

Spinal cord injuries and syndromes

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Spinal cord injury



- ▶ severe medical + psychosocial problem
- ▶ Frequent permanent extensive disability
- ▶ Necessity of increased attention of doctors and state sphere

Epidemiology

- ▶ incidence approx 4 / 100 000 inhab
- ▶ Males / females 3:1
- ▶ 2/3 of incidence up to 40 yrs



Epidemiology

- ▶ 50% traffic accidents
- ▶ 12% risk sports
- ▶ Work injuries
- ▶ criminal activities



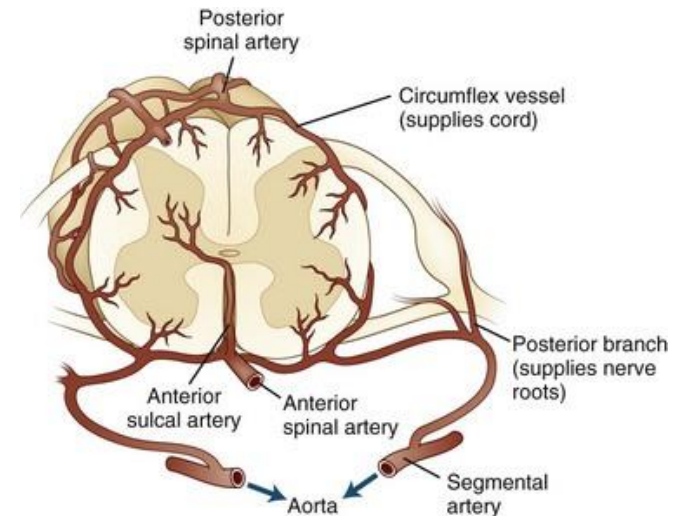
Pathophysiology of spinal cord damage

- ▶ Stretch – elongation
- ▶ Compression (bone fragment, disk, dislocation – fracture–dislocation of spine)
- ▶ Influence of diameter of spinal canal
- ▶ Predominant lesion in intumescences



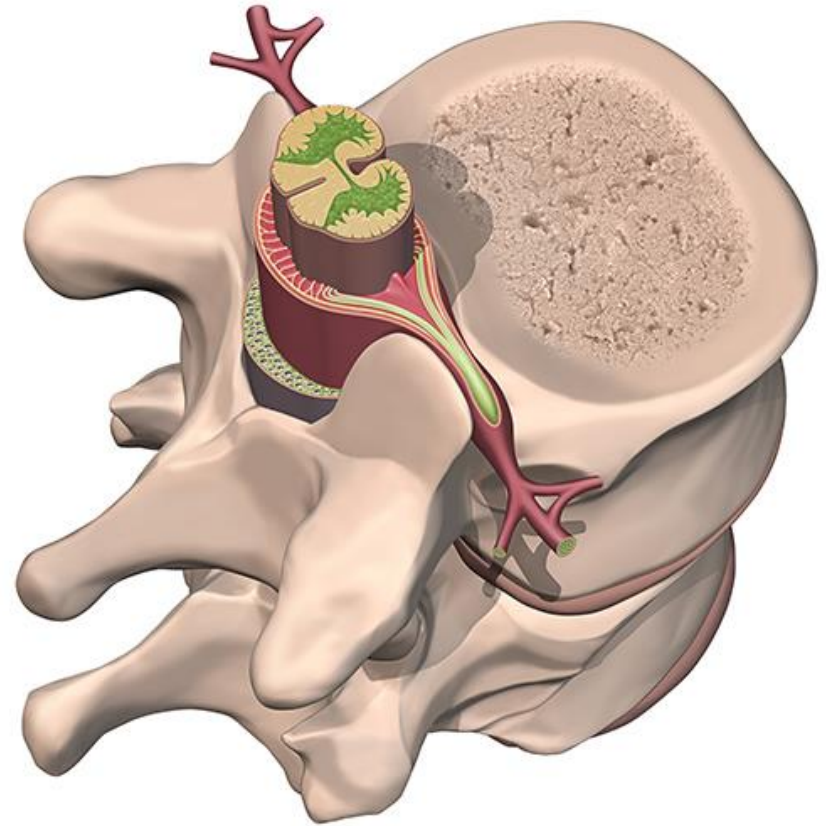
Indirect factors

- ▶ microcirculation disorder
- ▶ Blood flow decrease due to vazospasms + trombosis
- ▶ Loss of local autoregulation
- ▶ oedema



Spinal cord injuries

- ▶ Due to gravity (Freeman classification)
 - concussion
 - contusion
 - dilaceration
- ▶ Due to extent
 - incomplete lesion
 - complete lesion

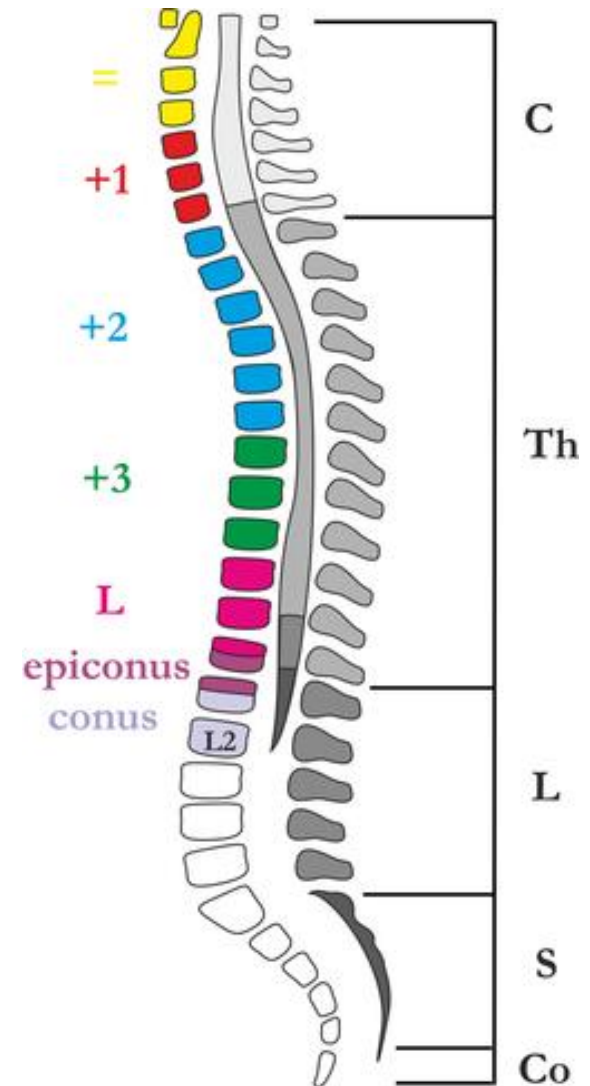


Symptoms

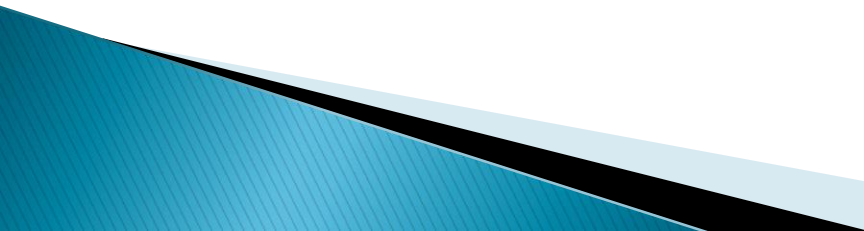
- ▶ Depend on location and type of injury
 - Knowledge of vertebromedular topography
- ▶ Meticulous examination of motor and sensory functions enables to find the last healthy – undamaged segment

Chipault rule

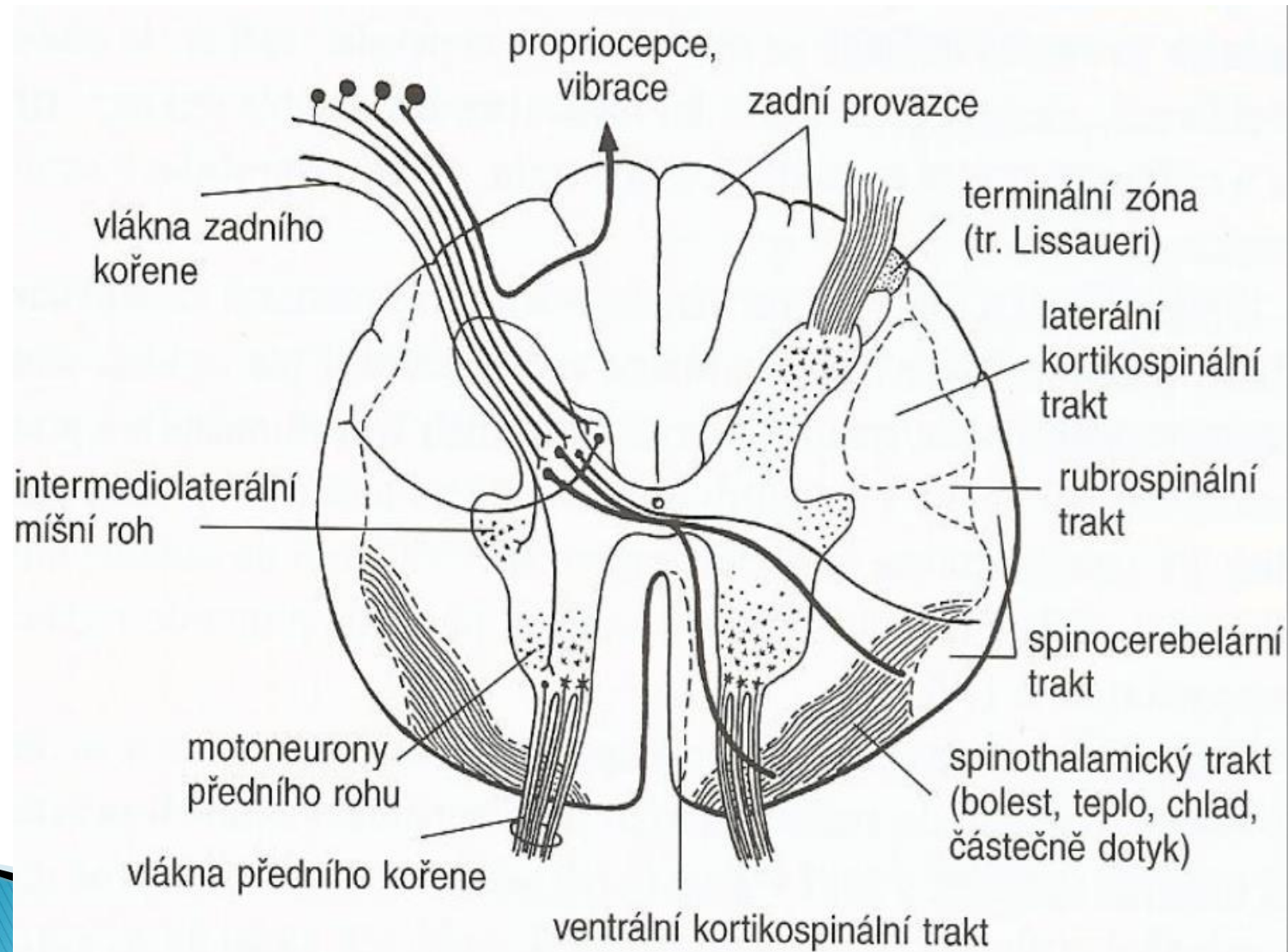
- ▶ Upper C – the same
- ▶ Lower C – +1
- ▶ Upper Th – +2
- ▶ Lower Th – +3
- ▶ Th 10-12 – L₁-L₄
- ▶ junction Th₁₂-L₁ – epiconus (L₅-S₂)
- ▶ L₁-L₂ – conus (S₃-Co)



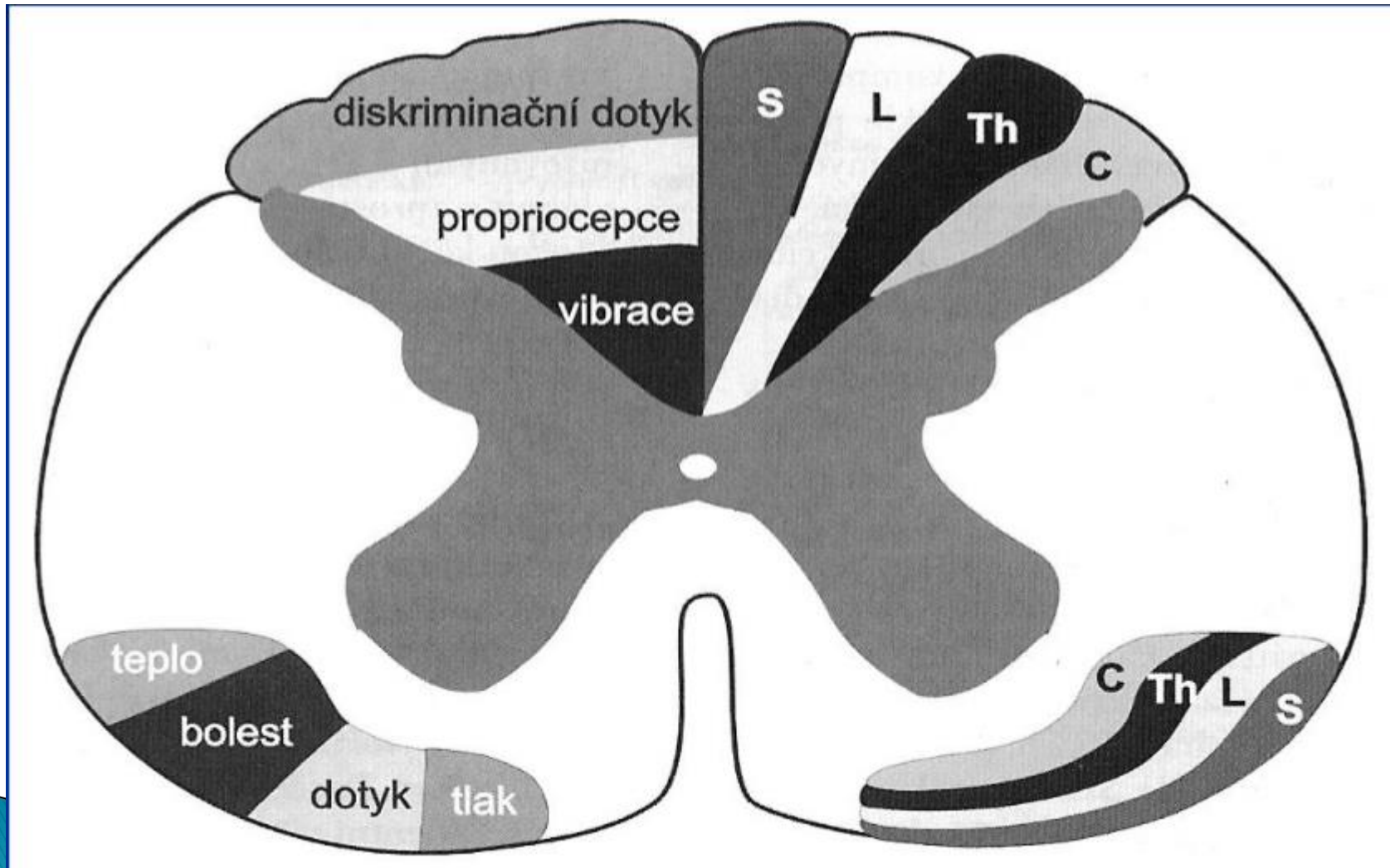
Spinal cord tracts

- ▶ Spinothalamic – nerve fibres between segments
 - ▶ Ascendent – to higher levels of CNS
 - spinothalamic system
 - Posterior lemniscal system
 - spinocerebellar system
 - ▶ Descendent – from higher centers of CNS to gray matter of spinal cord
 - ventromedial system
 - dorsolateral system
- 

Spinal cord

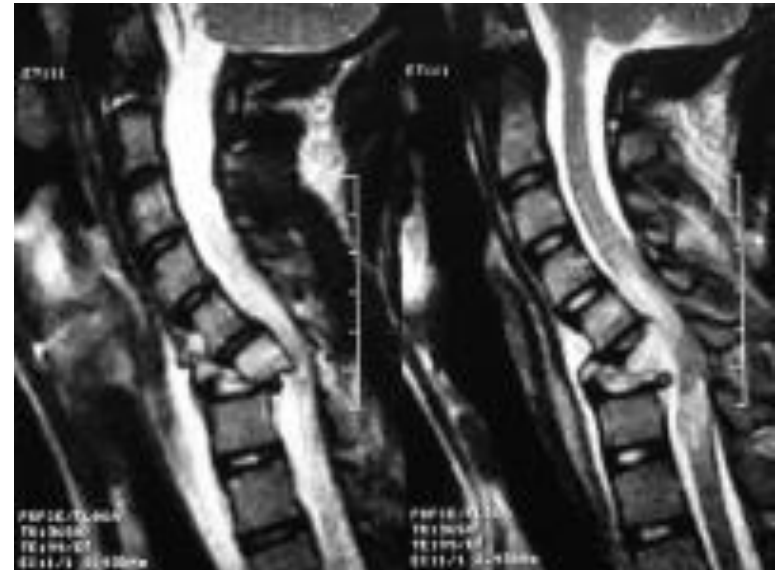
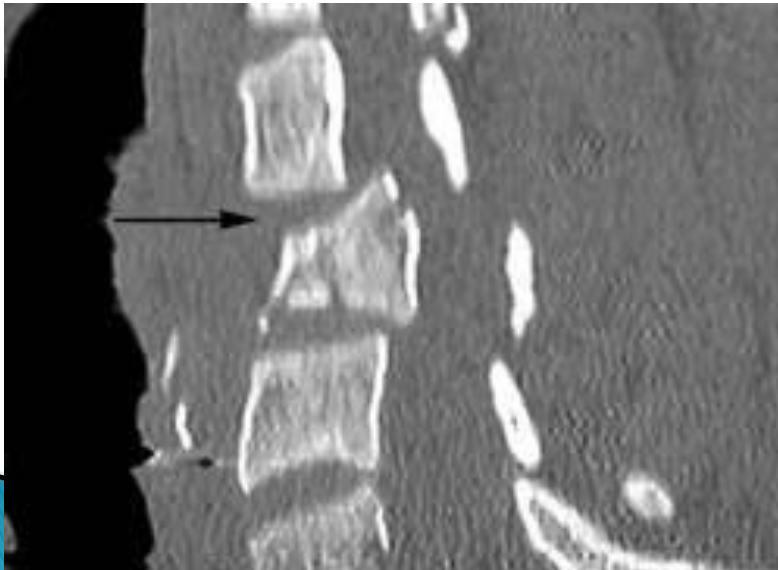


Topography of sensory tracts

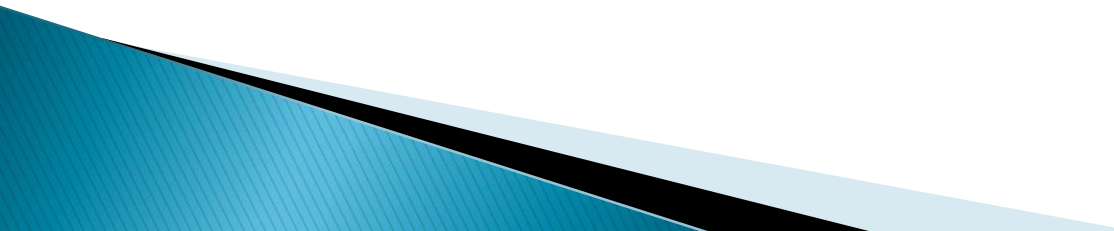


Diagnostics

- ▶ Meticulous clinical examination
- ▶ imaging methods



Frankel scale /ASIA

- ▶ A – plegia and anaesthesia
 - ▶ B – only sensory functions preserved
 - ▶ C – useless motor functions preserved
 - ▶ D – useful motor function of lower extremities
 - ▶ E – normal function
- 

AIS – ASIA impairment scale

- ▶ Examination of tactile and pain sensation of dermatomas
- ▶ Exam of key muscle groups
- ▶ grade A–E
 - A – complete lesion
 - B–D – incomplete
 - E – normal



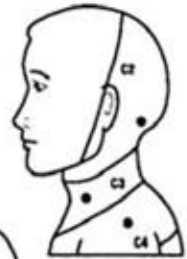
Jméno pacienta _____

Jméno vyšetřujícího _____

Datum/čas vyš. _____



MEZINÁRODNÍ STANDARDY PRO NEUROLOGICKOU KLASIFIKACI MÍŠNÍHO PORANĚNÍ



MOTORIKA

KLÍČOVÉ SVALY
(skórování je na zadní straně)

	P	L	
C5	<input type="checkbox"/>	<input type="checkbox"/>	Flexory lokte
C6	<input type="checkbox"/>	<input type="checkbox"/>	Extenzory zápěstí
C7	<input type="checkbox"/>	<input type="checkbox"/>	Extenzory lokte
C8	<input type="checkbox"/>	<input type="checkbox"/>	Flexory prstů (distální falanga prostředníku)
T1	<input type="checkbox"/>	<input type="checkbox"/>	Abduktory prstů (malík)

HORNÍ KONČETINA
CELKEM + =
(MAXIMUM) (25) (25) (50)

Komentář:

	P	L	
L2	<input type="checkbox"/>	<input type="checkbox"/>	Flexory kyče
L3	<input type="checkbox"/>	<input type="checkbox"/>	Extenzory kolena
L4	<input type="checkbox"/>	<input type="checkbox"/>	Dorzální flexory hlezna
L5	<input type="checkbox"/>	<input type="checkbox"/>	Dlouhý extenzor palce
S1	<input type="checkbox"/>	<input type="checkbox"/>	Plantární flexory hlezna

Volní anální kontrakce (ano/ne)

DOLNÍ KONČETINA
CELKEM + =
(MAXIMUM) (25) (25) (50)

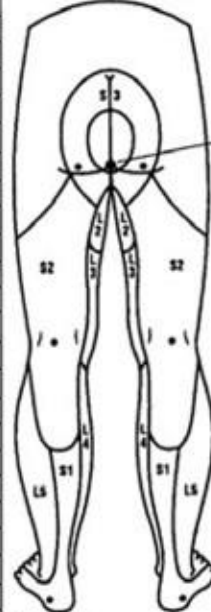
LEHKÝ PÍCHNUTÍ
DOTYK ŠPENDLÍKEM
P L P L

C2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
L1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
L2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
L3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
L4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
L5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S4-5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CELKEM + =
(MAXIMUM) (56) (56) (56) (56)

CITLIVOST
KLÍČOVÉ BODY

0 = chybí
1 = zmátnutý
2 = normální
NT = nedostupný



Hluboký anální tlak (ano/ne)

SKÓRE PÍCHNUTÍ ŠPENDLÍKEM (max. 112)

SKÓRE LEHKÉHO DOTYKU (max. 112) S1



• Klíčové body

NEUROLOGICKÁ
ÚROVEŇ

nejvyšší segment
s normální funkcí

CITLIVOST
MOTORIKA

P	L
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<input type="checkbox"/>	<input type="checkbox"/>

NEUROLOGICKÁ
ÚROVEŇ
LÉZE

KOMPLETNÍ NEBO NEKOMPLETNÍ?

nekompletní = jakákoliv senzitivní nebo motorická funkce v S4-S5

ROZSAH MÍŠNÍ LÉZE (AIS)

páže u kompletních poranění
ZÓNA ČÁSTEČNÉHO
ZACHOVÁNÍ FUNKCE

nejvyšší úroveň
s jakoukoliv nervací

CITLIVOST
MOTORIKA

P	L
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<input type="checkbox"/>	<input type="checkbox"/>

Spinal cord damage

According to pathophysiology

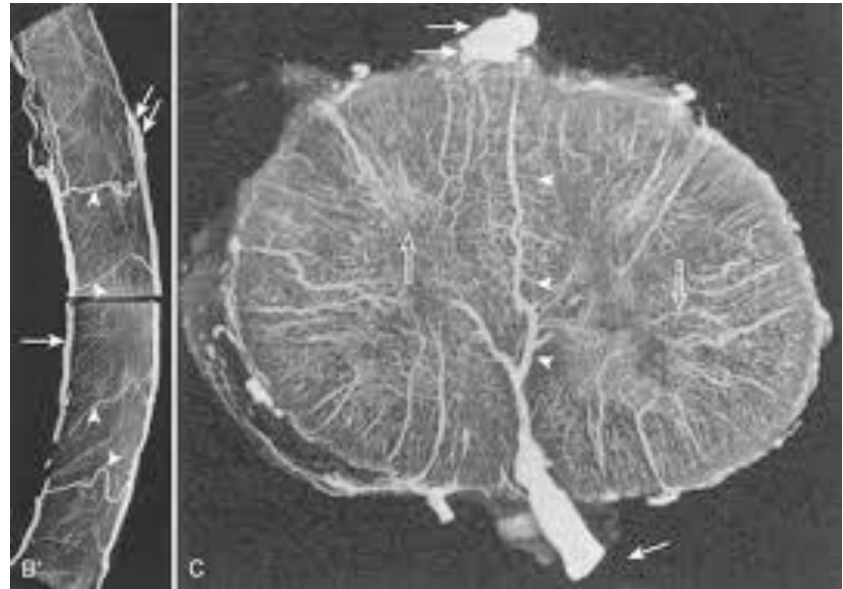
Primary damage

- ▶ immediately – by direct injury



Secondary damage

- ▶ Processes leading to extension/widening of posttraumatic lesion
 - Oedema, bleeding
 - Damage of blood flow
 - Action of free radicals



Spinal cord damage

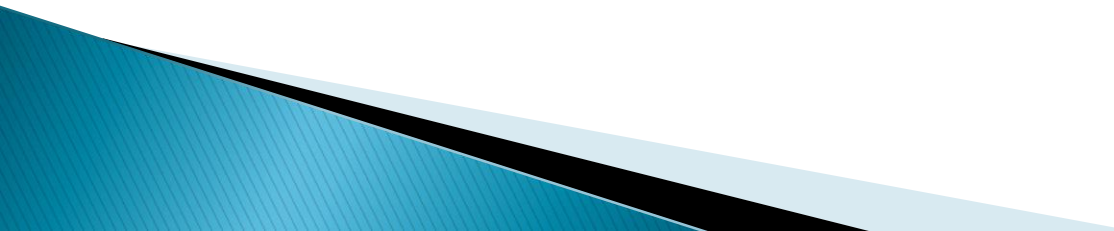
According to severity and injury mechanism

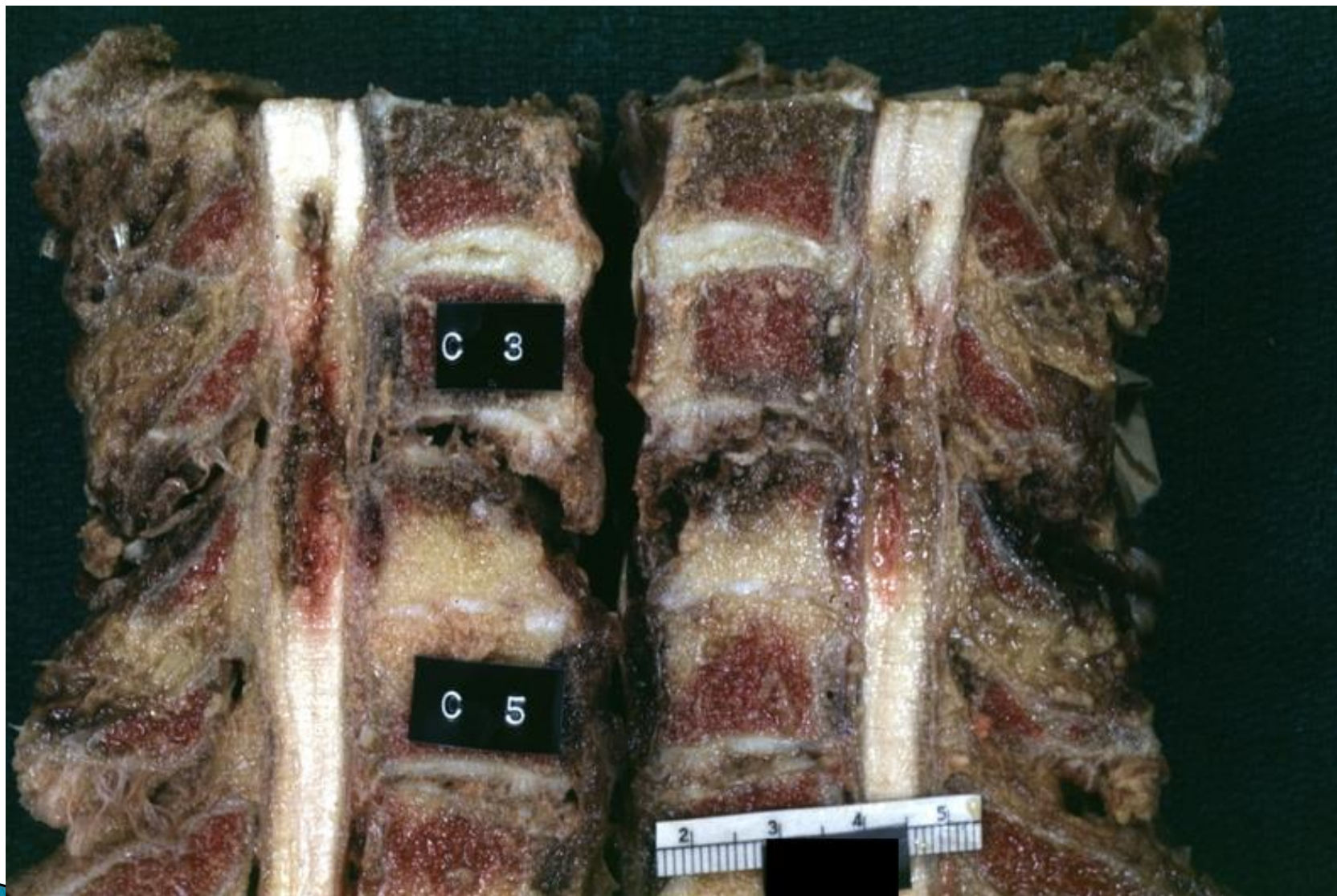
Concussion

- ▶ Short-time fully reversible impairment of motor, sensory and sfincter function without structural changes of spinal cord
- ▶ lasts minutes – hours
- ▶ Most frequently in sport activities
- ▶ pathophysiologic mechanism is not clear (conduction blockade of transmission)



contusion

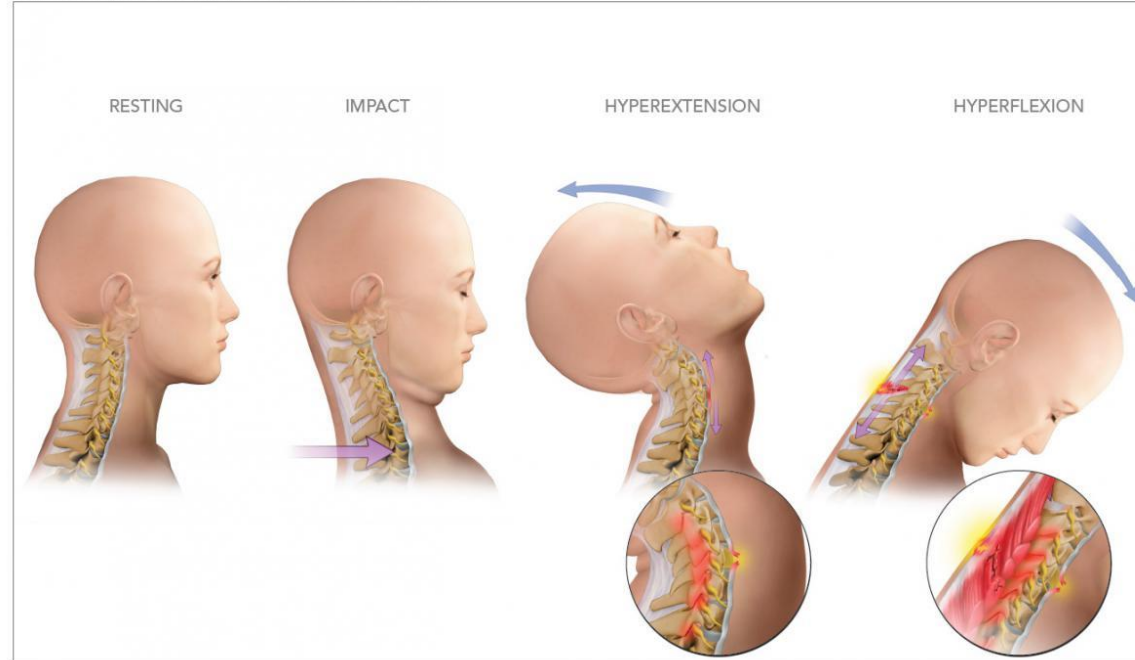
- ▶ Damage of the spinal cord with structural changes (oedema, bleeding, necrosis)
 - ▶ Prognosis depends on extent + location of damage
 - ▶ With permanent functional consequences
- 



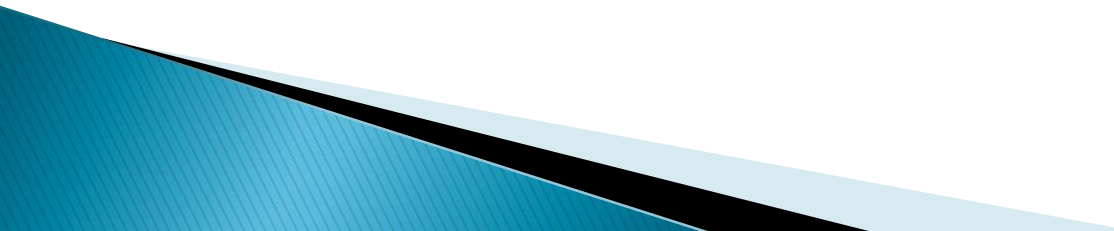
whiplash injury

- ▶ Effect of sudden unexpected acceleration–deceleration force usually during traffic accidents
- ▶ Mechanism compared to whip crack
- ▶ Typical for cervical region

WHIPLASH MECHANISM OF INJURY

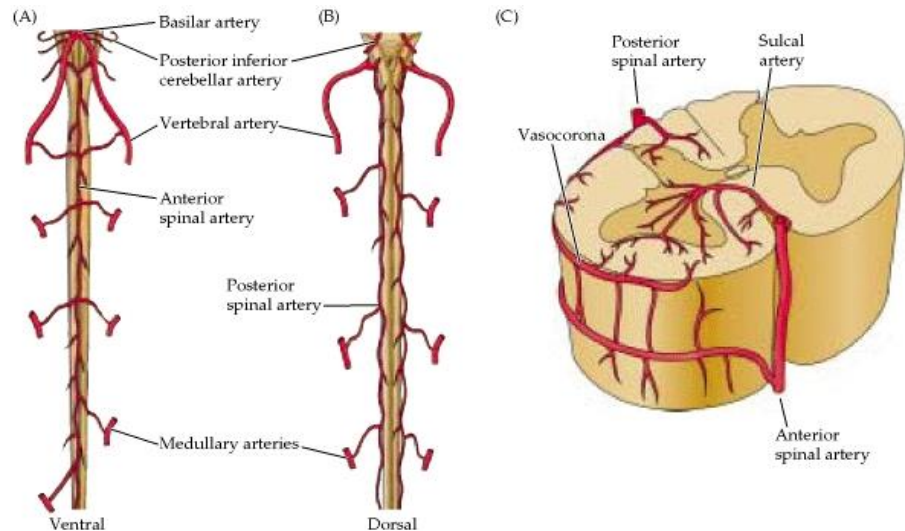


Whiplash injury – symptoms

- ▶ Neck pain
 - ▶ blockades
 - ▶ CB + CC syndromes
 - ▶ Vertigo / dizziness (post cervic sympathetic)
 - ▶ neurasthenia
- 

Spinal cord compression

- ▶ Caused by haematoma, bone fragment or dislocated disc
- ▶ Effect of direct spinal cord compression and disturbance of circulation



Dilaceration

- ▶ Due to mechanical force exceeding strength of dural sac and spinal cord
- ▶ Serious morfological damage
- ▶ Always functional consequences



Sagittal T1W

Sagittal T2W

Spinal cord damage

Functional classification

Syndromes



Complete x incomplete lesion

- ▶ complete lesion
 - No sensory or motor function below level of injury
- ▶ incomplete lesion
 - Part of motor or sensory functions preserved

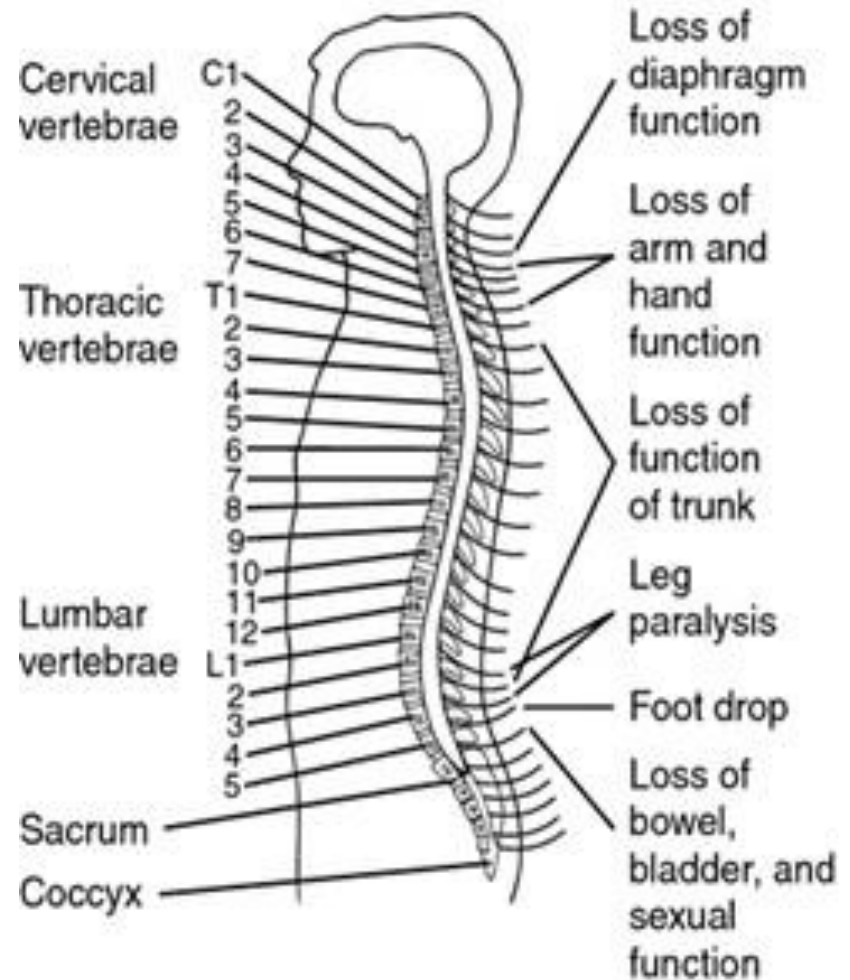
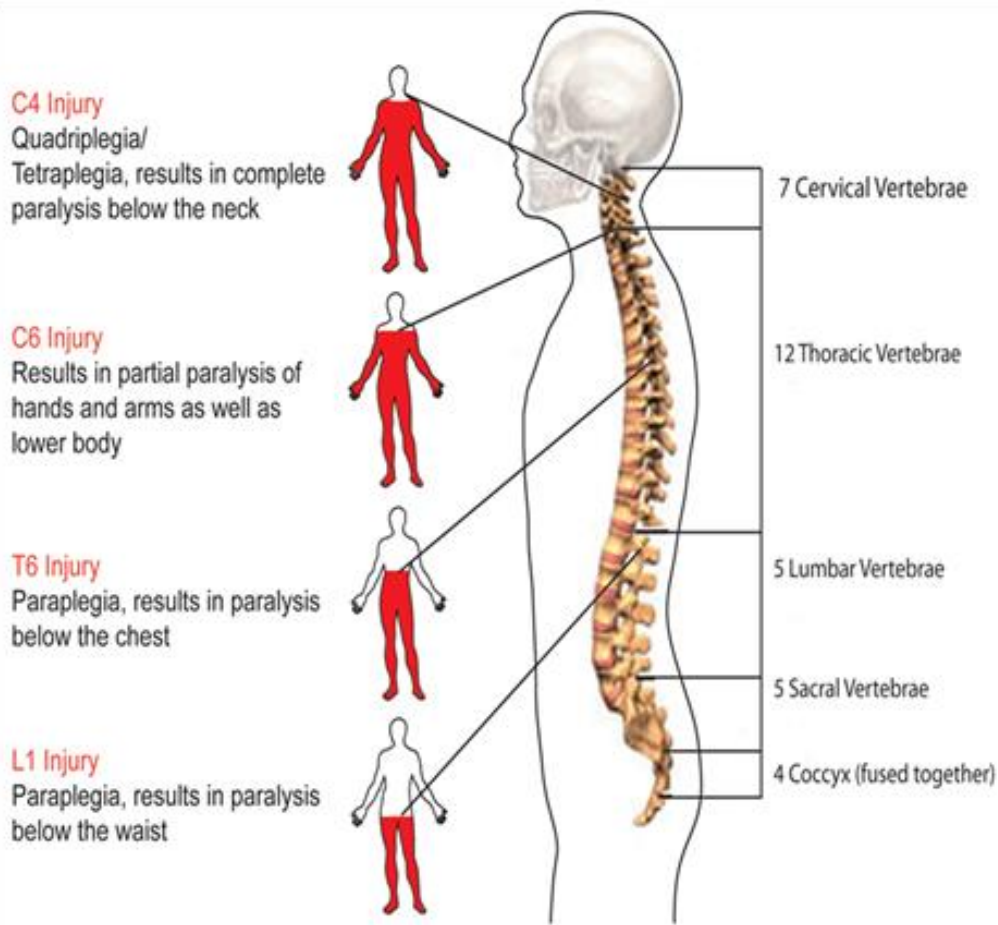
Complete lesion

Complete lesion

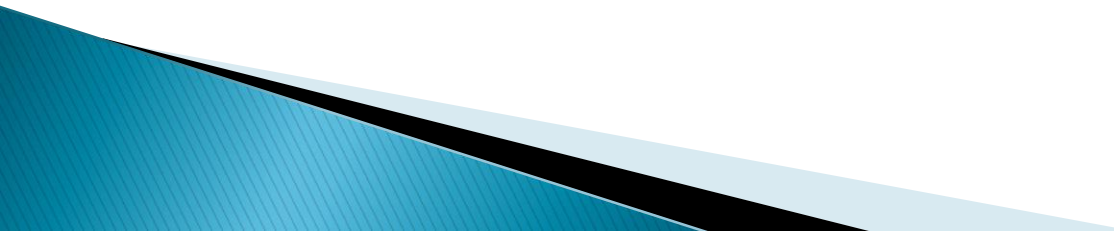
- ▶ Loss of all motor + sensory functions below lesion level
- ▶ Symptoms according to the lesion level
- ▶ Disorder of vegetative functions
 - breathing
 - trofic
 - thermoregulation
 - Intestinal function
 - Urinary function
 - sexual function



Complete lesions



Spinal shock

- ▶ clinical syndrome accompanying serious spinal cord lesions
 - ▶ Duration 2–3 weeks
 - ▶ symptoms – muscle atonia, areflexia, autonomous dysfunction
- 

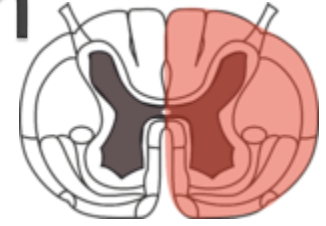
Spinal shock

- ▶ Withdrawal
 - Gradual increasing of muscle tone
 - increasing hyperreflexia,
 - Occurrence of dorsal response of plantar reflex (Babinski sign)
 - Beginning of spinal automatisms
- ▶ Complete loss of voluntary movements and anaesthesia

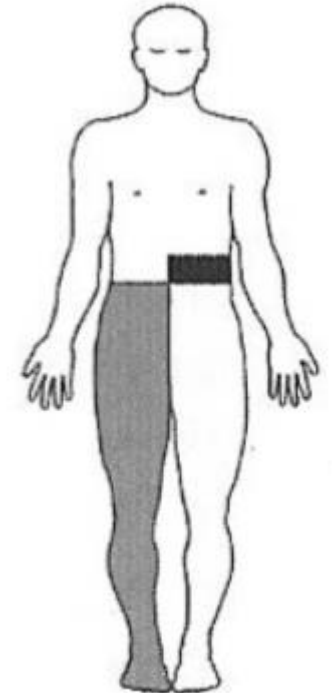
Incomplete lesion

Syndrome of spinal hemisection

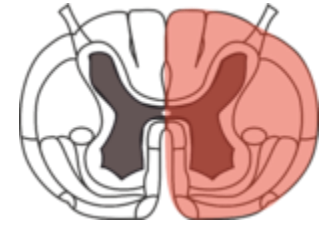
Brown – Séquard syndrome



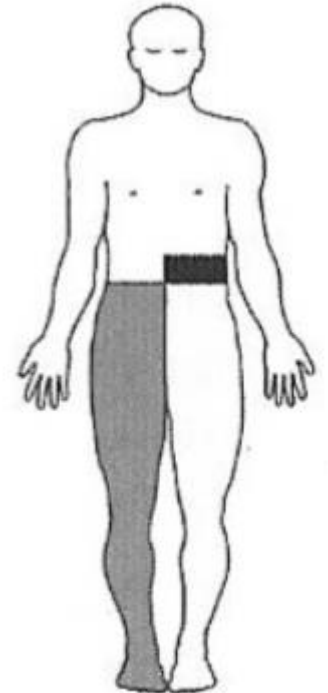
- ▶ Transversal damage of half of spinal cord
- ▶ Rare
- ▶ traumatic origin – penetrating injuries
- ▶ Damage by tumour, ischemia, inflammation



Brown – Séquard syndrome



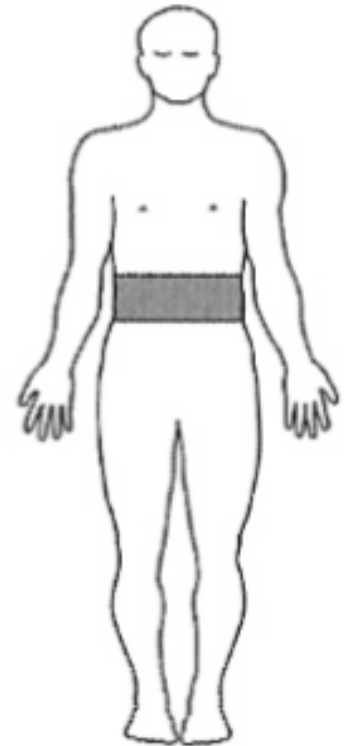
- ▶ At the level – full anaesthesia, flaccid paresis ipsilaterally, 1–2 segments above hypesthesia
- ▶ Below lesion
 - ipsilateral central paresis
 - ipsilateral disorder of deep sensation
 - contralateral disorder of pain + thermic sensation (2–3 segments lower)



Syndrome of central gray

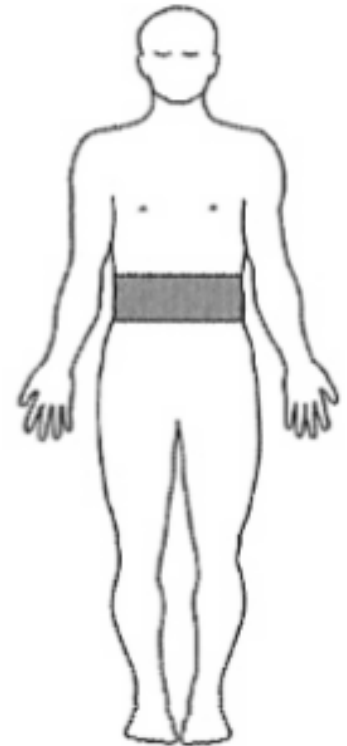
Syringomyelia syndrome

- ▶ rare
- ▶ traumatic origin due to hyperextension mechanism of spine injury (often pts with spinal stenosis)
- ▶ other causes – syringomyelia, intramedullary expansions



Syringomyelia syndrome

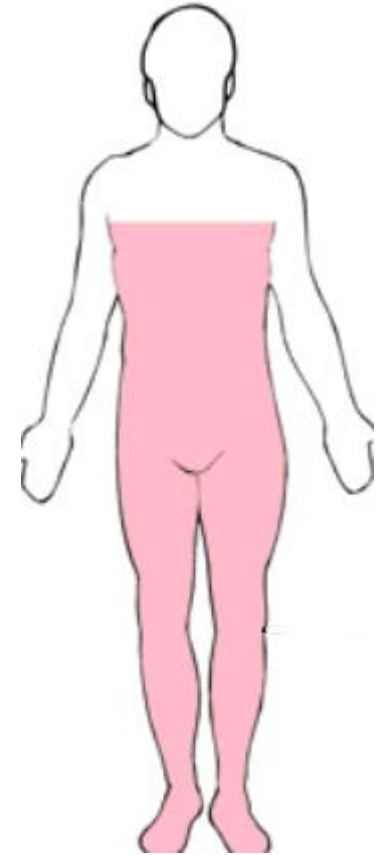
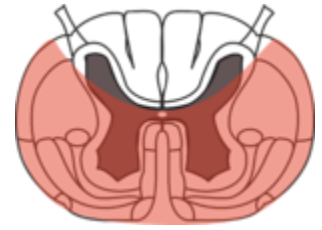
- ▶ Cut-off crossing of spinothalamic tracts (sensory dissociation)
 - Bilateral disorder of pain and thermal sensation
 - tactile sensation preserved
- ▶ In case of progression – anterior spinal horn damage → flaccid paresis with atrophy and fasciculation



Anterior spinal syndrome

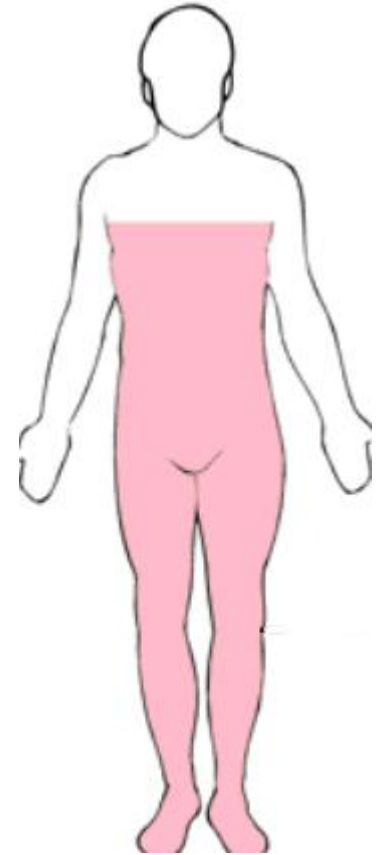
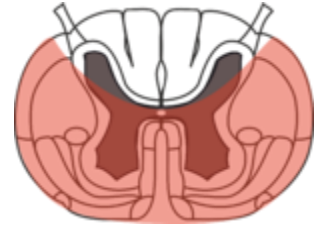
Syndrome of arteria spinalis anterior

- ▶ Most often – dive to water with head impact to bed
- ▶ Closure of artery or compression by bone fragment or disc



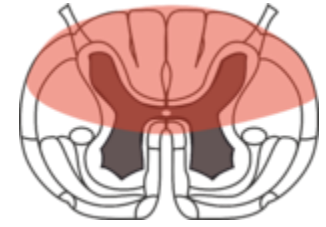
Syndrome of arteria spinalis anterior

- ▶ At damaged level flaccid paresis
- ▶ Caudally below lesion central paresis
- ▶ Damage of termic and algic sensation
- ▶ preserved dorsal tracts – proprioception and discriminative sensation

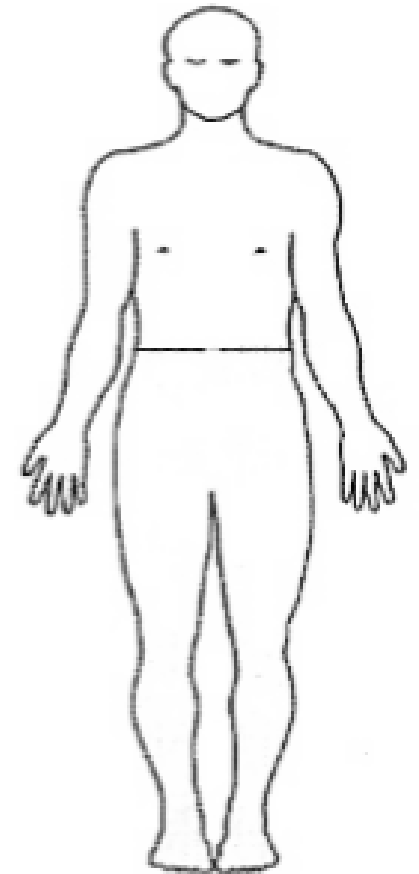


Posterior spinal syndrome

Syndrome of post tracts

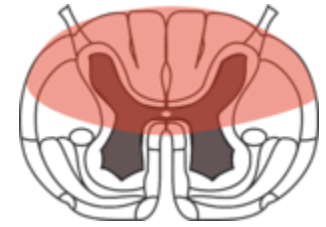


- ▶ traumatic – direct impact to spine, martial – combat sports
- ▶ Other causes – in the past tabes dorsalis, now avitaminoses B12

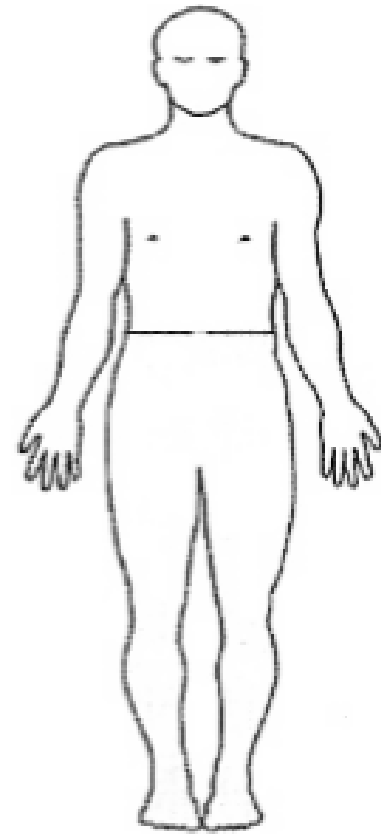


Posterior spinal syndrome

Syndrome of post tracts

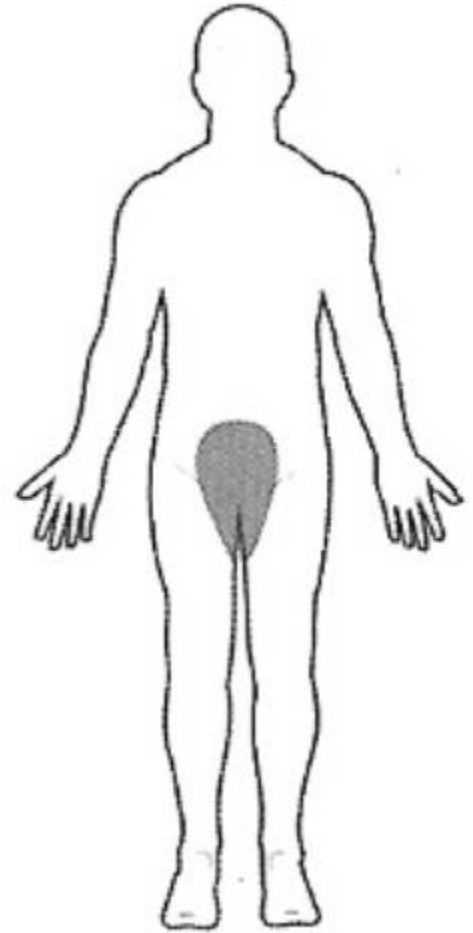


- ▶ Below lesion – damage of proprioception, vibration and discriminative sensation
- ▶ Minimum damage of superficial skin sensation
- ▶ Damage of coordination and ataxia



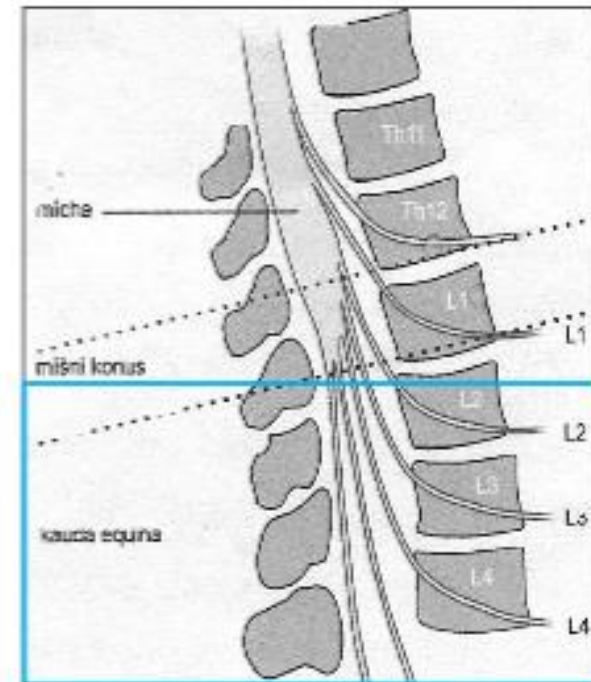
Syndrome of spinal cone

- ▶ saddle damage of sensation
- ▶ absence of anal + bulbocavernos reflexes
- ▶ Damage of sfincters
- ▶ Symmetrical perianogenital pain (even without pain)
- ▶ erectile dysfunction



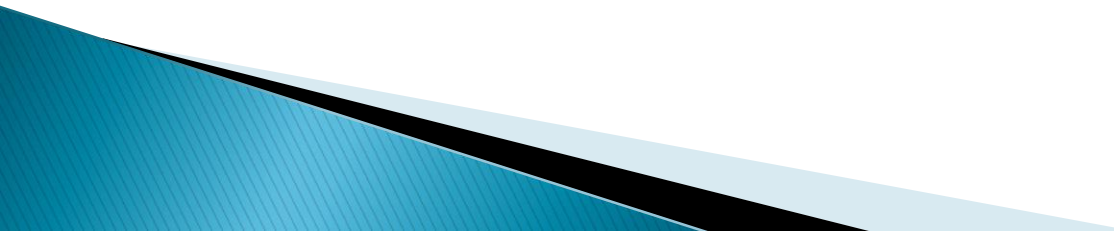
Cauda equina syndrome

- ▶ perianogenital sensation damage
- ▶ Radicular pain
- ▶ Flaccid paraparesis (lower extremities)
- ▶ Sfincter damage
- ▶ Usually asymmetric



	Conus medullaris	Cauda equina
Bolest	Chybí nebo je nepřilíš intenzivní, symetrická, lokalizovaná do perianogenitální oblasti;	Je přítomna, intenzivní, asymetrická, radikulárního charakteru
Motorické příznaky	Omezené na oblast svěračů; u epikonu postiženy drobné svaly nohy	Chabá obrna postihující svaly DKK oboustranně, asymetricky, zejména akrálně, ale i proximálně
Senzitivní příznaky	Bilaterální symetrická sedlovitá hypo- či anestézie v perianogenitální oblasti, může být disociovaného typu (postiženo algické a termické čítí)	Bilaterální asymetrická porucha citlivosti všech kvalit, postihující oblast perianogenitální, ale i DKK
Reflexy	Beze změn; u epikonu absence rŠA	Absence rŠA, případně i r. patelárního (dle úrovně postižení)
Sfinkterové poruchy	Inkontinence moči a stolice, absence análního a bulbokavernózního r.	Inkontinence moči a stolice, absence análního a bulbokavernózního r.
Sexuální poruchy u mužů	Impotence (erektilní dysfunkce)	Impotence (erektilní dysfunkce)
Symetrie	Symetrické postižení	Obvykle asymetrické postižení

Conclusion – spinal cord injuries

- ▶ serious problem
 - ▶ permanent consequences in majority of cases
 - ▶ In severe cases patient can be fully dependent on help of other people
 - ▶ Leads to the development of associated complications
 - ▶ Necessity of emphasis on prevention
- 

ALCOHOL



**MAKES MIRACLES
HAPPEN**