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# Occupational diseases caused by physical factors

## Musculoskeletal disorders (MSDs)

# MSDs

- Vibration syndrome
- Epicondylitis radialis et ulnaris humeri
- Carpal tunnel syndrome
- Impingement syndrome
- Professional vertebral algic syndrome

# Vibrations

- Mechanical oscillations of source
- Resonance of the head (brain) – 15 Hz
- Types
  - **Whole body** – can cause musculoskeletal, neurologic, circulatory, digestive system disorders, back pain ...
    - **Professions** – special truck drivers, miners ...
  - **Local** – hands – can induce **white-finger disease** (Vibration syndrome, Raynaud's phenomenon, Hand arm vibration syndrome)
    - **Professions** – construction and foundry workers, miners, machinists, shoemakers ...
- Effect on the hands is most frequent at frequency **125 – 300 Hz**
- Effect depend on duration of exposure, **effect is cumulative**
  - First symptoms can occur **after 2000** hours of work, **typically** after more than **8000** hours of work
- **Sources** – pneumatic hammer, electric drill, hand grinders ...

# Vibrations

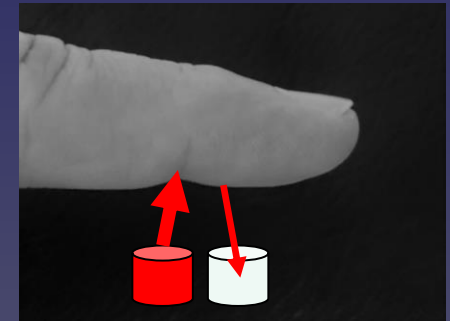
## Damage to health

- Vibration induced **whitefinger disease** – (Raynaud phenomenon)
- **Spasm of digital arteries, arterial muscle wall hypertrophy, demyelitising peripheral neuropathy, microvascular occlusion.**
- Occupational disease is when are damage three from next structures
  - vascular tissue
  - peripheral nerves
  - bones and joints



# Vibrations

- To the diagnostics of irreversible spasm of peripheral microcirculation we use
  - **Cold test** - The hands and whole forearms of the patient are immersed in the water at a temperature of **10 °C for 10 minutes**. The test is judged positive if at least part of one finger is bleached.
  - **Photoplethysmography (FPG)**
    - We measure peripheral blood microcirculation on 3th and 4th finger, before cold test, immediately after cold test and 5 min. after cold test

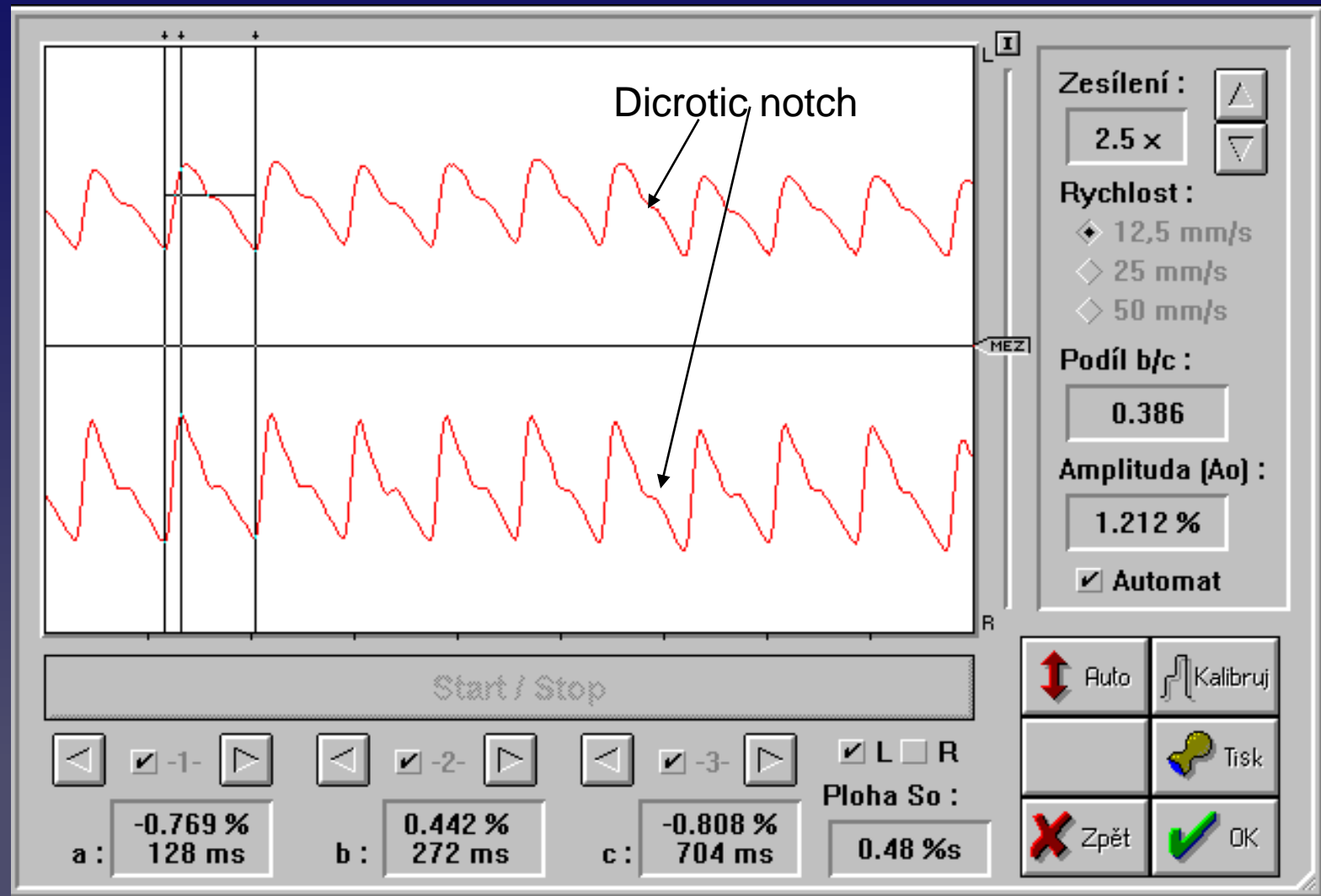


# Vibrations

- For the diagnostic of peripheral neuropathy are necessary
  - Neurological conciliar examination
  - Electromyography (EMG)
- For the diagnostic of pathologic changes of bones and joints are important
  - Orthopedic conciliar examination
  - X ray – hands, elbows

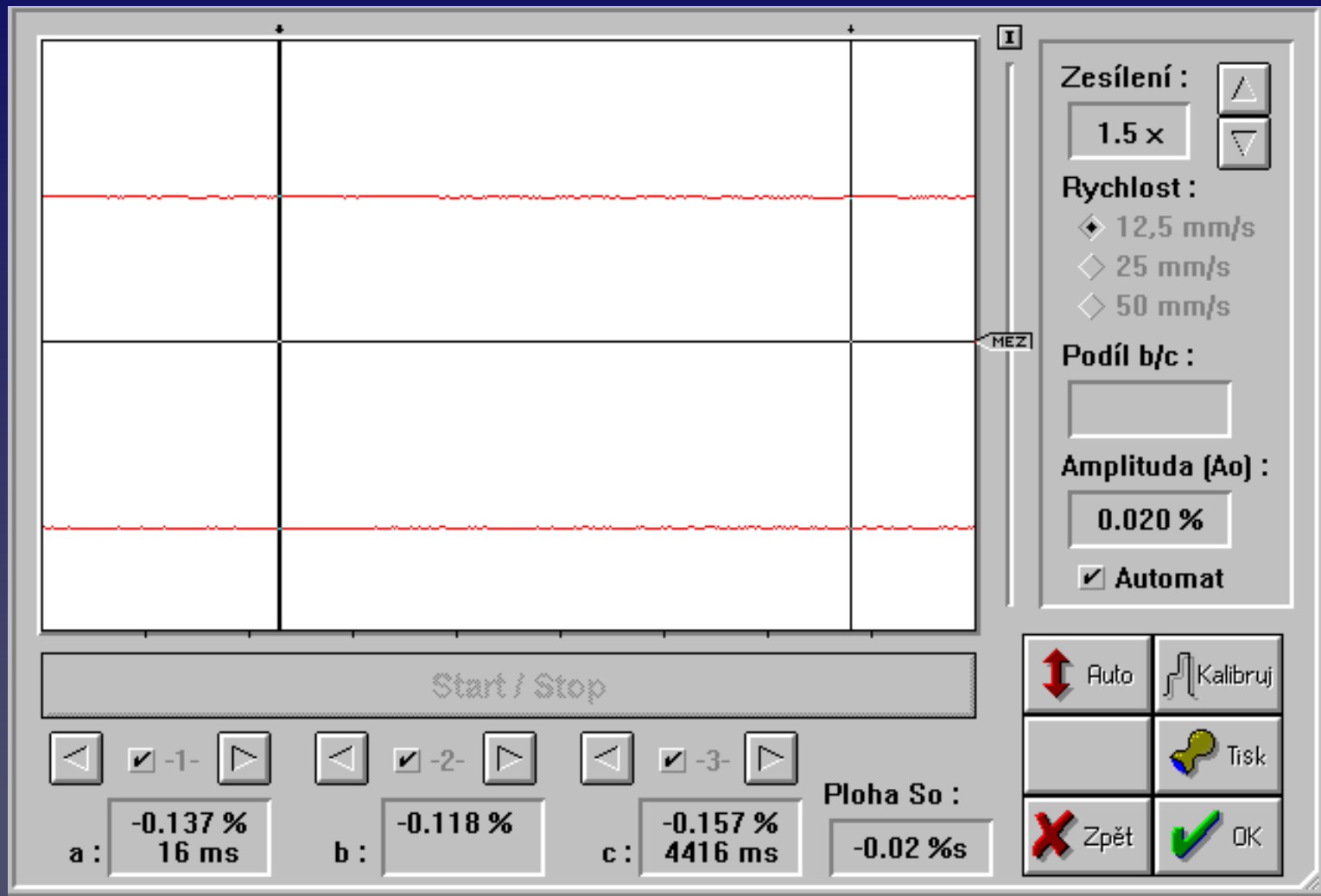
# Vibrations

Normal FPG curve



# Vibrations

## Pathologic FPG curve – Decomposition of curve





# MSDs after long-term, excessive and repetitive overloading

## Primary harmful factors:

1. Long-term – more years, usually 10 and more, depend on individual capacity of worker
2. Overload – permanent using of force more than 15% ( $F_{\max}$ ) cause unsatisfied regeneration of tissue and accumulation of anaerobe products
  - Static work – excessive force is over 10%  $F_{\max}$
  - Dynamic work – excessive force is over 20%  $F_{\max}$
  - Number of movements –

3. One - sided activity – repetitive movement more than half of work time, can cause damage of musculoskeletal structures

% $F_{\max}$	Počet pohybov za zmenu – 480 min.	Počet pohybov za minútu pri trvaní sťahu $\leq 2s$	Počet pohybov za minútu pri trvaní sťahu $\leq 3s$
7	27 600	37	24
8	24 300	36	23
9	21 800	34	22
10	19 800	33	21
11	18 100	32	20
12	16 700	30	19
13	15 500	29	19
14	14 000	28	18
15	13 500	27	17
16	12 700	26	16
17	12 000	25	15
18	11 400	24	15
19	10 900	23	14
20	10 400	22	14

# MSDs after long-term, excessive, unilateral overloading

## Secondary harmful factors:

- Microclimatic conditions
  - vibrations, noise, cold, neurotoxic substances ...
- Disposition of work place
  - unrespect of physiological position of arms, elbows, wrists
- Bad organization of work
  - No breaks
  - No changes of different activities during the shift
  - The work under time pressure
  - Stress ...



# MSDs after long-term, excessive, unilateral overloading

## Individual factors:

- Total fitness of workers
- Constitution of body
- Functional state
- Genetic attributes
- Other diseases of worker
  - Rheumatic diseases
  - Past injuries
  - Neuroinfections
  - Thyroid hypofunction
- Other similar activities, which are not connected with work



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# MSDs after long-term, excessive, unilateral overloading

## Examples of work:

- Working tools with different weight – stone-breakers, stonecutters, sawyers, miners
- Works on assembly lines, using of tools with small handle – shoemakers, butchers, bricklayers, hairdressers, stomatologic laboratory technician, dentists
- Works in enforced positions of the limbs – inside pipes, boilers, cisterns, carpenters
- Glass making – blowing, grinding, polishing
- Stereotype work of small muscles groups
- Work connected with pressure on nerve trunk - glass-grinder



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# MSDs after long-term, excessive, unilateral overloading

## Ethiopatogenesis:

- Aseptic inflammation of tendon and bursa – short time for regeneration
  - Damage or destruction chondrocytes
  - Swelling of tissue – moving malfunction inside bursa
- Joint changes – lead to athrosis
  - Damage of structure hyaline cartilage and subchondral bone
  - Progressive destruction intraarticular structures by exudates lead to narrow of distance between joint structures
  - Change of extraarticular structures – muscle, tendons
- Damage of peripheral nerves
  - Irritative manifestation – paresis, dysesthesia, hyperhidrosis
  - Hypotrophy of muscles
  - Weaken of muscles forces

# Occupational disorders due to overloading

## Groups of occupational disorders:

1. Injure of bursae – bursitis
  - Bursitis olecrani, Impingement syndrome ...
2. Injure of menisci
3. Injure of tendons and bursae
  - Tendovaginitis stenotisans – De Quervain tendosynovitis
4. Enthesopathias
  - Enthesopathy of insertion of extensors of the hand on radial epicondyl
  - Enthesopathy of insertion of flexors of the hand on ulnar epicondyl
5. Nerves paresis
  - Paresis n. mediani – Carpal tunnel syndrom
6. Isolated arthroses – a.g. arthrosis of the one knee

# Occupational disorders due to overloading

## Lateral humeral epicondylitis (tennis elbow)

- Symptoms:
    - Pain of the elbow during and after work
    - Pain spreads along the extensors
    - In the forearm muscle force is significantly reduced
  - Clinical finding and examination:
    - Painful palpation of radial epicondyls
    - Hypotrophy of antebrachial extensors
    - Positivity of provocative tests
      - Painful handgrip
      - Painful dorsal extension the wrist against resistance
      - Painful extension of III. Finger against resistance →
- (The patient feels pain in the radial epicondyle)



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# Occupational disorders due to overloading

## Lateral humeral epicondylitis (tennis elbow)

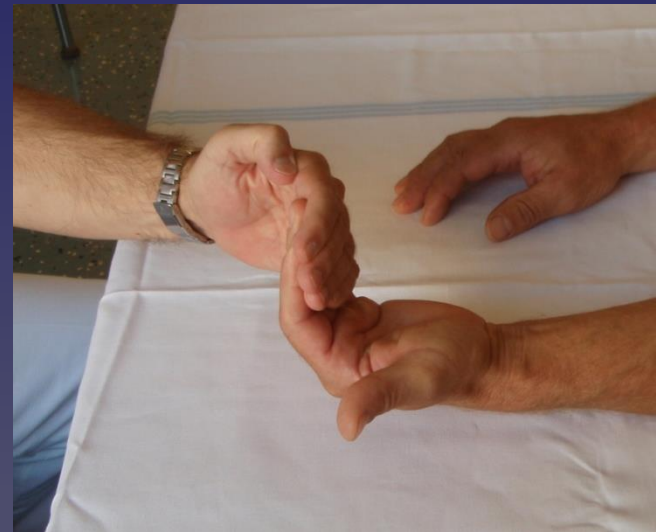
- Other diagnostic examinations
  - X- ray findings can be normal
  - X-ray – finding of calcification around lateral epicondyle
  - MRI
  - Three-phase bone scintigraphy
- Treatment
  - Ending of harmful activity
  - Nonsteriod anti – inflammatory drugs
  - Mesocain + corticoid injection around the epicondyle



# Occupational disorders due to overloading

## Medial humeral epicondylitis (golfer's elbow)

- Symptoms:
    - Pain of the elbow during and after work
    - Pain spreads along the flexors
    - In the forearm muscle force is significantly reduced
  - Clinical finding and examination:
    - Painful palpation of medial epicondyls
    - Hypotrophy of antebrachial flexors
    - Positivity of provocative tests
      - Painful handgrip
      - Painful flexion of the fingers and wrist against resistance →
      - Painful flexion of III. Finger against resistance
- (The patient feels pain in the medial epicondyle)



# Occupational disorders due to overloading

## Medial humeral epicondylitis (golfer's elbow)

- Other diagnostic examinations
  - X- ray findings can be normal
  - X-ray – finding of calcification around medial epicondyle
  - MRI
  - Three-phase bone scintigraphy
- Treatment
  - Ending of harmful activity
  - Nonsteriod anti – inflammatory drugs
  - Mesocain + corticoid injection around the epicondyle

As a result of elbows overloading we very often see epicondylitis of both epicondyle - medial and lateral

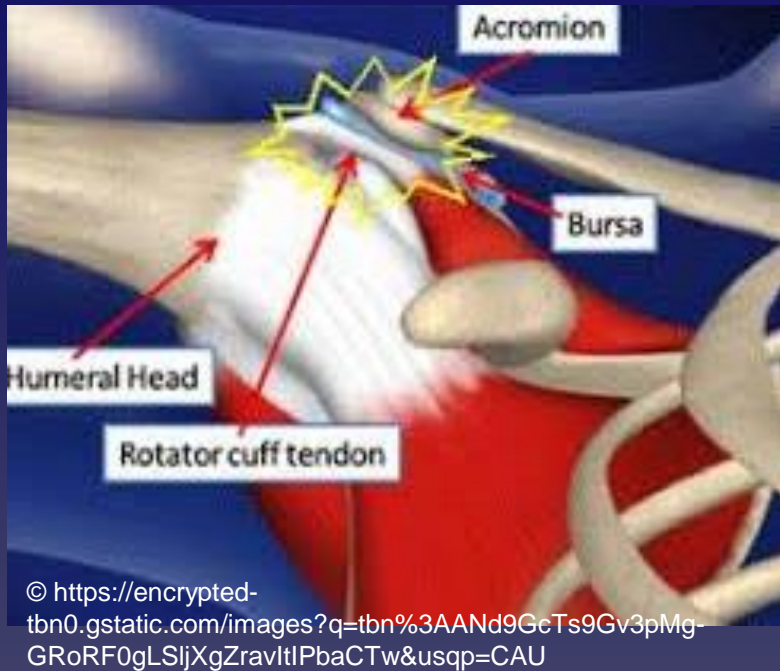
# Occupational disorders due to overloading

## Impingement syndrome (Neer's disease)

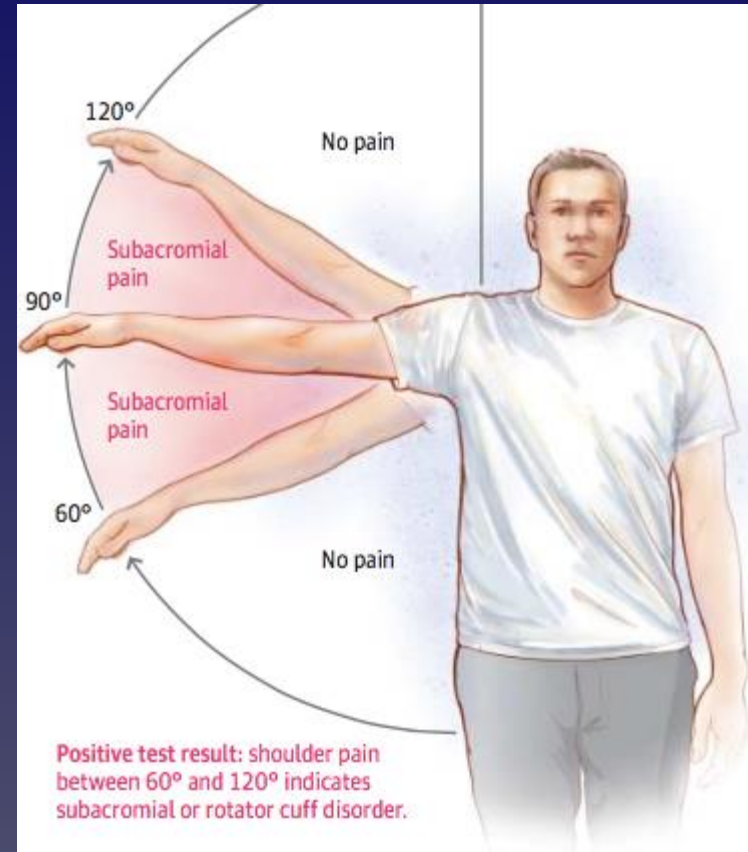
- Painful shoulder with rotator cuff disease
- Disease is connected with repetitive motion work activities involving the shoulders (overhead, overuse)
- Clinical findings and examinations:
  - Shoulder pain can be gradual or acute
  - All levels of pain can occur – severe pain at rest
  - Frequent is night pain
  - Painful abduction against resistance
  - Active internal or external rotation is painful
  - Positive Neer's test – injection of anesthetic to subacromial bursa – downgrade of pain

# Occupational disorders due to overloading

## Impingement syndrome



In the case of impingement syndrome, the supraspinatus muscle tendon is calcified or torn



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# Occupational disorders due to overloading

## Impingement syndrome

- Other diagnostic examinations
  - X- ray findings can be normal
  - MRI – most sensitive examination
  - USG
- Treatment
  - Ending or restriction of harmful activity
  - Nonsteriod anti – inflammatory drugs
  - Mesocain + corticoid injection into the subacromial space
  - Surgical treatment

# Occupational disorders due to overloading

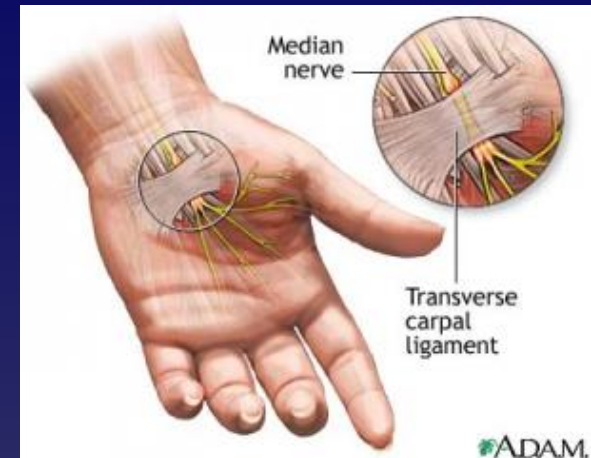
## Carpal tunnel syndrome

### Etiology

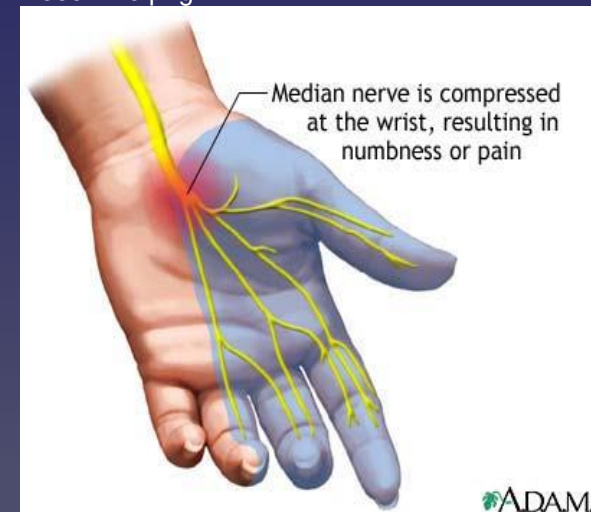
- Non professional
  - Injury of wrist, Colles´ fracture
  - Rheumatoid arthritis
  - Hypothyreosis – rarely – myxomatous tissue
  - Repetitive wrist and finger overload
  - Unknown
- Professional
  - pressure overload

### Clinical findings:

- Developing of paresthesias in the median nerve innervations
- Night pain and numbness
- Sometimes disturbances of finger movability, swelling of hand



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# Occupational disorders due to overloading

## Carpal tunnel syndrome

- Diagnostic
  - EMG
  - Phalen's test

Negative Phalen's test



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Positive Phalen's test



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# Occupational disorders due to overloading

## Carpal tunnel syndrome

- **Diagnostic**
  - Tinel's test  
(percussion on the ligamentum carpi transversum causes the radiation of pain to 1.- 3. fingers)
- Dif Dg. – C6 – radiculopathy
- **Treatment**
  - Anti-inflammatory drugs,
  - Physiotherapy
  - Lokal injections - corticoids
  - Surgical carpal tunnel release
    - resection of the ligamentum carpi transversum



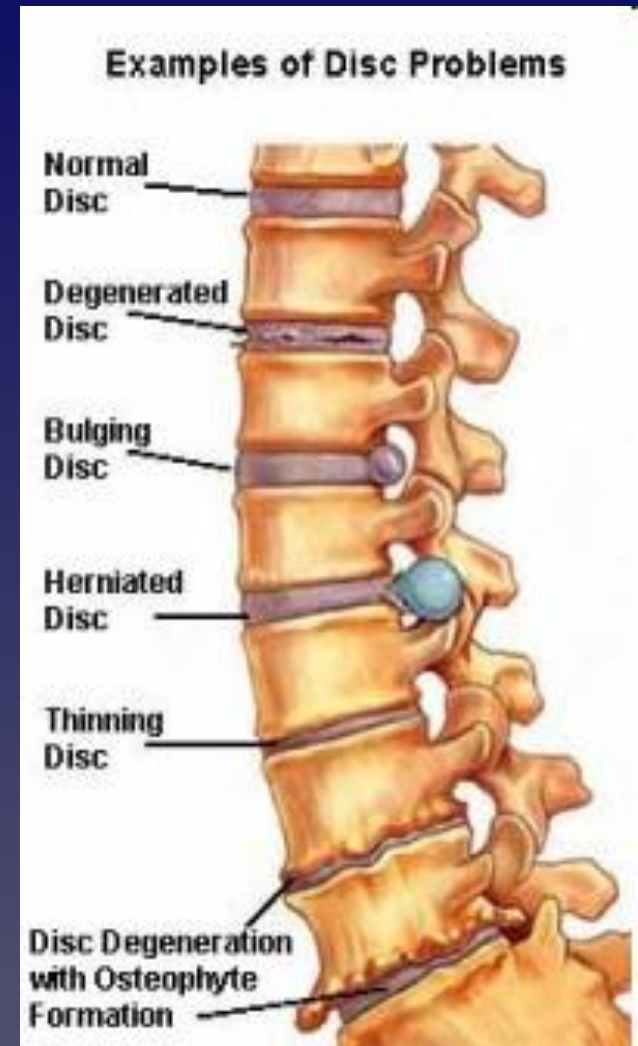
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# Occupational disorders due to overloading

## Professional vertebral algic syndrome (low back pain)

- Pre-existing degenerative diseases of intervertebral disc and vertebrae
  - Degeneration of
    - Annulus fibrosus
    - Disc with osteophyte
- Etiology:
  - Injury – wrong lifting of load
  - Long term bad forward position at work
  - Whole body vibrations
  - Long term heavy manual labor
- Clinical findings:
  - Back pain lower lumbar region – connected with motion and at rest
  - Depend on localization of lesion – shot to lower extremities



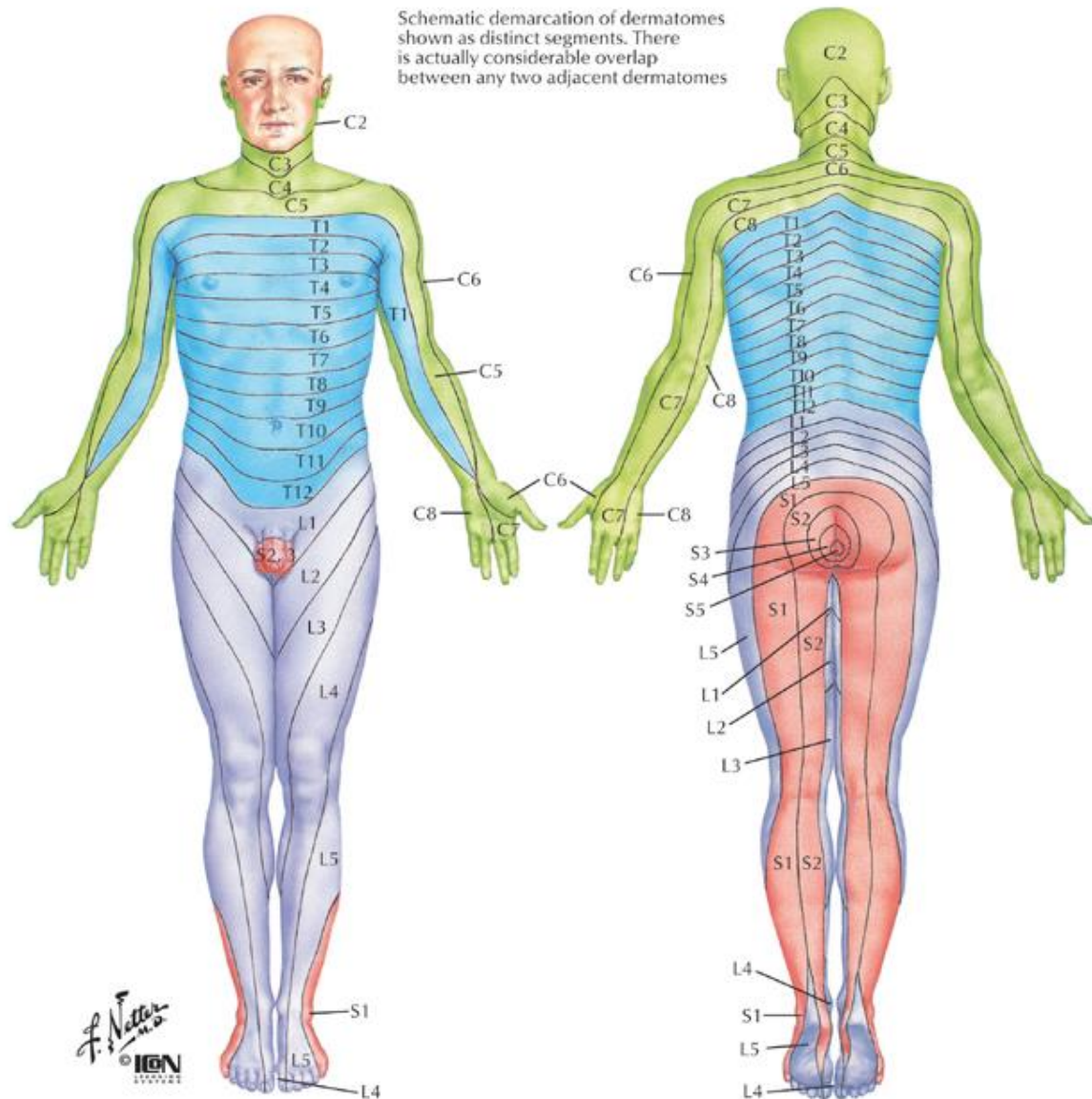
# Occupational diseases from vertebral overloading

## • Diagnostic:

- Work history
- Neurological clinical examination
- X-ray
- CT, MRI

## • Treatment

- Conservative
- Surgical



### Levels of principal dermatomes

C5	Clavicles
C5, 6, 7	Lateral parts of upper limbs
C8, T1	Medial sides of upper limbs
C6	Thumb
C6, 7, 8	Hand
C8	Ring and little fingers
T4	Level of nipples

T10	Level of umbilicus
T12	Inguinal or groin regions
L1, 2, 3, 4	Anterior and inner surfaces of lower limbs
L4, 5, S1	Foot
L4	Medial side of great toe
S1, 2, L5	Posterior and outer surfaces of lower limbs
S1	Lateral margin of foot and little toe
S2, 3, 4	Perineum