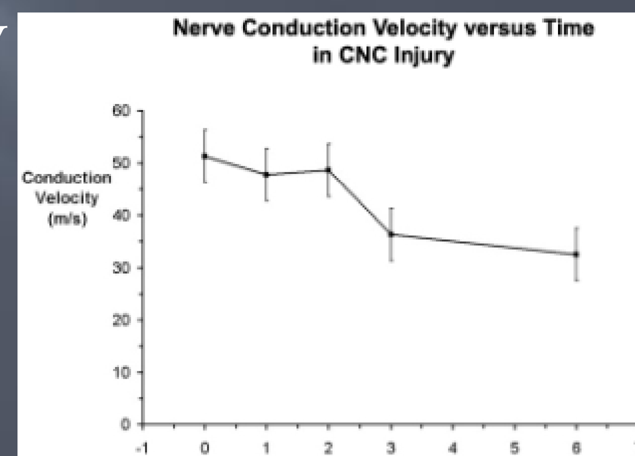
Nerve damage evidence



- Schwann cell proliferation and apoptosis
  in the early stages of the disorder



- Downregulate myelin , proteins, leading to local demyelination and remyelination in the region of injury



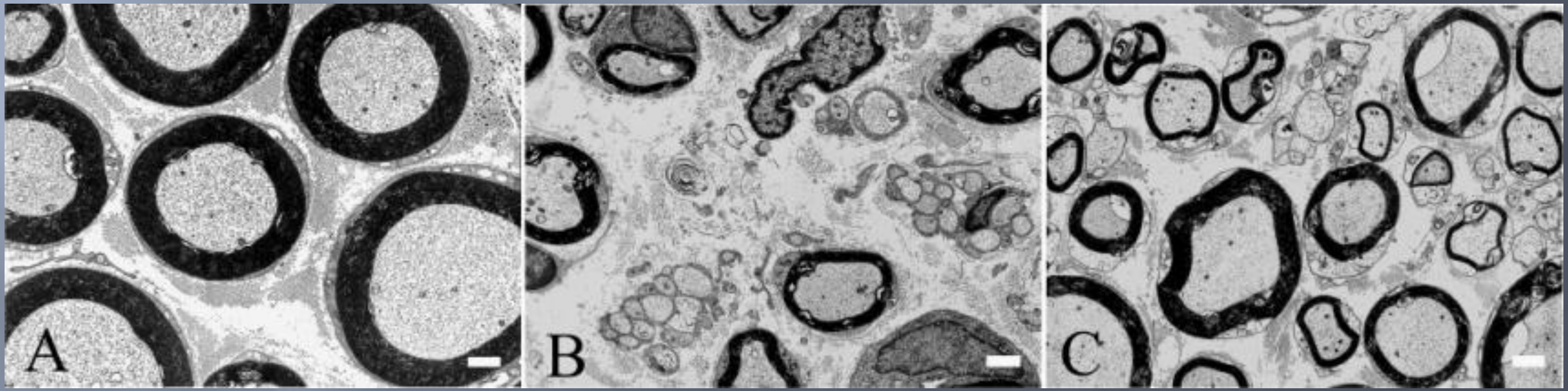
- No morphological or electrophysiological evidence

Khoa Pham, B.S.,1 and Ranjan Gupta, M.D.1–3
Neurosurg Focus 26 (2):E7, 2009

Changes in nerve after injury

Following injury, there is reorganization of this basic structure, - increase in the average g-ratio (axon diameter/total fiber diameter) from

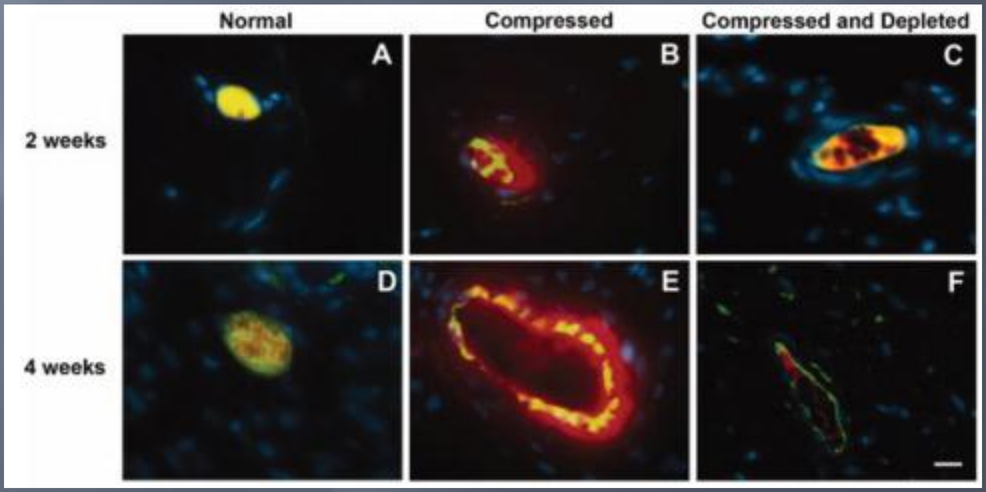
~ 0.6 to 0.8 in rodent models of CNC.



EM of sections of rat sciatic nerves obtained in control animals (A), after 1 month of compression (B), and after 8 months of compression (C). 1-month show decreased myelin thickness with intact healthy axons, with a significant increase in the number of Schwann cells and unmyelinated axons. Pathological features were localized to the periphery of the nerve; the center remained normal. The 8-month s show a similar decrease in myelin thickness; however, the increased number of unmyelinated axons is not present. Bar = 1 μm.

Changes in neurovascular barrier

- **Macrophage Recruitment Following CNC Injury**
- Gradual infiltration of macrophages over a period of weeks into the
- An interruption of axonal architecture is a trigger For macrophage recruitment
- Therefore, the primary role of macrophages to participate in the clearance of axonal and myelin debris.



Animal models for CNC

- Silastic tube placed around the sciatic nerve of Sprague- Dawley rats
- An angioplasty catheter is inserted into a rabbit carpal tunnel and used to increase the intracarpal pressure
- Repeated electrical stimulation of the flexor digitorum profundus muscle or coaxing the animal into repeated wrist movements.

Pathophysiology – nerve tissue

- Vibration to rat's hind lower limb caused nerve edema after 5 days

- the permeability of
- intraneural microvessels

Intraneural edema following exposure to vibration

Göran Lundborg, Lars B Dahlin, Nils Danielsen, Hans A Hansson, Lars E Necking and Ilmari Pyykkö
Scandinavian Journal of Work, Environment & Health
Vol. 13, No. 4, Stockholm Workshop 86: Symptomatology and diagnostic methods in the hand-arm vibration syndrome: Hässelby Castle, Stockholm, 21—23 May 1986 (August 1987), pp. 326-329

Human nerve pathology

In a postmortem study

subclinical entrapment of the median and ulnar nerves, a

Thickening of the endoneurium, perineurium, and pineurium was noted

Fibers teased from these nerves – surgery revealed

Thinning and retraction of the myelin and intercalated segments indicative of previous demyelination

microvessels

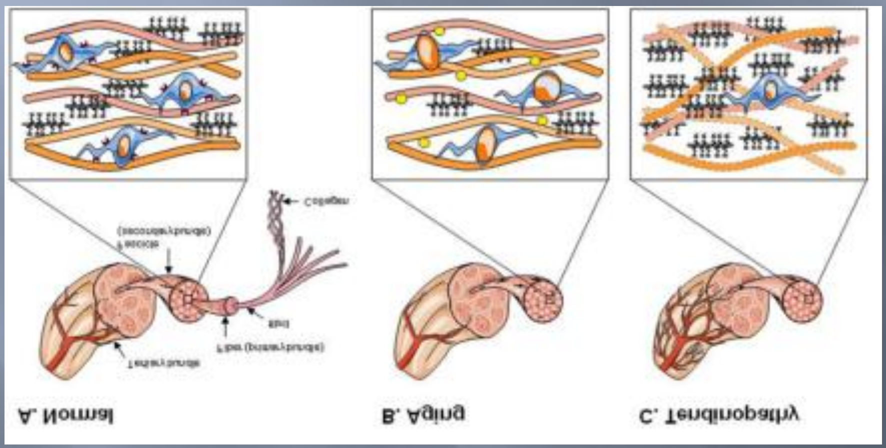
Pathophysiology nerve tissue

- Pressure
- Ishemia

Pathophysiology tendon tissue

<u>Healthy</u>

- Glistering white
- Hirarchial arrangement packed paralel collagen



<u>Tendinopathy</u>

•Grey and amorphos
•Discontinious, disorganized collagen
•Mucoid ground substance
•Tenocytes - plump & chondroid appearance
•Capillary proliferation
•Fibroblastic and miofibroblastic appearance
•**Absence of inflamatory cells**

Karim M. Khan,[1] *Jill L. Cook,*[2] *Fiona Bonar,*[3] *Peter Harcourt*[2] and *Mats Åstrom*[4]

Sports Med 1999 Jun; 27 (6): 393-408

Tendon damage in microtauma

- **In rabbits model**
- Damage induced acutely - an inflammatory cell infiltrate is seen
- **Chronic loading - only degenerative histological changes are seen**
- Early phase of low level inflammation cannot be ruled out.

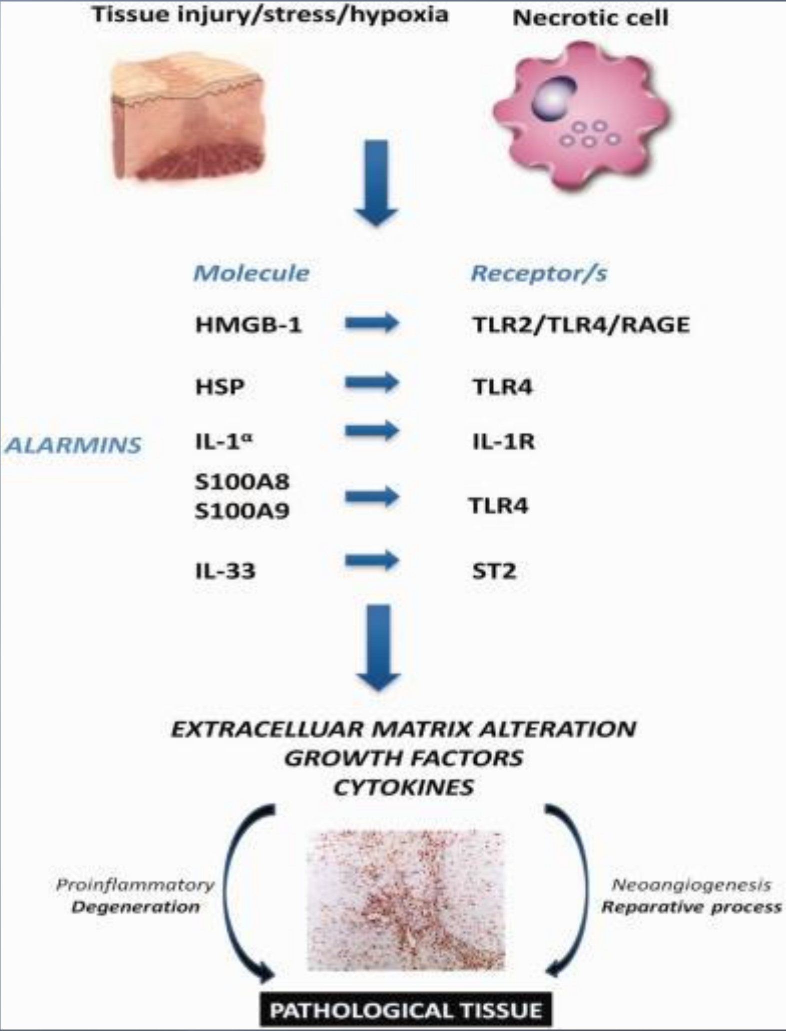
- Repetitive mechanical stretching increases PGE2 production in human patellar tendon fibroblasts. PGE2 is a potent **inhibitor of type I collagen synthesis** and has **catabolic effect** on tendons

Arthritis Res Ther. 2009; 11(3): 235.

Pathogenesis of tendinopathies: inflammation or degeneration?

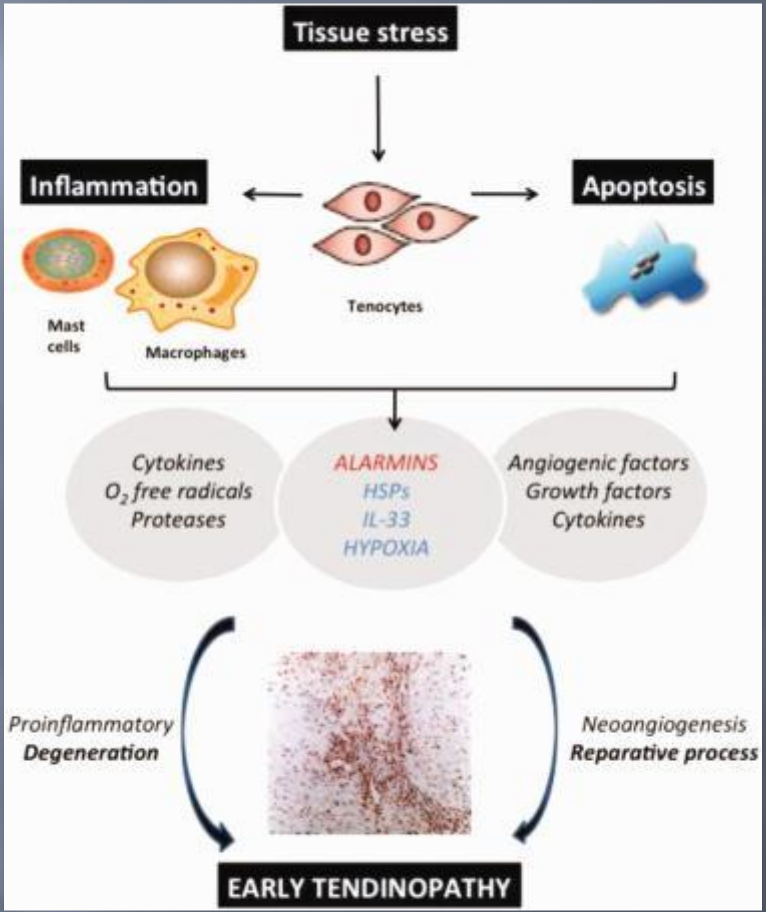
Michele Abate,[1] Karin Gravare-Silbernagel,[2] Carl Siljeholm,[3] Angelo Di Iorio,[4] Daniele De Amicis,[5] Vincenzo Salini,[5] Suzanne Werner,[3] and Roberto Paganelli[6]

The biology of alarmins in inflammatory disease.Tissue damage/stress results in the release of alarmins which in turn signal via the highlighted receptor complexes.



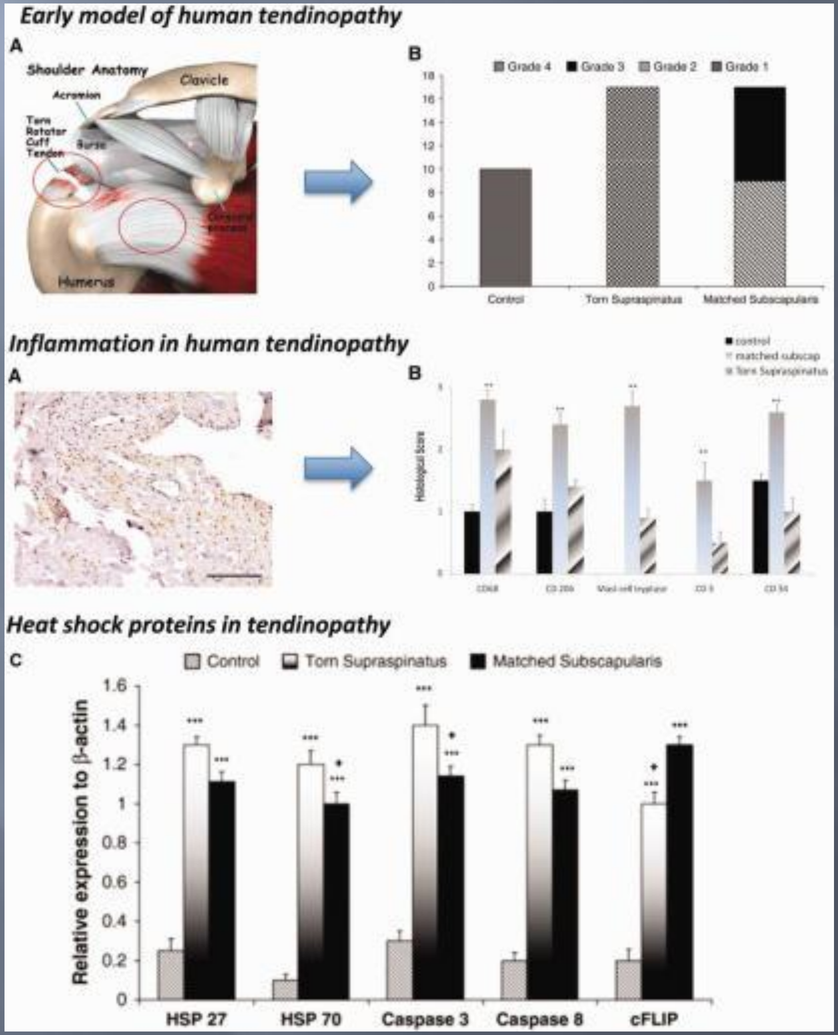
Millar N L et al. Rheumatology 2013;52:769-779

Overview of alarmin biology in tendinopathy.Schematic diagram illustrating the manner in which early tendinopathy may arise due to alarmin release.



Millar N L et al. Rheumatology 2013;52:769-779

Key molecular events in tendinopathy.Early human tendinopathy: (A) Anatomical depiction of biopsy sites within the shoulder highlighted by red circles.



Millar N L et al. Rheumatology 2013;52:769-779

Key pathological features of tendinopathy

Findings	Macroscopic	Light microscopy	US findings
Normal tendon	Brilliant white	Organized parallel collagen bundles	Regular uniform fibre structure
	Firm fibroelastic texture	Spindle shaped tenocyte nuclei	Parallel hyperechoic features
		Parallel nuclei alignment	
Tendinopathy	Grey or brown	Disorganized collagen bundles	Local hypoechoic areas
	Thin tissue, fragile and disorganized	Round dark-stained tenocyte nuclei	Irregular fibre structure
	Loose texture	Increased number of nuclei with loss of parallel arrangement	Neovascularization on power Doppler
		Mucoid degeneration and vacuoles	Widening of tendon
		Increase of vascular and nerve ingrowth	
		Increased ground substance and GAG	

Tendinopathy summary

- The exact pathogenesis of chronic tendinopathy remains largely unknown but seems to be overuse & multifactorial process.

- Vascularization and ischemia and metabolism changes
- Anatomical changes
- Deseases and medocations

- The scientific background for most of these suggestions is lacking

Bony changes in microtrauma

Pathophysiology of stress fracture animal model

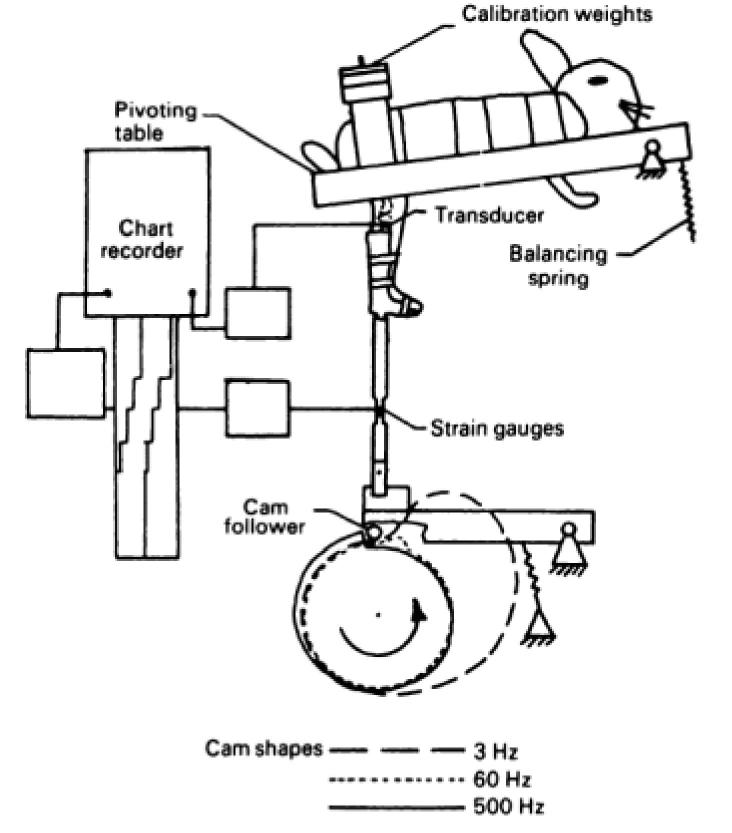


Fig. 1

The apparatus used to apply cyclical loading to the rabbit hind limb. Reproduced with permission from Paul et al (1978).

Fig. 2d

Scintigraphic images of rabbit hind limbs to show the grading system used to evaluate uptake of ^{99m}Tc: a) grade 1, b) grade 2, c) grade 3, and d) grade 4. Focal changes around the knee and ankle were excluded from the evaluation.

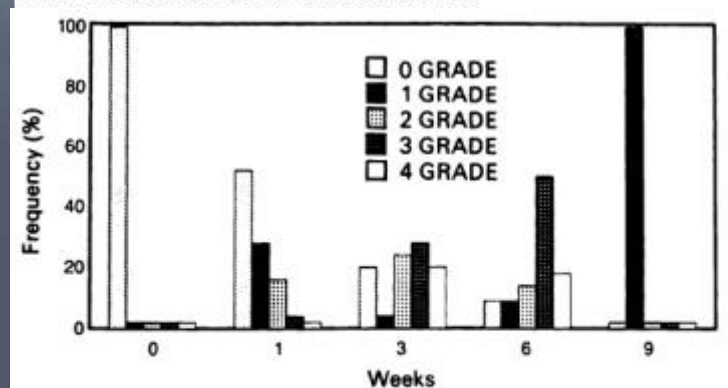


Fig. 3

Histogram showing the grade of scintigraphic lesions after each time period. The severity of the lesions increased up to six weeks; the absence of severe lesions after nine weeks may indicate some spontaneous healing.

DB Burr; C Milgrom; RD Boyd;WL Higgins;G

J Bone Joint Surg [Br] 1990; 72-B: 370–5.

Pathophysiology of stress fracture animal model 2

- Acute phase
- Healing

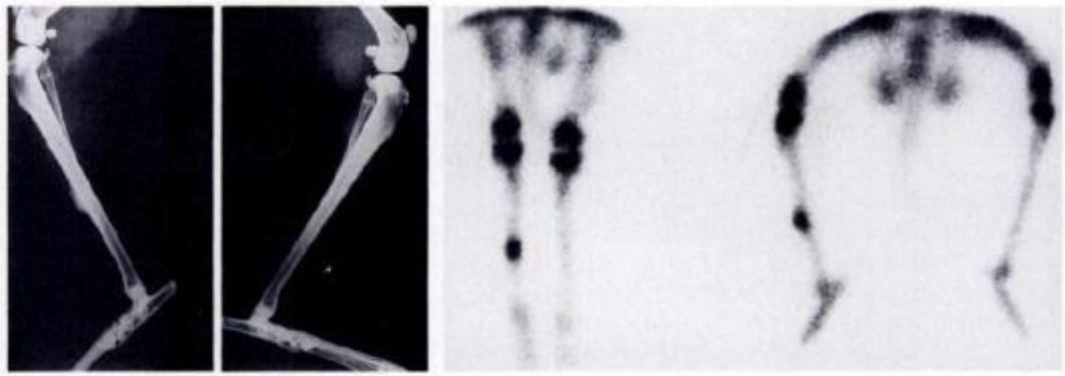


Fig. 6

Radiographs and scintigraphic images showing the corresponding change produced by a stress fracture.

Fig. 7a

Fig. 7b

Many micro-cracks were observed in the tibiae with positive bone scans: photomicrographs from separate animals show micro-cracks (arrows) found in the areas in which ^{99m}Tc uptake was increased (Magnification × 30).

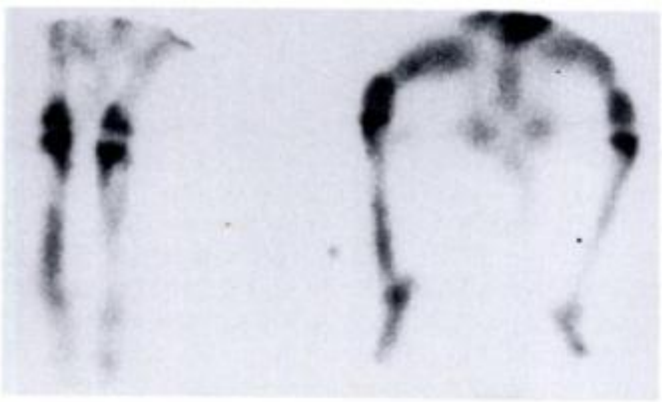


Fig. 5

Scintigraphic image of a rabbit hind limb which showed evidence of spontaneous healing. The edges of the lesion are no longer clearly demarcated and the uptake of ^{99m}Tc is diffuse.

Pathophysiology stress fracture

- Osteoclastogenesis / Osteoblastogenesis
- Repetitive loading in the setting of inadequate remodelling
- Excess strain , acumulation microdamage , fatigue failure , repair

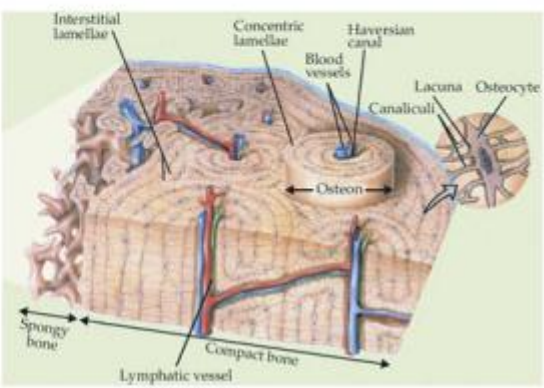


Fig. 1.1 Illustration of the Haversian system and vascular supply in cortical bone. With permission from Springer Science+Business Media: Initiation Fracture Toughness of Human Cortical Bone as a Function of Loading Rate, 2013, C. Allan Gunnarsson

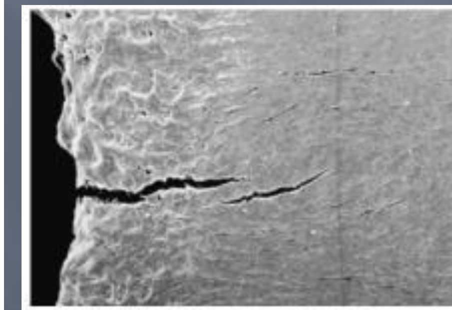
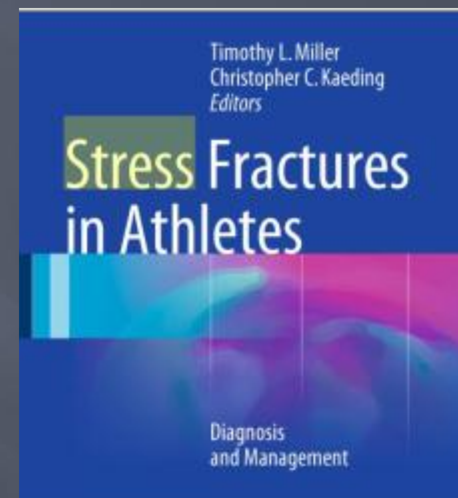


Fig. 1.2 Crack initiation in bone. Reprinted by permission from Macmillan Publishers Ltd: Nature Materials, Nalla RK, Kiney JH, Ritchie O. Mechanistic fracture criteria for the failure of human cortical bone, 2(3). Copyright 2003



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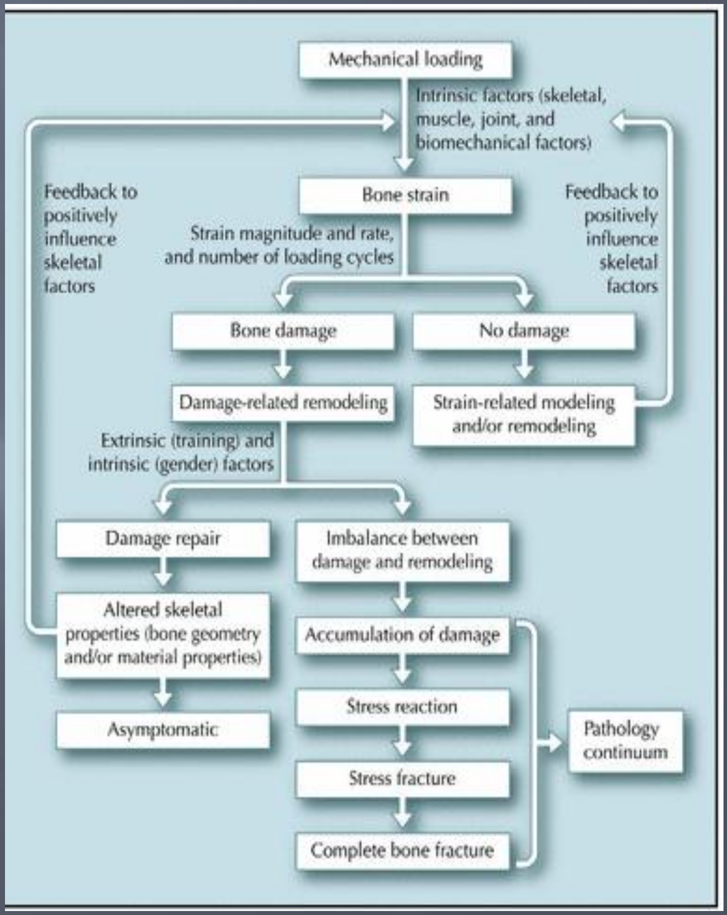
Library of Congress Control Number: 2014951350

Pathophysiology stress fracture

- **Repetitive** bouts of mechanical loading
- **Bone strain** =Change in length/unit length of a bone
- **Microstrain** - usual strain (400-1500MS)

  Stress causing failure (10000 MS)
- Imbalance accumulation **microdemage** and it's removal – **regenerartion**
- **Stress reaction , Stress fructure , complete fracture**
- Number loading **cycles, rate, magnitude, duration**
- **Intrinsic factors** – Genetic
- **Extrinsic factors**



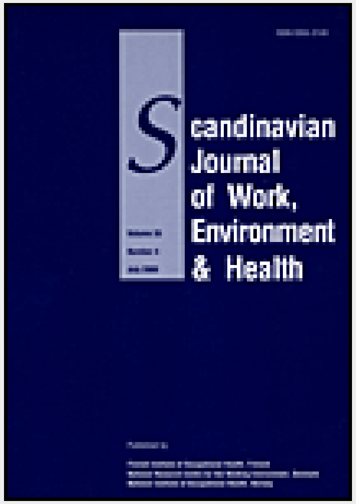
Stress Fractures: Pathophysiology, Epidemiology, and Risk Factors

Stuart J. Warden, PhD, PT, David B. Burr, PhD, Peter D. Brukner, MBBS

Current Osteoporosis Reports 2006, **4**:103–109

Radiology

Radiological documentation of bone and joint pathology in the hands and arms of workers using vibrating tools



Bone and joint pathology in workers using hand-held vibrating tools: An overview [with Discussion]

Gösta Gemne, Helena Saraste, Eberhard Christ and Heinrich G Dupuis
Scandinavian Journal of Work, Environment & Health
Vol. 13, No. 4, Stockholm Workshop 86: Symptomatology and diagnostic methods in the hand-arm vibration syndrome: Hässelby Castle, Stockholm, 21—23 May 1986 (August 1987), pp. 290-300

Microtrauma due to vibration

The closer the organ is to vibration source the more it will be affected.

Vibration

Can lead to injury when you are:

- Using reciprocating tools
- Using grinding or impact tools
- Using vibrating tools

- Working in or on motorized vehicles

Vibrating tools

Pneumatic percussive tools may cause premature elbow and wrist osteoarthrosis

- . Exposure to **low-frequency** percussion may, however, play a particular etiologic role
- Exposure to vibration of **higher frequencies** (such as from rotating drills, grinders, and chain saws) **does not** seem to be associated with excess bone and joint pathology

Scandinavian Journal of Work, Environmen... Vol. 13, No. 4, August 1987

Epidemiology

- May be the most important tool to assess activity c microtraum

Organ involvement

Overuse & microtrauma - Shoulder

- The overuse syndrome, which is caused by repetitive microtrauma, is another source of intrinsic tendinitis, bursitis, and impingemen

Current Concepts Review - Subacromial Impingement Syndrome*
LOUIS U. BIGLIANI, M.D.†, NEW YORK, N.Y.; WILLIAM N. LEVINE, M.D.‡, BALTIMORE, MARYLAND
J Bone Joint Surg Am, 1997 Dec;79(12):1854-68

Foot and ankle conditions

- There is currently **no unequivocal literature support upon which to invoke cumulative industrial trauma as a clear etiology** of these disorders
- Hallux valgus, interdigital neuroma, tarsal tunnel syndrome, lesser toe deformity, heel pain, adult acquired flatfoot, and foot and ankle osteoarthritis.

Cumulative Industrial Trauma as an Etiology of Seven Common Disorders in the Foot and Ankle: What Is the Evidence?
Gregory P. Guyton, M.D.⇓ Roger A. Mann, M.D. Lauren Eric Kreiger, M.D. Tuvi Mendel, M.D. Julia Kahan, M.D.
Foot & Ankle International **December 2000** vol. 21 no. 12 **1047-1056**

Knee bursitis

- **Conclusions** The study showed a concentration of cases among male workers exposed to heavy workloads and frequent kneeling.

Prevalence of knee bursitis in the workforce
A. **P. Le Manac'h[1], C. Ha[2], A. Descatha[3], E. Imbernon[2] and Y. Roquelaure[1]**
B. Occup Med (Lond) (2012) 62 (8):658-660.

Overuse syndromes in musicians

- Upper limb are common in musicians.
- Lhours spent playing.
- Pathological causes are as well as the ergonomic patterns of playing required of some instruments and other anatomical factors that predispose.
- Strings, saxophone, piano, trumpet

Clinical Rheumatology April 2013, Volume 32, Issue 4, pp 475-479 Date: 08 Feb 2013

Musculoskeletal Disorders and Workplace Factors

A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

July 1997

Neck

- 40 epidemiologic studies

Table 1. Evidence for causal relationship between physical work factors and MSDs

Body part *Risk factor*	Strong evidence (+++)	Evidence (++)	Insufficient evidence (+/0)	Evidence of no effect (-)
Neck and Neck/shoulder				
Repetition		•		
Force		•		
Posture	•			
Vibration			•	

Shoulder

- 20 epidemiologic studies

Table 1. Evidence for causal relationship between physical work factors and MSDs

Body part *Risk factor*	**Strong evidence (+++)**	**Evidence (++)**	**Insufficient evidence (+/0)**	**Evidence of no effect (-)**
Shoulder				
Posture		•		
Force			•	
Repetition		•		
Vibration			•	

Elbow

- 20 epidemiologic studies

Table 1. Evidence for causal relationship between physical work factors and MSDs

Body part *Risk factor*	**Strong evidence (+++)**	**Evidence (++)**	**Insufficient evidence (+/0)**	**Evidence of no effect (–)**
Elbow				
Repetition			•	
Force		•		
Posture			•	
Combination	•			

Hands and arms of workers using vibrating tools

- There is evidence that work with pneumatic percussive tools (such as chipping hammers and sealers) may cause premature elbow and wrist osteoarthrosis, although of very low prevalence

- Strong dynamic and static joint loading (often in extreme positions of the joint) and the repetitive hand-arm movements

Scandinavian Journal of Work, Environmen Vol. 13, No. 4, August 1987

Hand & Wrist

- 30 epidemiologic studies

Table 1. Evidence for causal relationship between physical work factors and MSDs

Body part *Risk factor*	Strong evidence (+++)	Evidence (++)	Insufficient evidence (+/0)	Evidence of no effect (-)
Hand/wrist				
Carpal tunnel syndrome				
Repetition		•		
Force		•		
Posture			•	
Vibration		•		
Combination	•			

Tendinitis

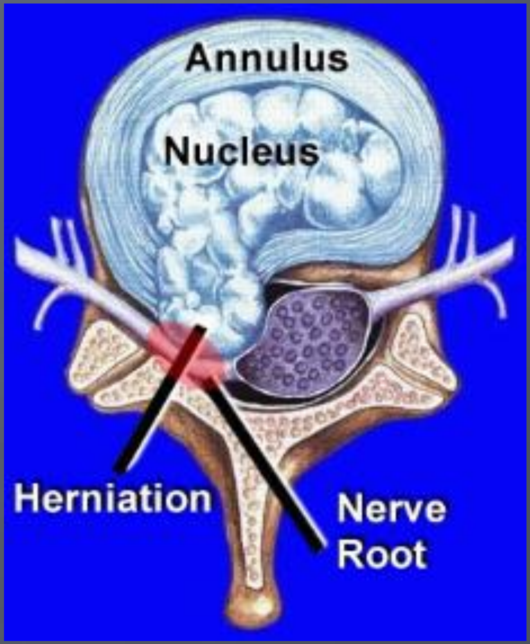
- 20 epidemiologic studies
- Hand and wrist tendinitis
- Hand arm vibration syndrome

Table 1. Evidence for causal relationship between physical work factors and MSDs

Body part *Risk factor*	**Strong evidence (+++)**	**Evidence (++)**	**Insufficient evidence (+/0)**	**Evidence of no effect (-)**
Tendinitis				
Repetition		•		
Force		•		
Posture		•		
Combination	•			

Back

- 40 epidemiologic studies



- Disc weakens and damages is frequently the result of cumulative, repetitive trauma
- Outer disc fibers repeatedly tear and heal as a result of repetitive overloading

Table 1. Evidence for causal relationship between physical work factors and MSDs

Body part *Risk factor*	**Strong evidence (+++)**	**Evidence (++)**	**Insufficient evidence (+/0)**	**Evidence of no effect (-)**
Back				
Lifting/forceful movement	•			
Awkward posture		•		
Heavy physical work		•		
Whole body vibration	•			
Static work posture			•	

Cumulative trauma in foot and ankle

- Hallux valgus, interdigital neuroma, tarsal tunnel syndrome, lesser toe deformity, heel pain, adult acquired flatfoot, and foot and ankle osteoarthritis.
- In none of the disorders analyzed could cumulative industrial trauma be an etiology

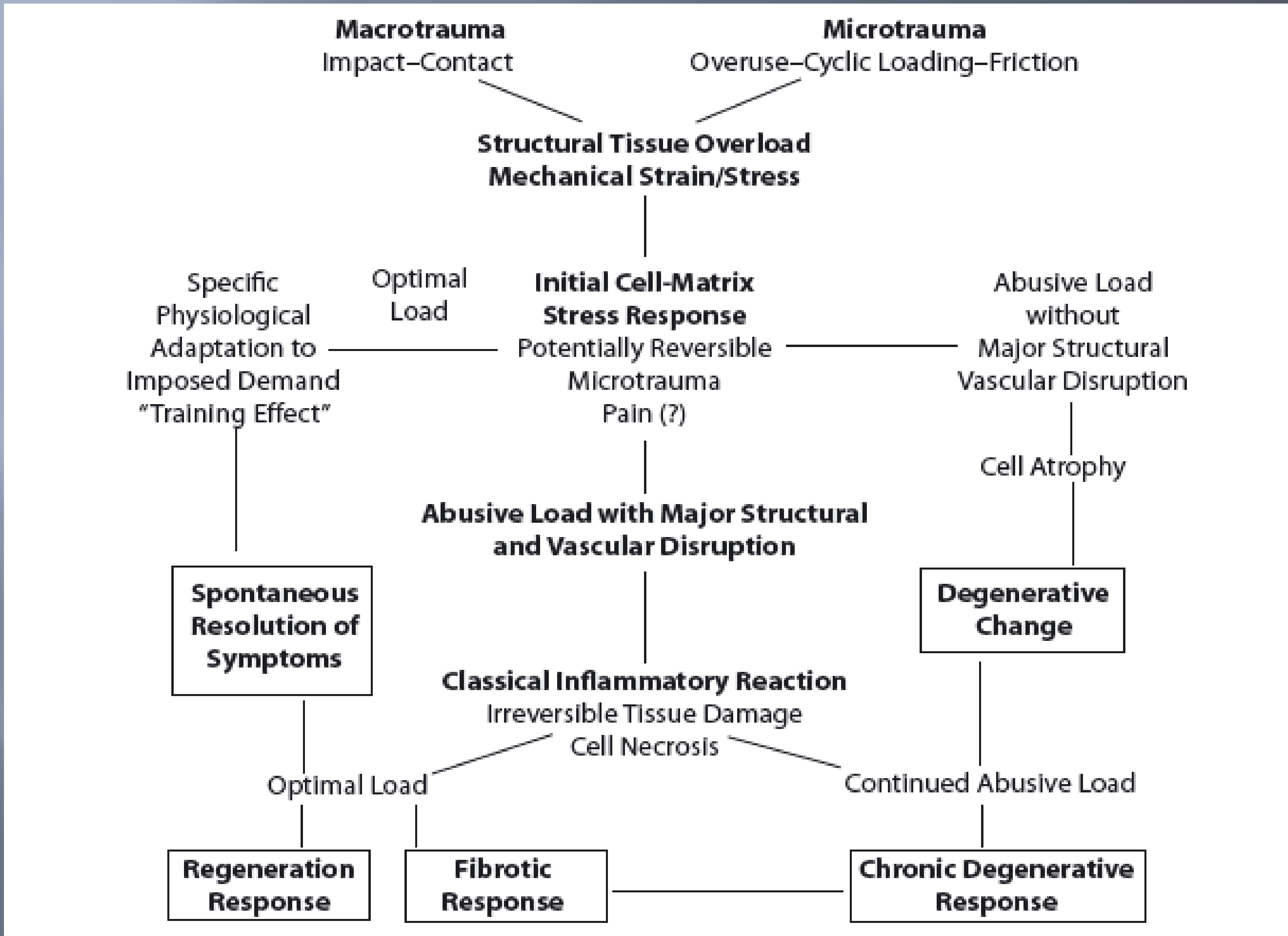
Gregory P. Guyton, Roger A. Mann, Lauren Eric Kreiger, Tuvi Mendel, Julia Kahan, M.D

FAI 2000 21 : 12:1047-1056

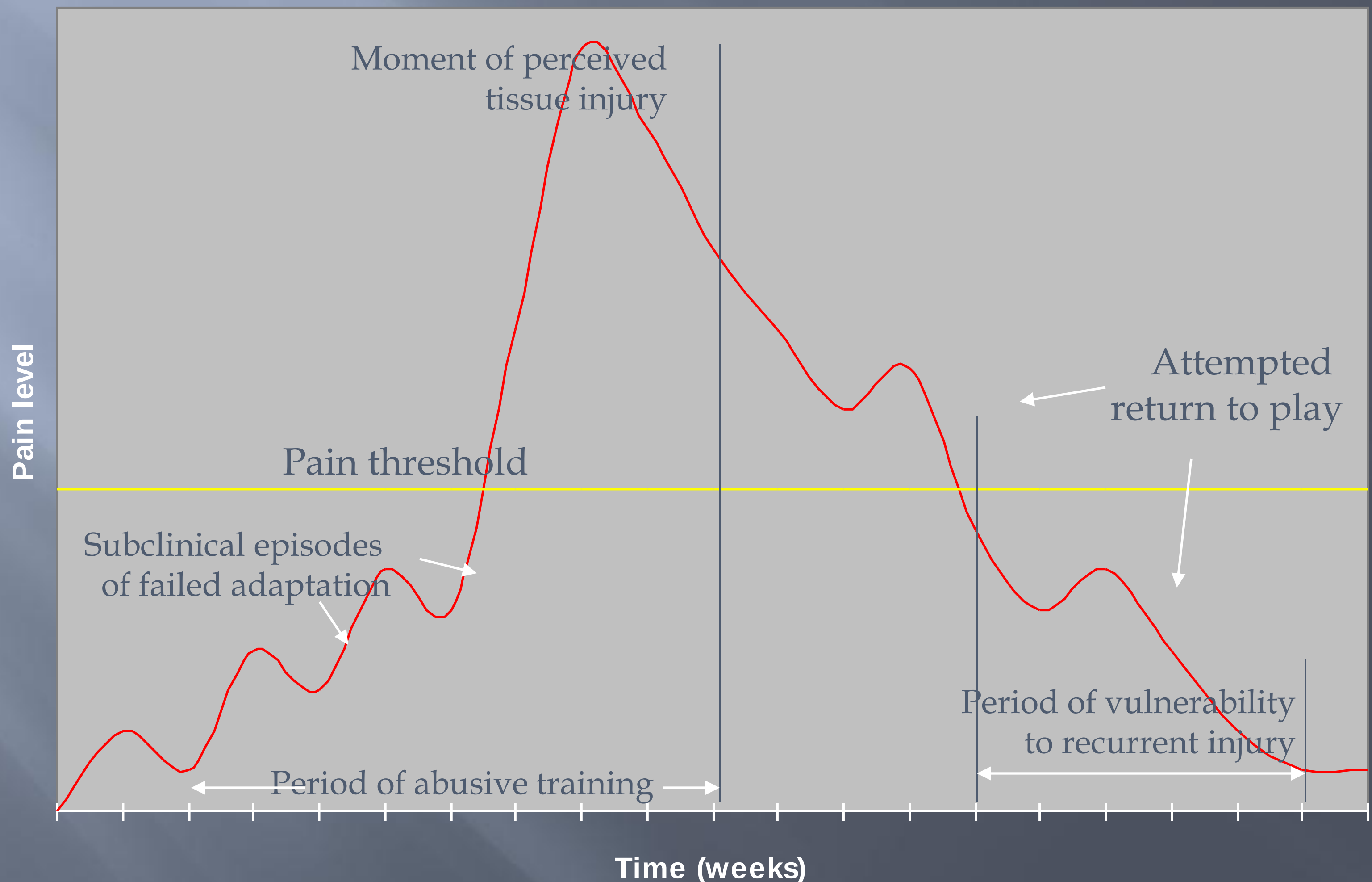
Sport Overuse Injuries

50-65% of sports
injuries
seen in primary care
are secondary to
overuse.

Theoretical pathways of sport induced tissue damage



Profile of Microtraumatic Soft-Tissue Injury



Common Overuse Injury Forms

- Musculoskeletal
  - Bone
  - Tendon
  - Muscle
  - Cartilage
  - Joint capsule
  - Nerve
  - Ligament
  - Bursa

  - Example of mixed overuse injury

- Non-Musculoskeletal
  - Overtraining Syndrome
  - Female Athlete Triad

Chronic occupational repetitive strain injury

Barbara A. O'Neil, MD Michael E. Forsythe, MD William D. Stanish, MD, FRCS

DISORDERS	COMMENT
TENDON-RELATED DISORDERS	
Tendonitis and tenosynovitis	Most common tendon disorders involve inflammation of tendon and sheath
De Quervain's stenosing tenosynovitis	Pain and tenderness along anatomical snuffbox
Epicondylitis (medial epicondylitis or golfer's elbow; lateral epicondylitis or tennis elbow)	Pain and tenderness over unsheathed tendons of either flexor (medial) or extensor (lateral) compartment of the forearm
Rotator cuff tendonitis	Impingement of the supraspinatus tendon (usually) on the acromion causing pain during overhead activities

VOL 47: FEBRUARY • FÉVRIER 2001 ❖ *Canadian Family Physician* •

PERIPHERAL NERVE ENTRAPMENT DISORDER	
Carpal tunnel syndrome	Most common; compression of median nerve; pain, paresthesia on lateral aspect of palm with mild weakness, usually worse at night
Cubital tunnel syndrome	Second most common; similar symptoms to carpal tunnel; due to compression of ulnar nerve in cubital tunnel at elbow
Guyon tunnel syndrome	Impingement of ulnar nerve as it passes through Guyons canal in wrist, producing numbness and tingling in ulnar nerve distribution distal to wrist

Data from Schwartz,[1] Downs,[2] Melhom,[3] Yassi,[4] and Millender and colleagues.[6]

Prevention

Key points

- Diagnosis of repetitive strain injury (RSI) relies on a careful history of work and leisure activities and on physical examination checking for muscle strength, sensation, and deep tendon reflexes. Special physical tests for certain syndromes can also help.

Chronic occupational repetitive strain injury

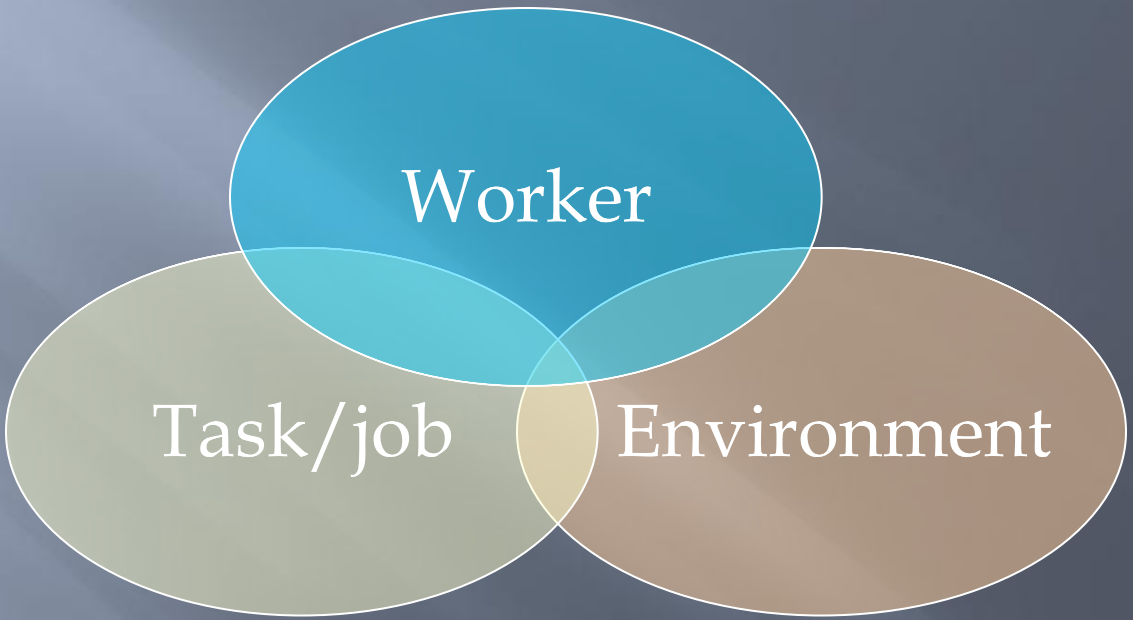
Barbara A. O'Neil, MD Michael E. Forsythe, MD William D. Stanish, MD, FRCS

Editor's key points

- Fit surrounding and job to the worker
- Train worker to his job

- Management strategies include modifying duties and ergonomic adjustments at work and eccentric exercises, which allow the muscle-tendon unit to lengthen against resistance.

What is Ergonomics?



The goal of ergonomics is to design the job to fit the worker,
NOT fit the worker to the job.

Identify Risk Factors for Musculoskeletal Disorders

- Excessive force
- Awkward and/or prolonged postures
- Repetition
- Direct Pressure
- Temperature Extremes
- Vibration
- Work organization

Excessive Forces

Common risky problems:

- Lifting and carrying
- Pushing and pulling
- Reaching to pick up loads
- Prolonged holding
- Pinching or squeezing

Awkward Postures

Common risky postures:

- Working overhead
- Kneeling all day
- Reaching to pick up loads
- Twisting while lifting
- Bending over to floor/ground
- Working with wrist bent

Work Organization

Common issues to look for:

- Scheduling
- Lack of planning
- Communication
  - with crew
  - with other patient stakeholders
- Work practices

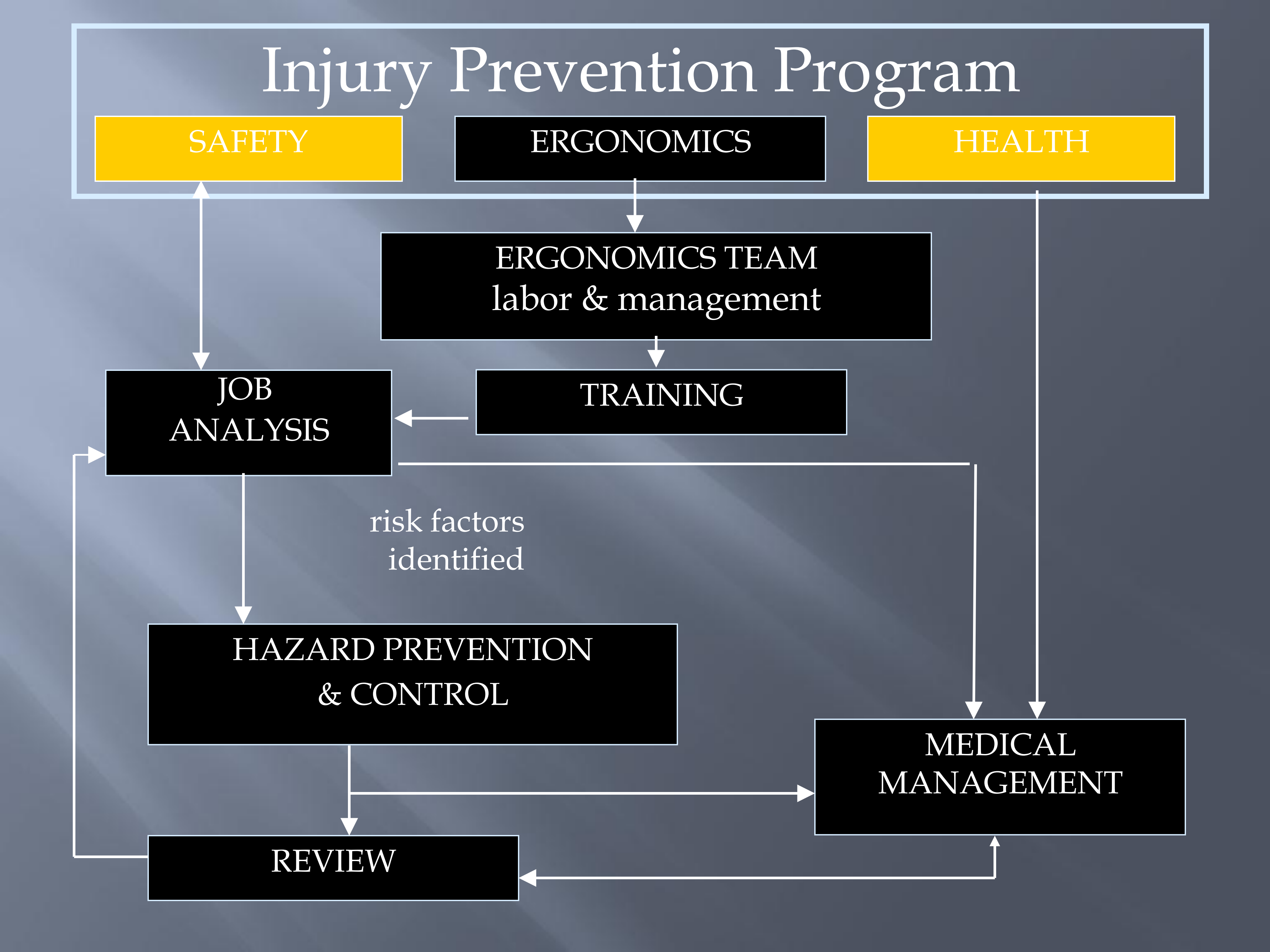
An Activity is Likely to Become an Injury

When:

- You perform the activity frequently
- You do the activity a long time
- The work intensity is high
- There are a combination of factors

Musculoskeletal microtrauma

עפר אלישוב


Injury Prevention Program
SAFETY
ERGONOMICS
HEALTH
ERGONOMICS TEAM
labor & management
TRAINING
JOB
ANALYSIS
risk factors
identified
HAZARD PREVENTION
& CONTROL
MEDICAL
MANAGEMENT
REVIEW

Ergonomics Program Elements

- ✓ Assessment of musculoskeletal hazards
- ✓ Prevention and control of musculoskeletal hazards
- ✓ Training
- A medical management system
- Procedures for reporting injuries
- A plan for the implementation of the program
- Methods for evaluating the program

Breaking Through the Musculoskeletal Injury Plateau
Preventing Microtrauma Injuries

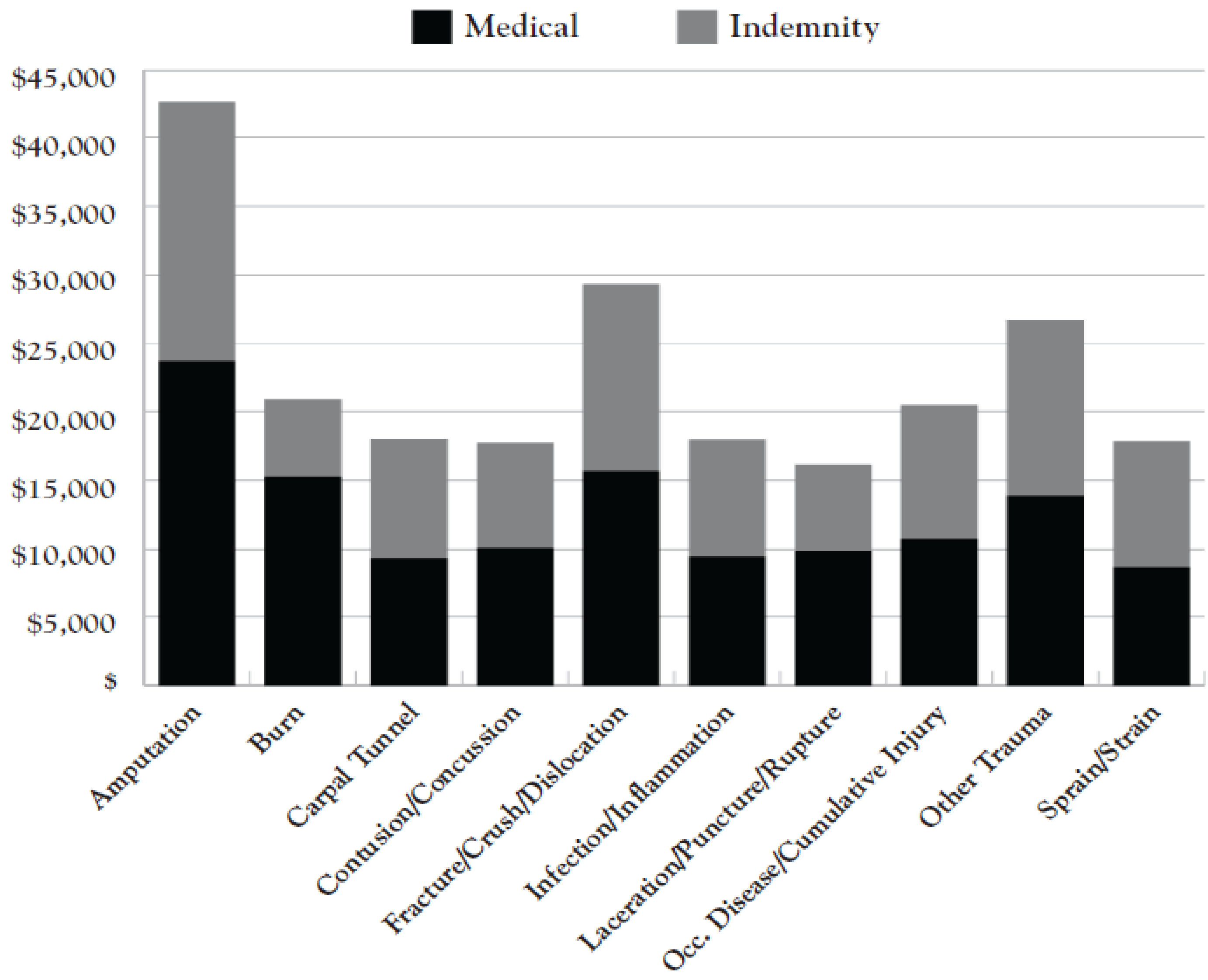
- Sprains' strains. Microtrauma and repetitive stress injuries – contribute significally to the overall cost of injuries in the workplace

The Journal of Workers Compensation

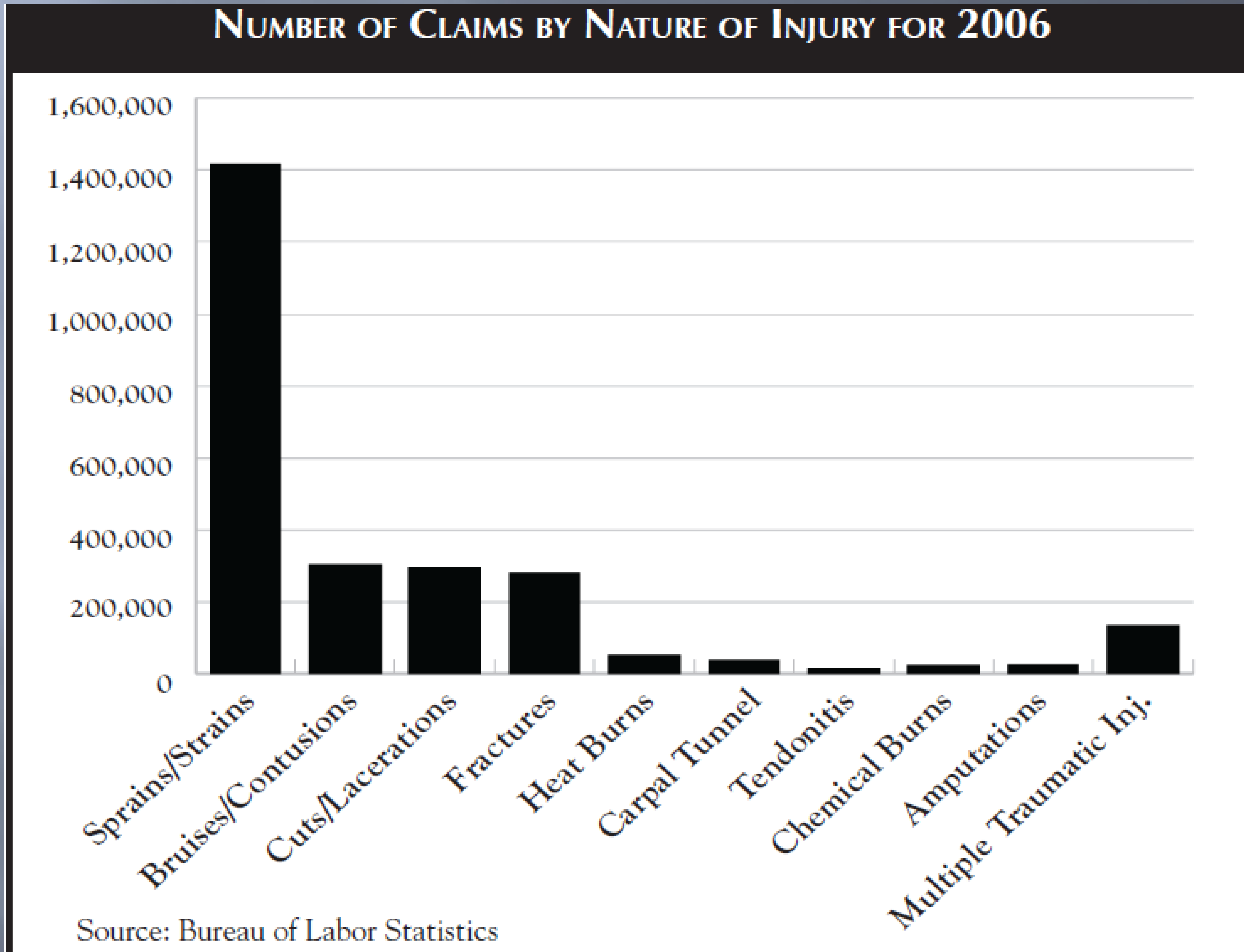
A quarterly review of risk management and cost containment strategies

VOL. 17 NO. 4 SUMMER 2008

Average Total Incurred Costs per Claim by Nature of Injury, 2004–2005



Source: National Safety Council Injury Facts 2008 Edition

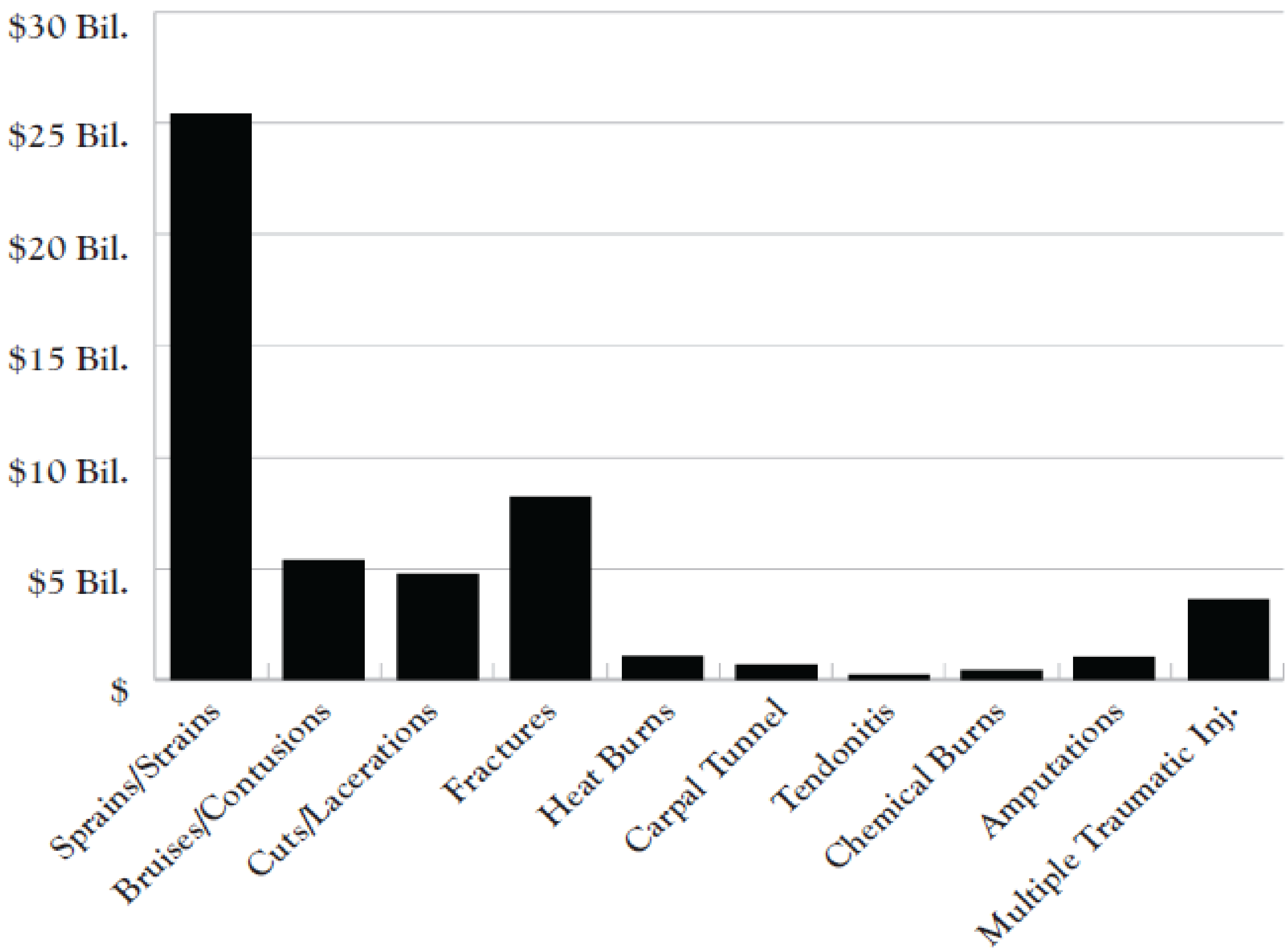

NUMBER OF CLAIMS BY NATURE OF INJURY FOR 2006
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Sprains/Strains
Bruises/Contusions
Cuts/Lacerations
Fractures
Heat Burns
Carpal Tunnel
Tendonitis
Chemical Burns
Amputations
Multiple Traumatic Inj.
Source: Bureau of Labor Statistics

ESTIMATED TOTAL MEDICAL COST BY NATURE OF INJURY

	Total Claims	Avg. Cost per Claim	Total
Sprains/Strains	1,418,210	$17,893	$25,376,031,530
Bruises/Contusions	303,770	$17,690	$5,373,691,300
Cuts/Lacerations	298,360	$16,081	$4,797,927,160
Fractures	282,330	$29,250	$8,258,152,500
Heat Burns	52,310	$20,971	$1,096,933,010
Carpal Tunnel	39,020	$17,971	$701,228,420
Tendonitis	14,260	$20,449	$291,602,740
Chemical Burns	22,470	$20,971	$471,218,370
Amputations	23,970	$42,637	$1,022,008,890
Multiple Traumatic Injuries	136,690	$26,649	$3,642,651,810

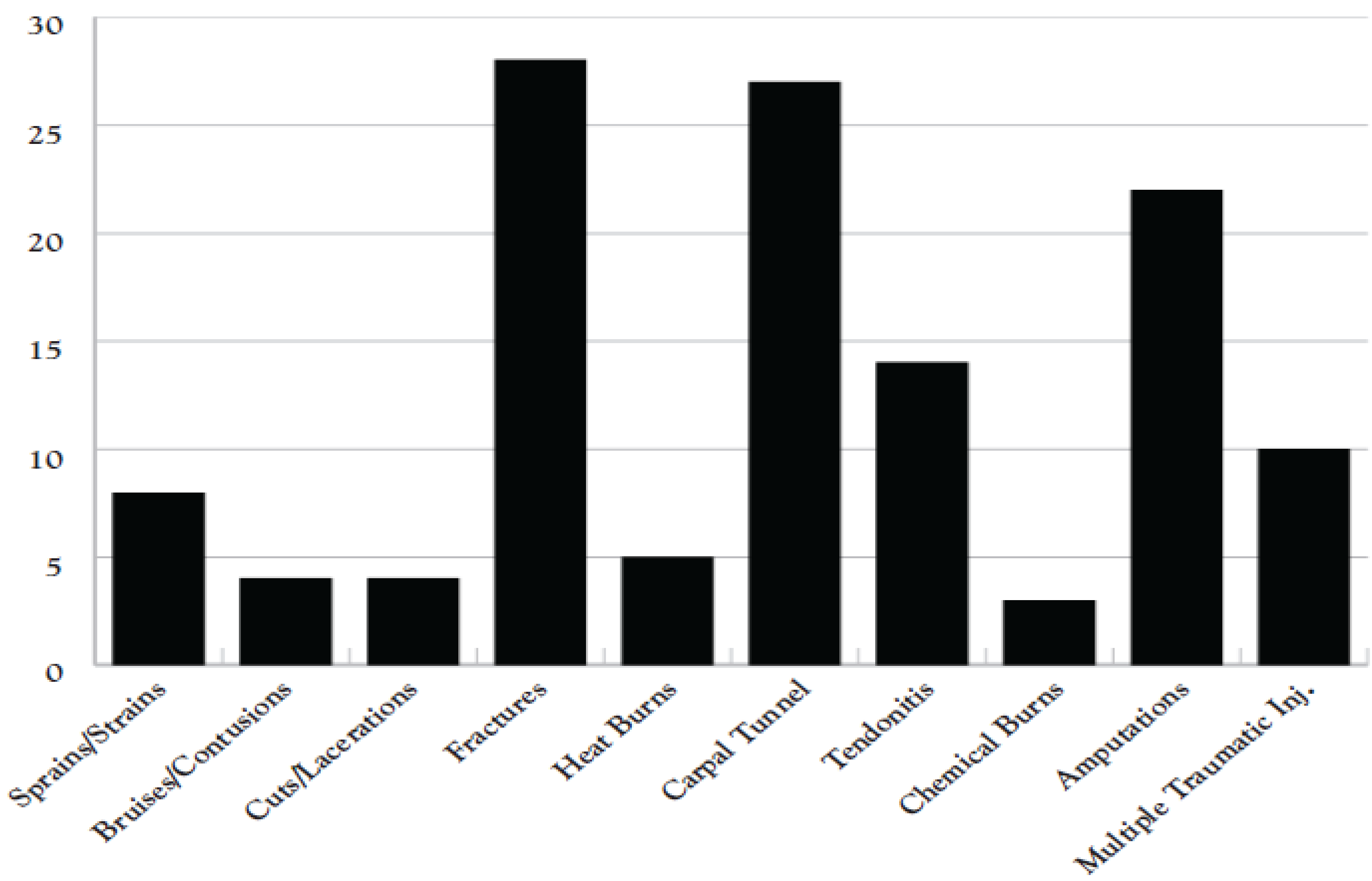
Note: These results were obtained by multiplying the costs per claim by nature of injury for 2004–2005 from the National Safety Council times the number of claims by nature of injury for 2006 from the Bureau of Labor Statistics.

Estimated Total Medical Cost by Nature of Injury



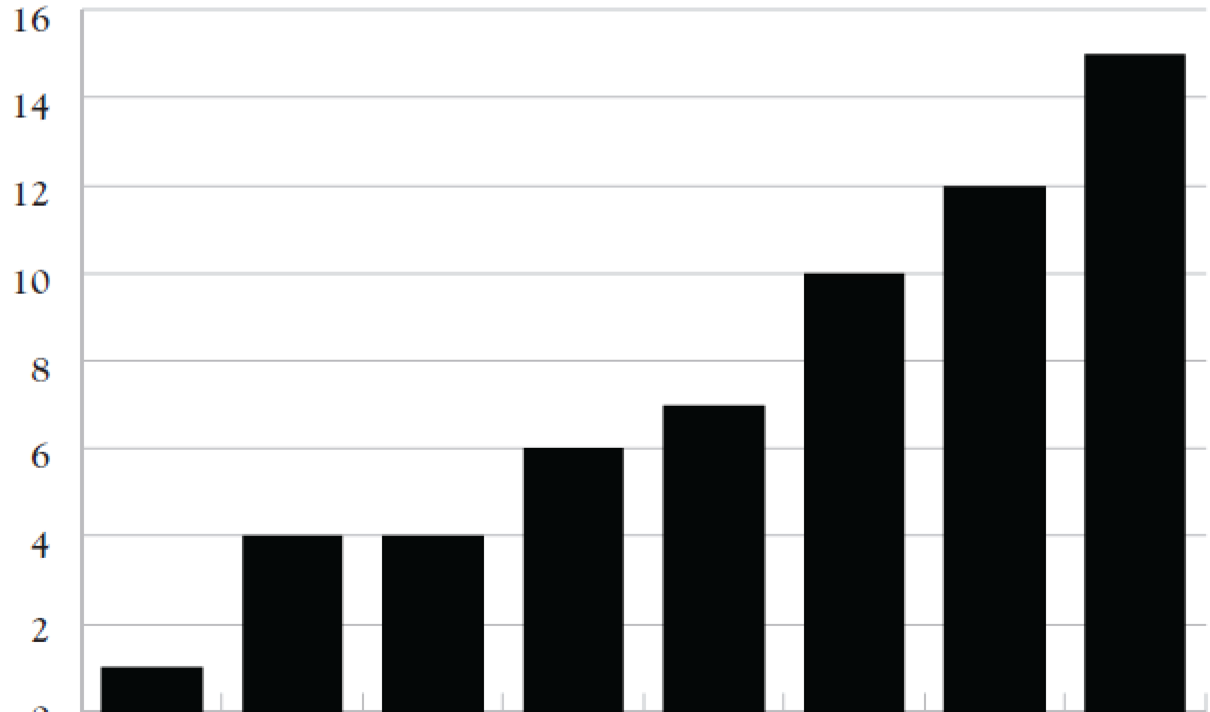
Note: These results were obtained by multiplying the costs per claim by nature of injury for 2004–2005 from the National Safety Council times the number of claims by nature of injury for 2006 from the Bureau of Labor Statistics.

NONFATAL OCCUPATIONAL INJURIES AND ILLNESSES INVOLVING DAYS AWAY FROM WORK



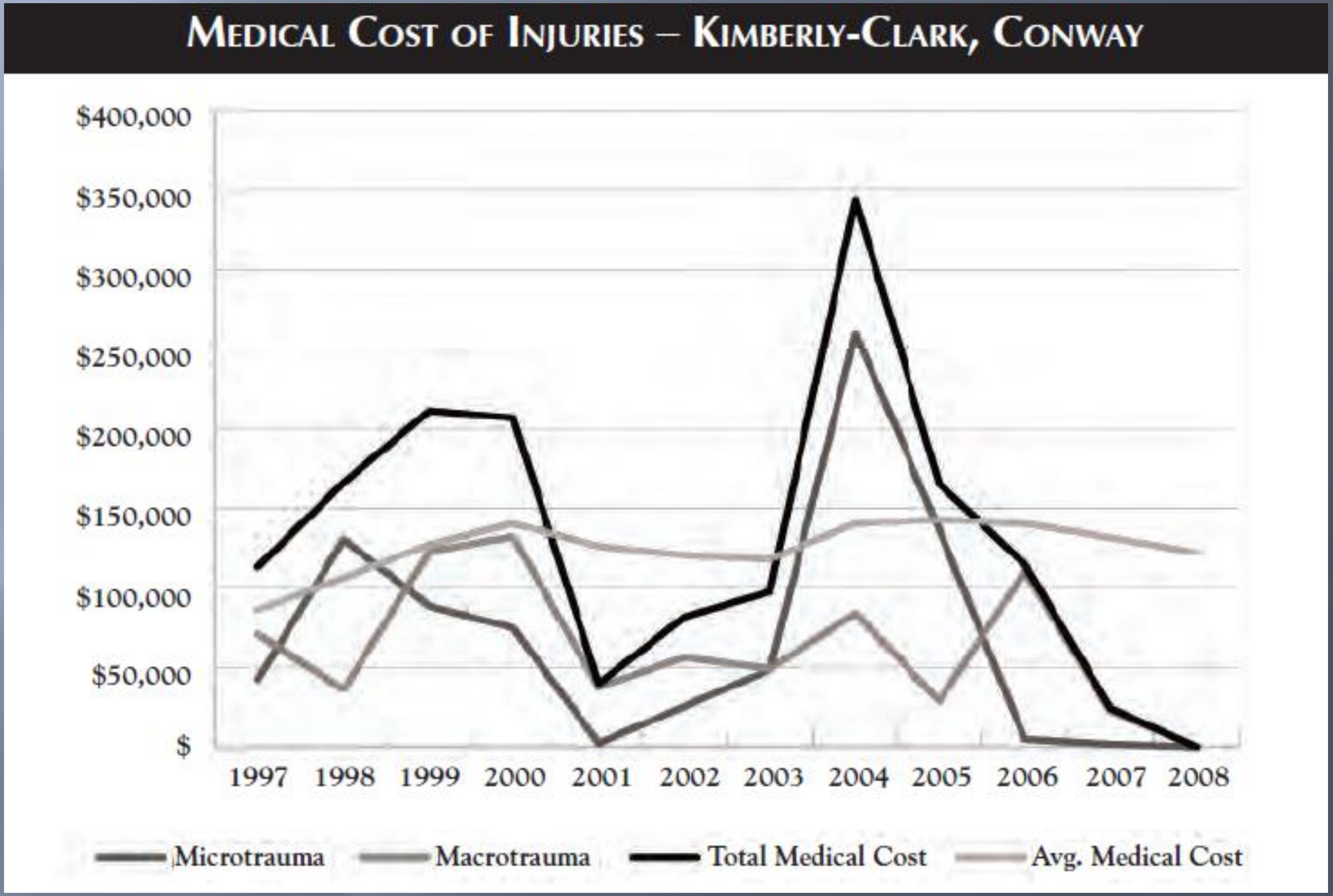
Source: Bureau of Labor Statistics

Nonfatal Occupational Injuries and Illnesses Involving Days Away From Work for 2006 by Age



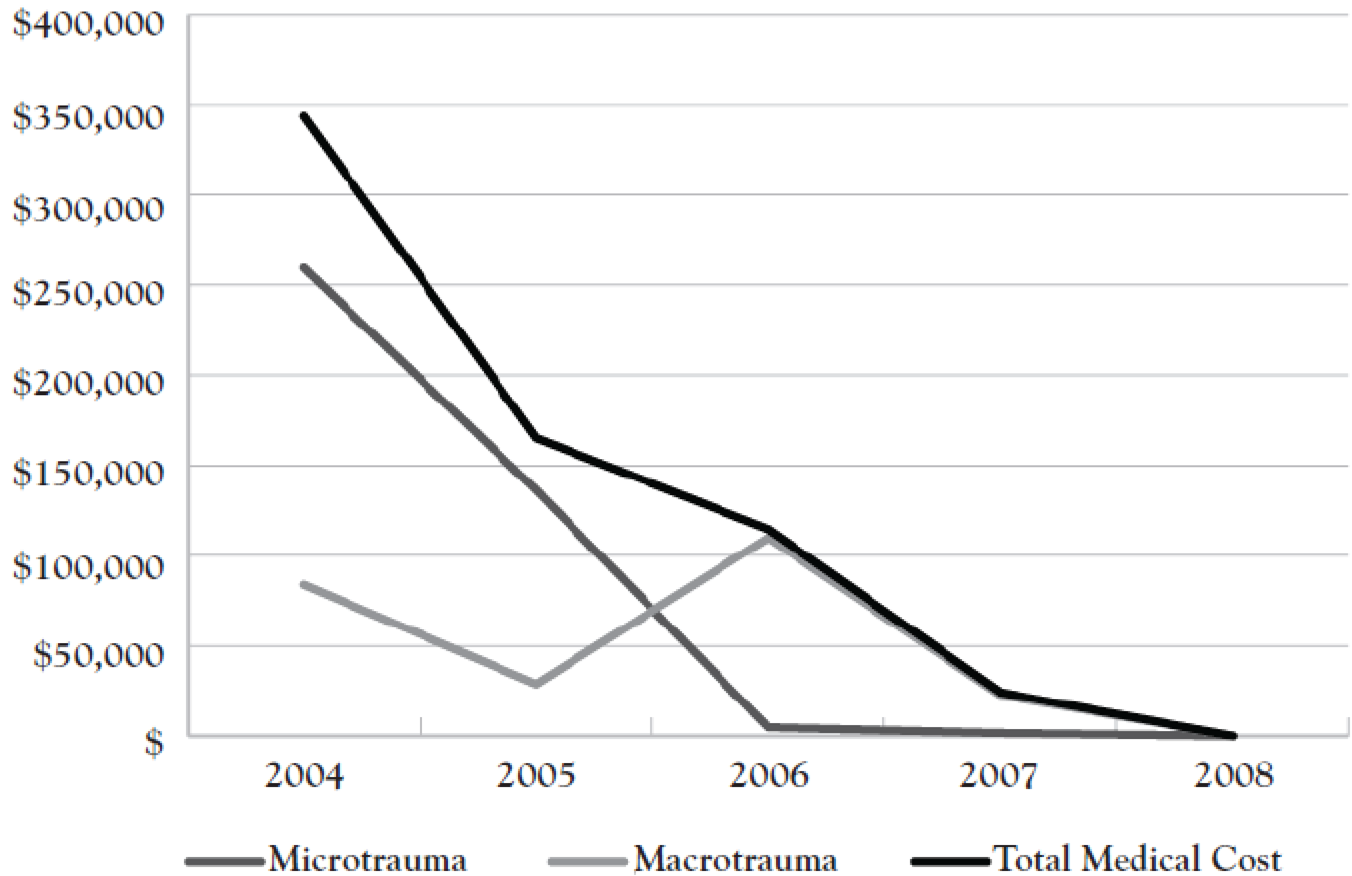
12-15	16-19	20-24	25-34	35-44	45-54	55-64	65 & Over
1	4	4	6	7	10	12	15

Source: Bureau of Labor Statistics, U.S. Department of Labor, Survey of Occupational Injuries and Illnesses in cooperation with participating state agencies.



Medical Cost of Injuries – Kimberly-Clark, Conway
$400,000
$350,000
$300,000
$250,000
$200,000
$150,000
$100,000
$50,000
$
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Microtrauma
Macrotrauma
Total Medical Cost
Avg. Medical Cost

Medical Costs of Injuries — Kimberly-Clark, Conway



Note: All microtrauma claims in 2006 and 2007 are closed. No additional workers compensation expenses for microtraumas will be charged to those years.

Goals

1. Reduce musculoskeletal injuries in the workplace
2. Reduce workers compensation and related costs
3. Identify and reduce risk
4. Increase worker productivity

In 2005, Kimberly-Clark's Conway, Arkansas, manufacturing facility launched a pilot program with InjuryFree, Inc., to reduce musculoskeletal injuries in the workplace, particularly those injuries resulting from microtrauma

The Visions: Prevent Microtrauma and Repetitive Stress Injuries

Conclusions

- Cumulative trauma occurs over time
  - may not result in an injury for many years
  - may be disabling
- Applying ergonomics = injury prevention
- Understand injury risk factors
- Some situations may have little room for improvement, but with others you have the control to improve:
  - equipment
  - work practices
  - bodymechanics

Conclusions

- Repetitive strain injuries continues to be an important health problem
- Epidemic shows no signs of slowing down
- RSI rising social ans financial cost

- Ensuring ergonomically sound work enviroments and adequate time away from work is important to decrease incidence.

Thank you