بسم الله الرحمن الرحيم

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SPINAL CORD LESION& Paraplegia

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Paraplegia and Spinal cord lesions

Anatomical considerations

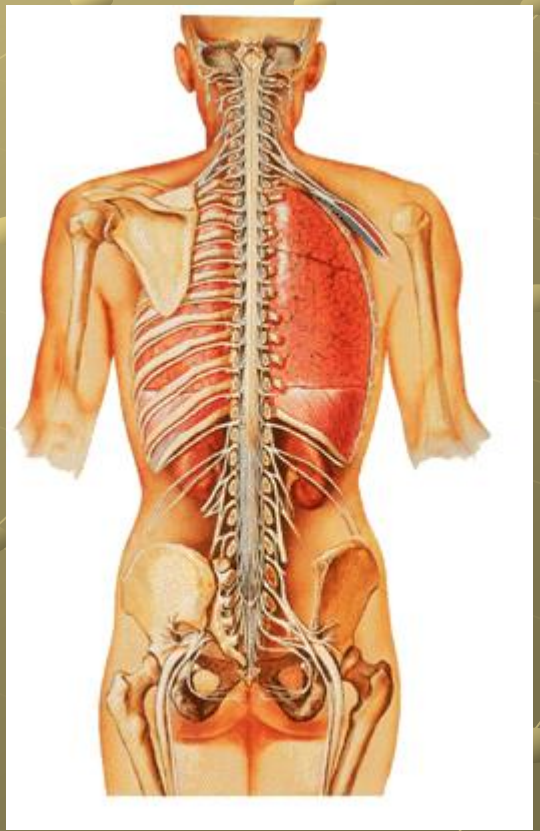
Extension of the spinal cord

extends from the lower part of the medulla

at the level of the foreman magnum "level of atlas" down to the level of L1 or L2

Enlargements

cervical and lumber



Segments

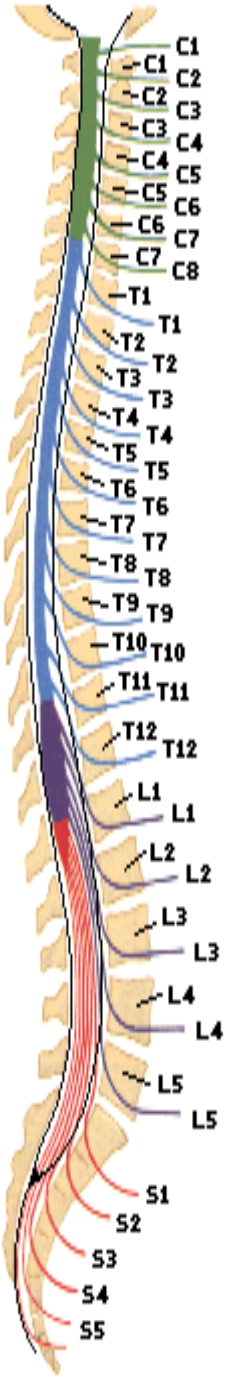
(8) cervical , (12) thoracic or dorsal ,(5) lumber,(5) sacral , (1) coccygeal

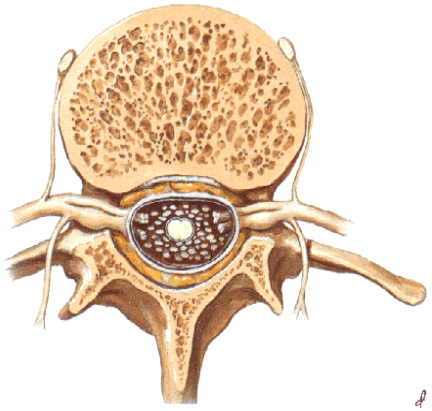
Roots

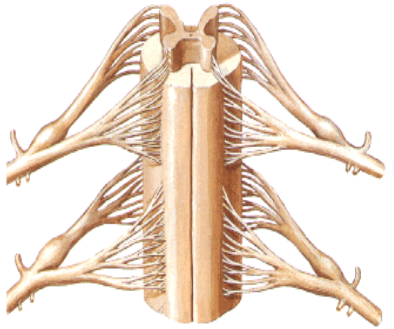
two pairs of roots emerge →

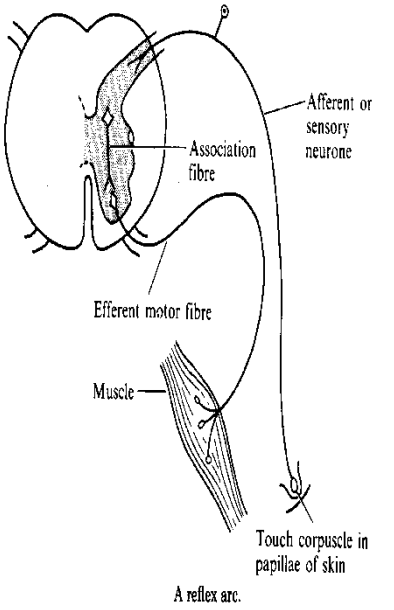
posterior dorsal root (sensory) & a nterior ventral root (motor), one ve ntral and the corresponding

dorsal root join together to form→ a spinal nerve.









Meningeal coverings

The pia matter

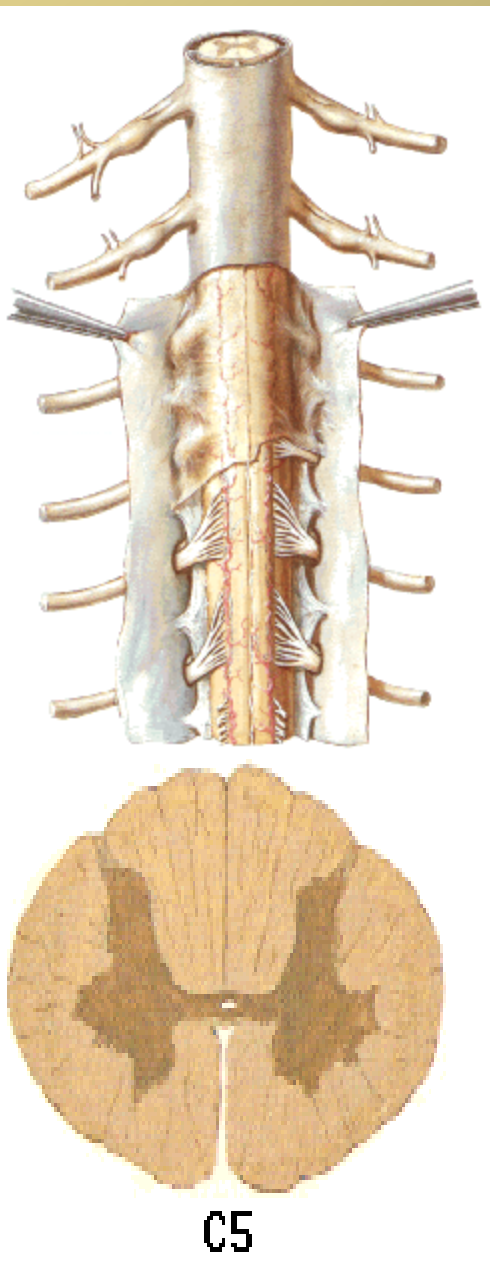
the arachnid matter

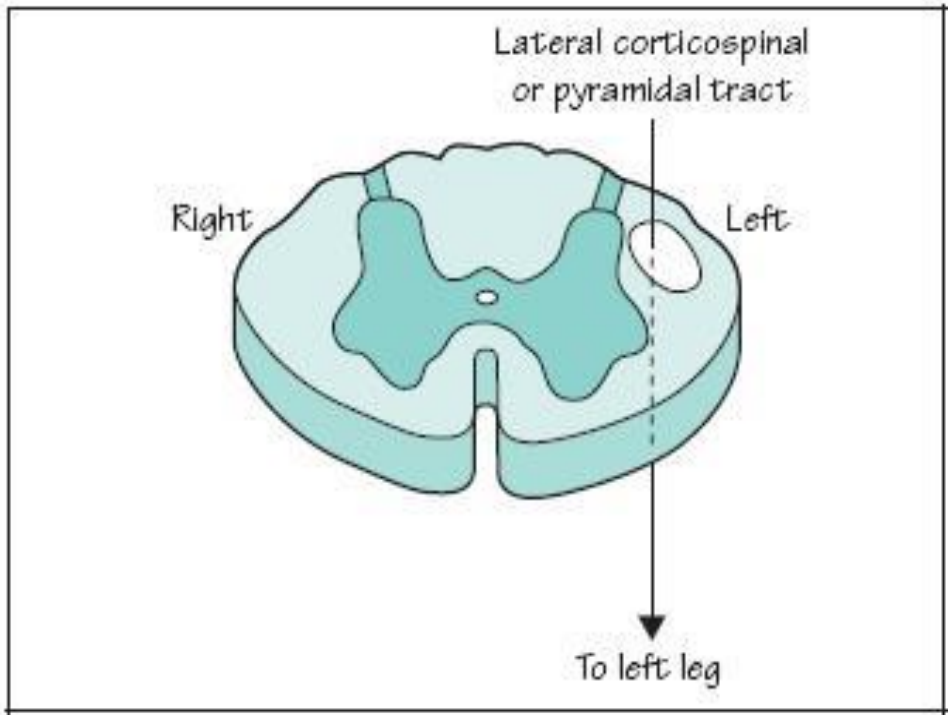
dura matter

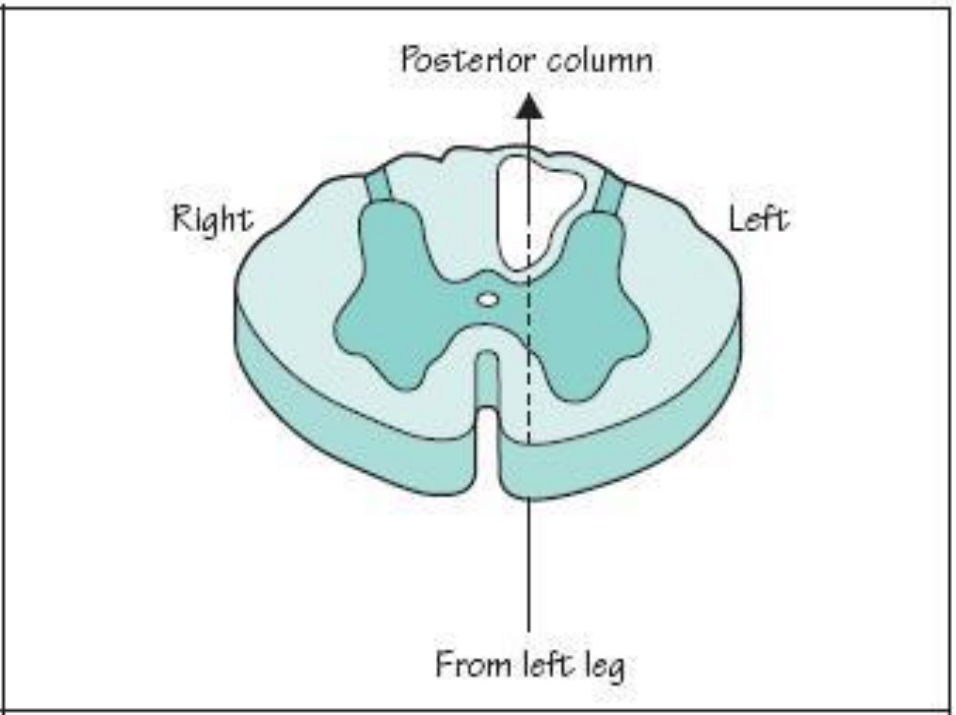
Transverse section

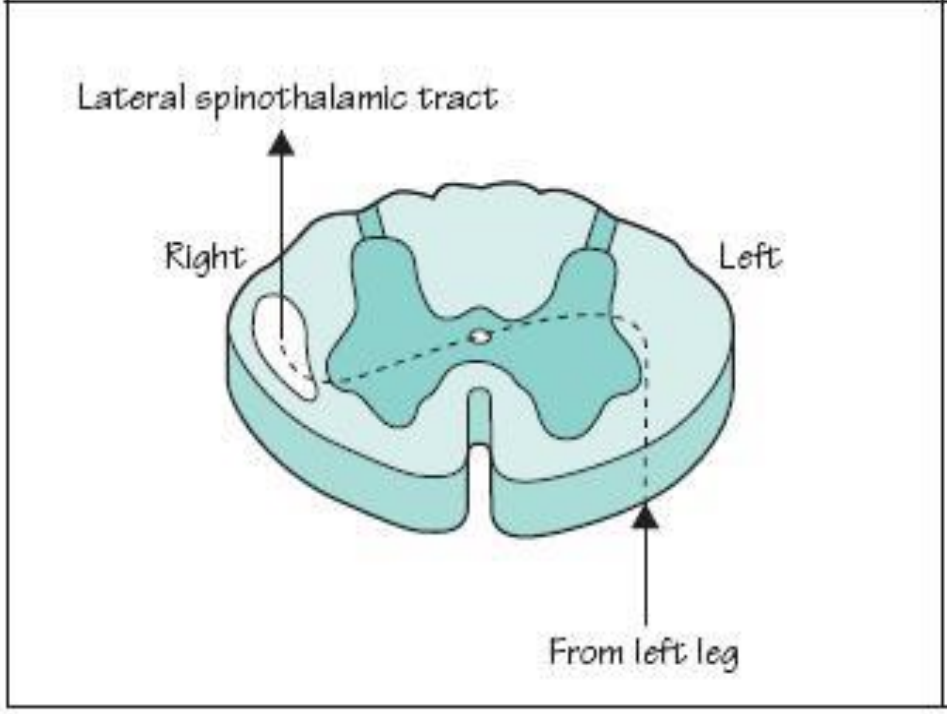
H" shaped grey matter of ganglion

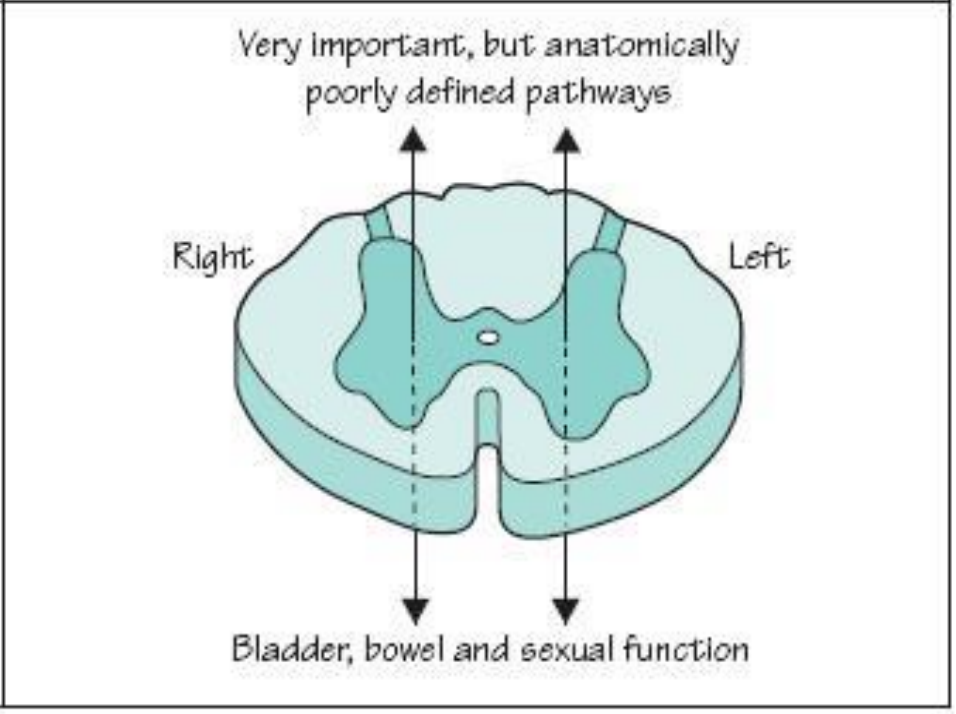
cells and nerve fibers and peripheral white matter of nerve fibers and myelin sheaths




Lateral corticospinal
or pyramidal tract
Right
Left
To left leg


Posterior column
Right
Left
From left leg


Lateral spinothalamic tract
Right
Left
From left leg


Very important, but anatomically
poorly defined pathways
Right
Left
Bladder, bowel and sexual function

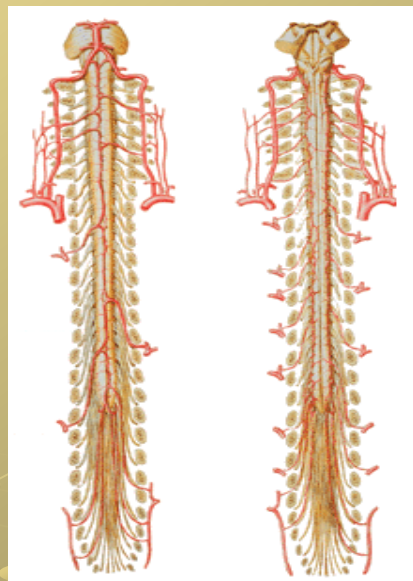
Blood supply

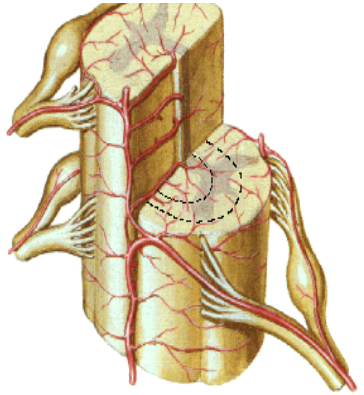
single anterior spinal artery (ASA) branch from the vertebral artery

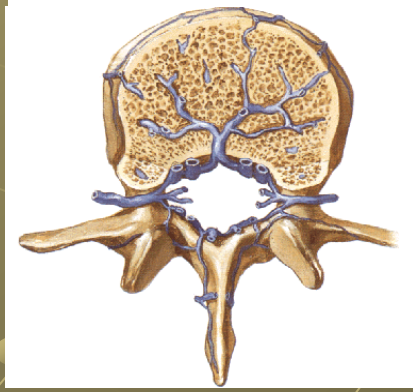
Two posterior spinal arteries (PSA) arising from the vertebral or the posterior inferior cerebellar arteries

Segmental arteries the artery of Adamkiewicz

T5&T8







Cauda equina

lumbosacral roots which occupies the rest of the spinal canal below L1-L2

Conus medullaris

lower most three segments of the spinal cord S3, 4, 5.

Epiconus

L4, 5 &S1, 2 cord segments

Paraplegia

- **Definition**
- **Causes**

1- Cerebral

2-Brainstem

3-Spinal

A- Focal

i- Vertebral

- Truma
- Arthritis
- Spondylosis
- Congenital deformities
- T.B., Syphilis

- Tumours (primary – secondary – deposits)
- Abcess

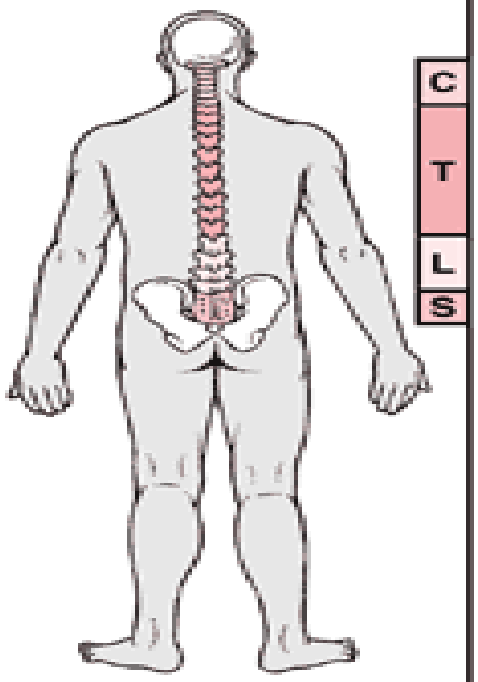
ii- meningeal

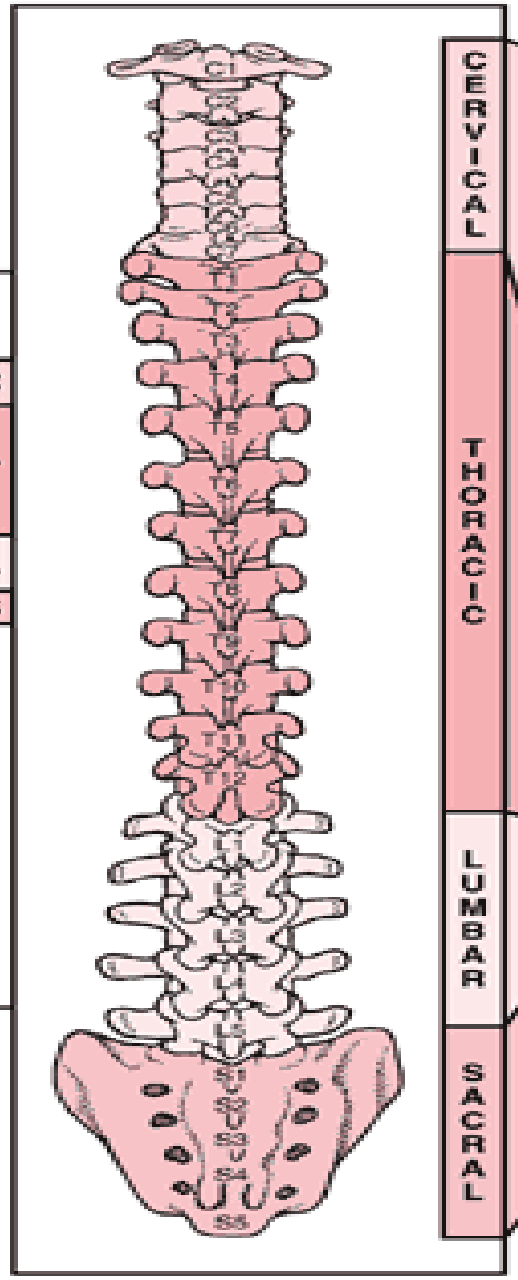
- Inflammatory (pachymeningitis,cystic arachinoidits)
- Neoplastic (Meningiomas, Neurofibromas and others)
- Cysts (Arachoid, parasitic)

Iii- Intramdullary

- Inflammatory (TM, Myeloradiculitis, MS)
- Neoplastic (Gliomas, others)
- Degenerative (syringiomyelia, NTD)
- Vascular (ant spinal artery occlusion)
- Myelopathy (Radiation, toxic)
- Compression sickness.
- Hematomyelia.
- Tropical spastic paraparesis (HLTV-1)

Effects of Spinal Injury





Level of Injury	Effect*
C1 to C5	Paralysis of muscles used for breathing and of all arm and leg muscles; usually fatal.
C5 to C6	Legs paralyzed; slight ability to flex arms
C6 to C7	Paralysis of legs and part of wrists and hands; shoulder movement and elbow bending relatively preserved
C8 to T1	Legs and trunk paralyzed; eyelids droop; loss of sweating on the forehead (Horner's syndrome); arms relatively normal; hands paralyzed
T2 to T4	Legs and trunk paralyzed; loss of feeling below the nipples
T5 to T8	Legs and lower trunk paralyzed; loss of feeling below the rib cage
T9 to T11	Legs paralyzed; loss of feeling below the umbilicus
T12 to L1	Paralysis and loss of feeling below the groin
L2 to L5	Different patterns of leg weakness and numbness
S1 to S2	Different patterns of leg weakness and numbness
S3 to S5	Loss of bladder and bowel control; numbness in the perineum

*Loss of bladder and bowel control can occur with severe injury anywhere along the spinal column

Definition of Paraplegia

Weakness or paralysis of both LL due to bilateral corticospinal tract lesions.

Causes of Paraplegia

- Cerebral → rare causes
- Brain stem → rare causes
- Spinal → the commonest

Causes of Paraplegia

(1) Cerebral causes:

The lesion must involve leg areas of both cerebral hemispheres "both Para central lobules" as in:

Depressed fracture over the vault of the skull.

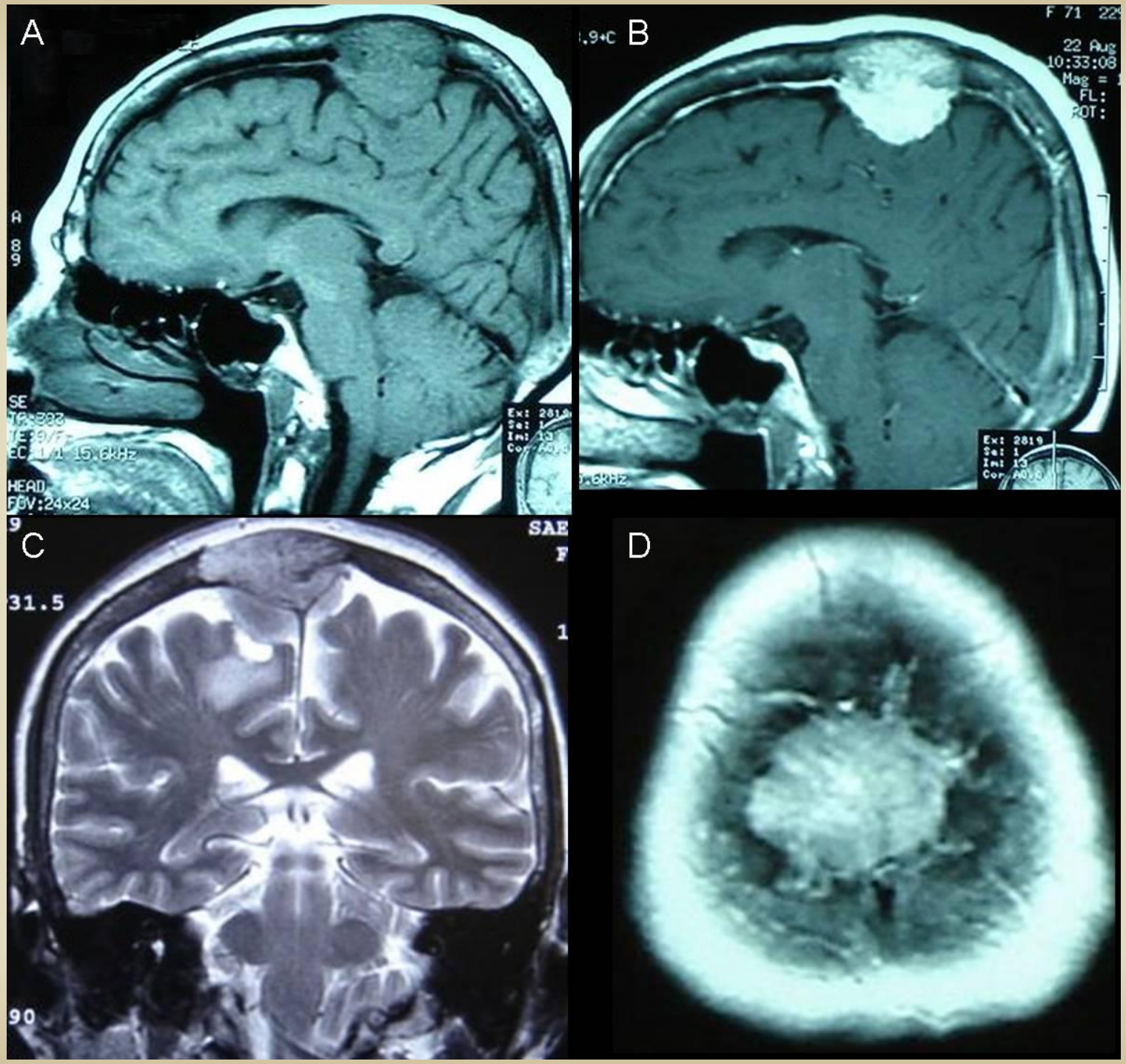
Tumors.

Superior sagittal sinus thrombosis.

Encephalitis.

Cerebral palsy.

Paraplegia here is associated with higher cerebral functions disorders


A
B
C
D
HEAD
FOV:24x24
22 Aug
10:33:08
31.5
90

Causes of Paraplegia

(2) Brain stem causes:

Must involve the midline structures to affect both corticospinal tracts, cranial nerves affection are present, e.g. brain stem tumors, vascular lesions, syringobulbia.

(3) Spinal causes:

Focal → the commonest.

Systemic → rare causes.

Disseminated→ rare causes.

Causes of Paraplegia

Focal spinal paraplegia:

Extramedullary causes:

Extradural (vertebral).

Intradural (meningeal).

Intramedullary.

Causes of Paraplegia

A- Vertebral causes (extradural):-

1- Atlanto axial dislocation.

2-Central disc prolapse→ direct compression.

3-Cervical spondylosis→ direct compression & interference with blood supply.

4-Fracture, fracture dislocation

6- Trauma or rheumatoid arthritis of the odontoid process of axis.

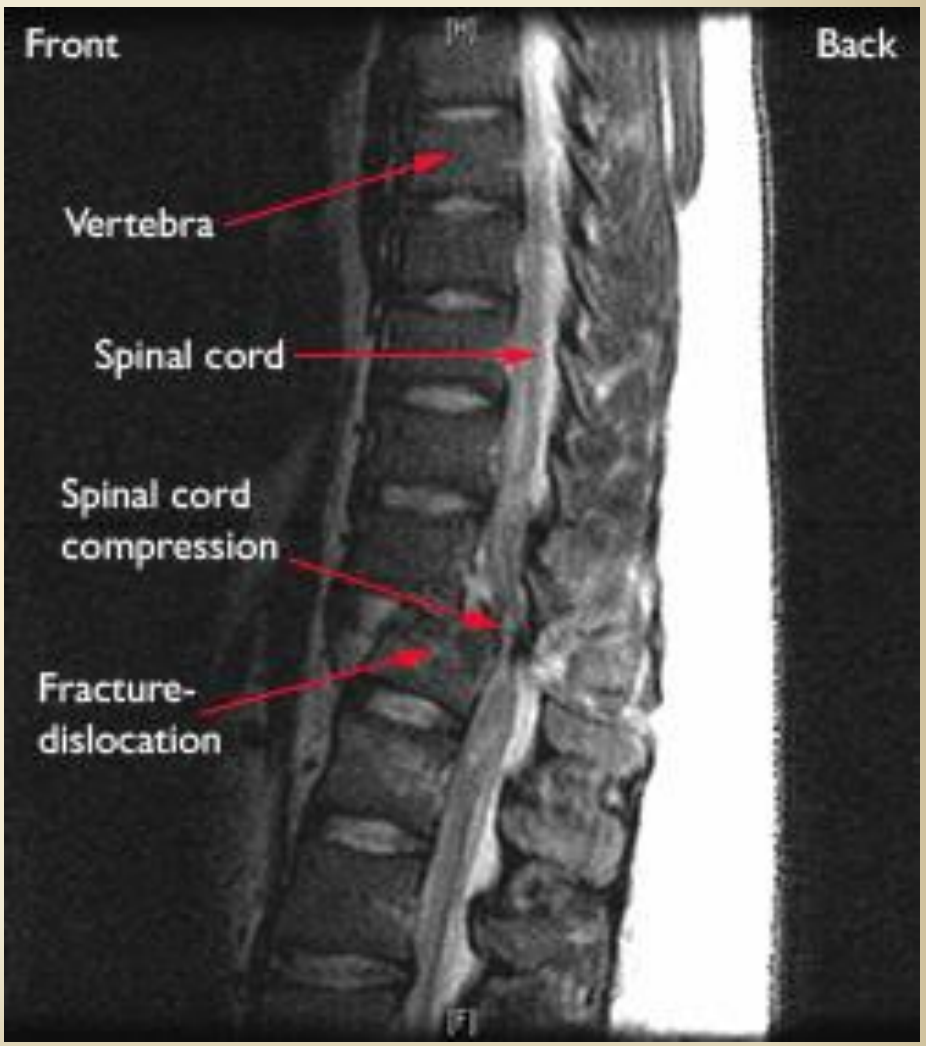
7- Congenital marked deformity of the spines e.g. kyphoscoliosis

8- Tuberclous spinal osteitis:

- **Common in young adults, Common in dorsal cord.**
- **Paraplegia may be acute or chronic**
- **Acute paraplegia results from sudden collapse of the diseased vertebrae with angular deformity, the discs are spared.**
- **TB endarteritis.**

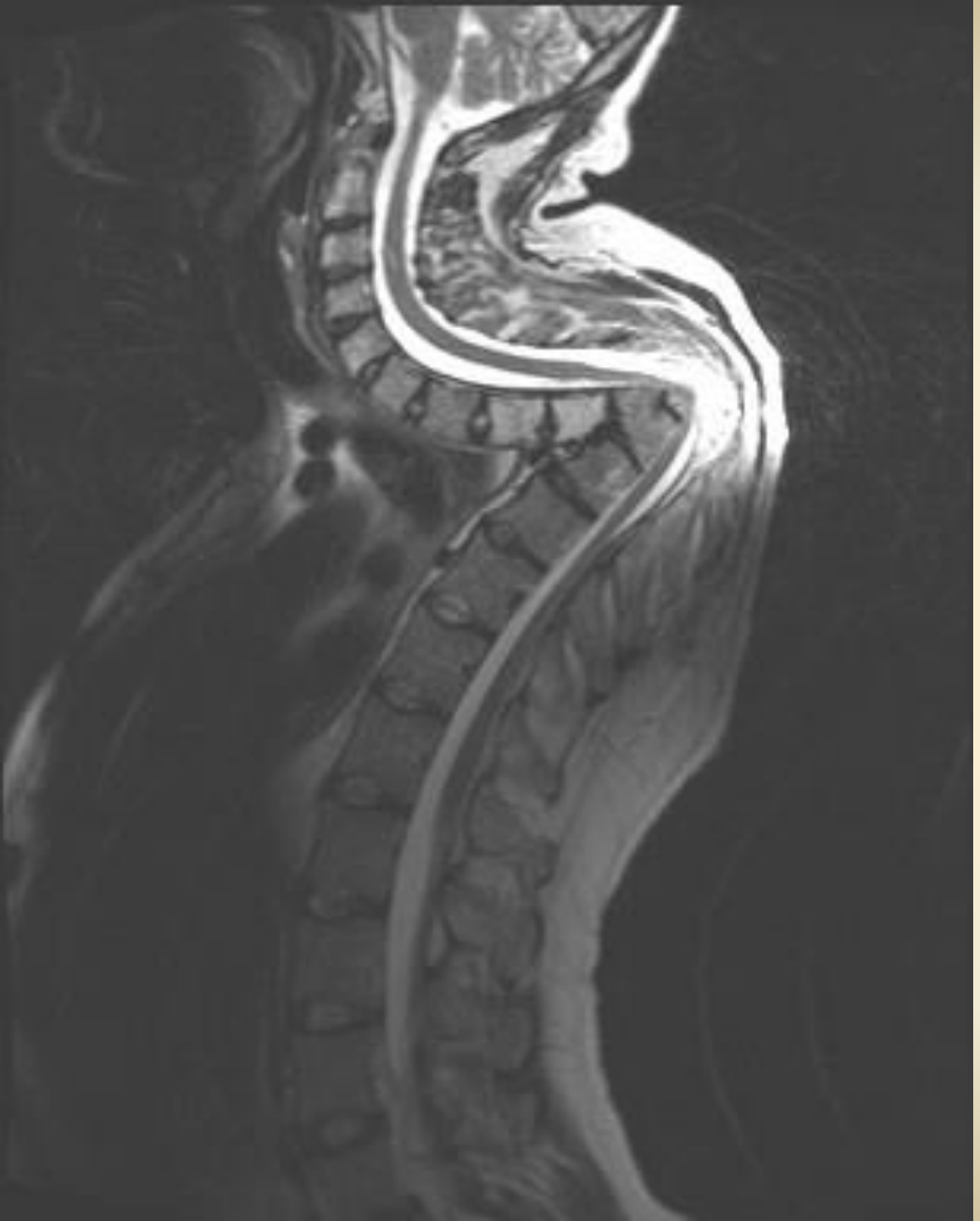

C3
C3

Fracture dislocation



TB spine

TB spine



TB-thoracic-spine kyphosis

TB-thoracic-spine kyphosis

Causes of Paraplegia

9-Syphilitic spinal osteitis:

It is now a very rare cause of spinal paraplegia.

10- Neoplasm of the vertebral column which may be:

Primary: - sarcoma - osteoma - myeloma

- cavernous haemangioma -chondroma

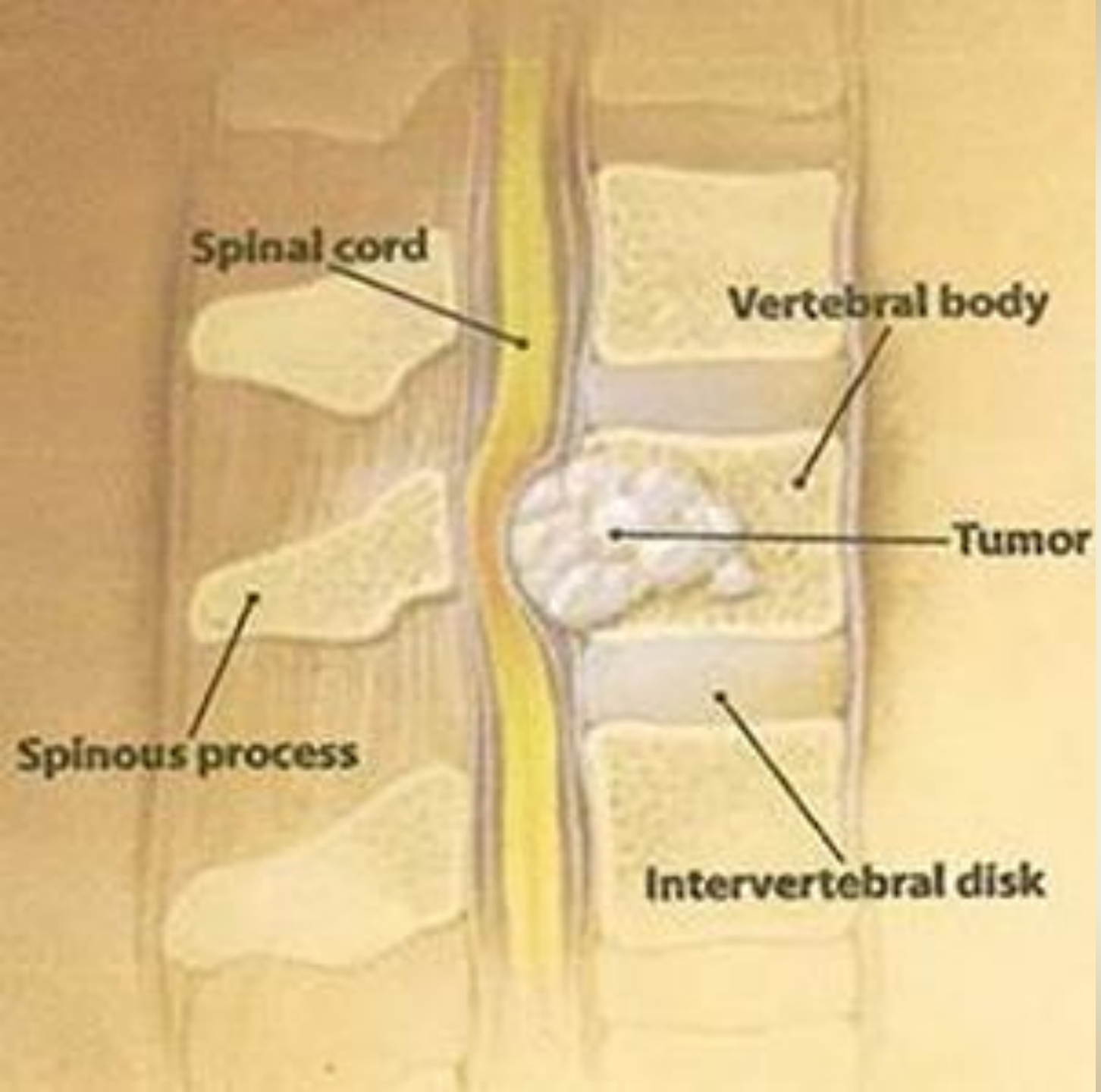
Secondary:

The commonest, rare before 35ys old, usually the primary in the lung, breast, thyroid or prostate .

Blood borne, via lymphocytes or direct extension.

Deposits of reticulosis, leukemic metastasis.

11- Spinal extradural abscess: blood born infections or from vertebral osteomyelitis .


Spinal cord
Vertebral body
Tumor
Spinous process
Intervertebral disk

Tumor


05-Mar-2008 13:27
GENESIS_SIGNA GEMSOW
HFS
SC:SAG T2 FSE
Series: 103
512 x512 x16
MRI T-SPINE W/O CONTR
A
P
200 mm
W:1212 L:607
Filter:None Fact:0
Diameter: 360.00
Aquisition: 1048050000.00
Aquired Matrix: 448 0 0 224
#Excitation: 4.00
2D
Echo: 1
TR: 4460.00
TE: 105.8
Slice:3.00 Loc:12.74

Metastasis

Causes of Paraplegia

B- Meningeal (intradural) causes:

1- Inflammatory causes:

- **Pachymeningitis: TB, post-traumatic, sarcoidosis, meningitis.**
- **Cystic arachnoiditis**

2- Neoplasm:

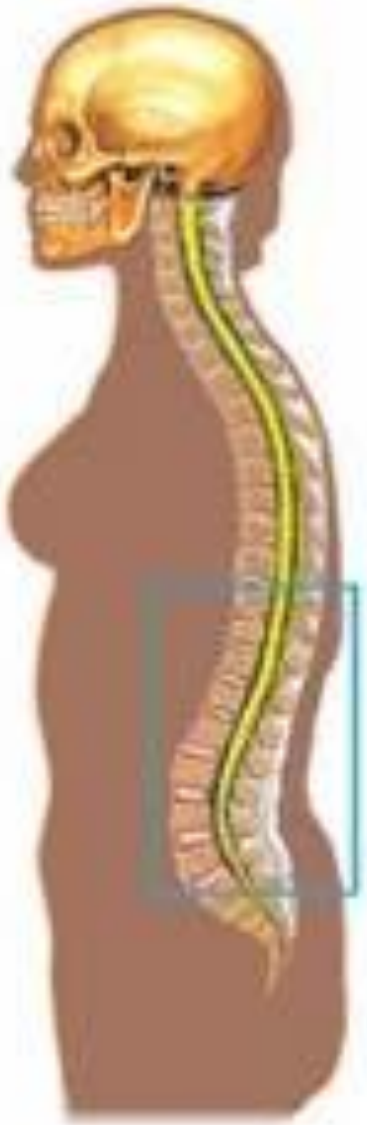
-Meningioma→ common in dorsal region, more in females, arise from arachnoids covering the root.

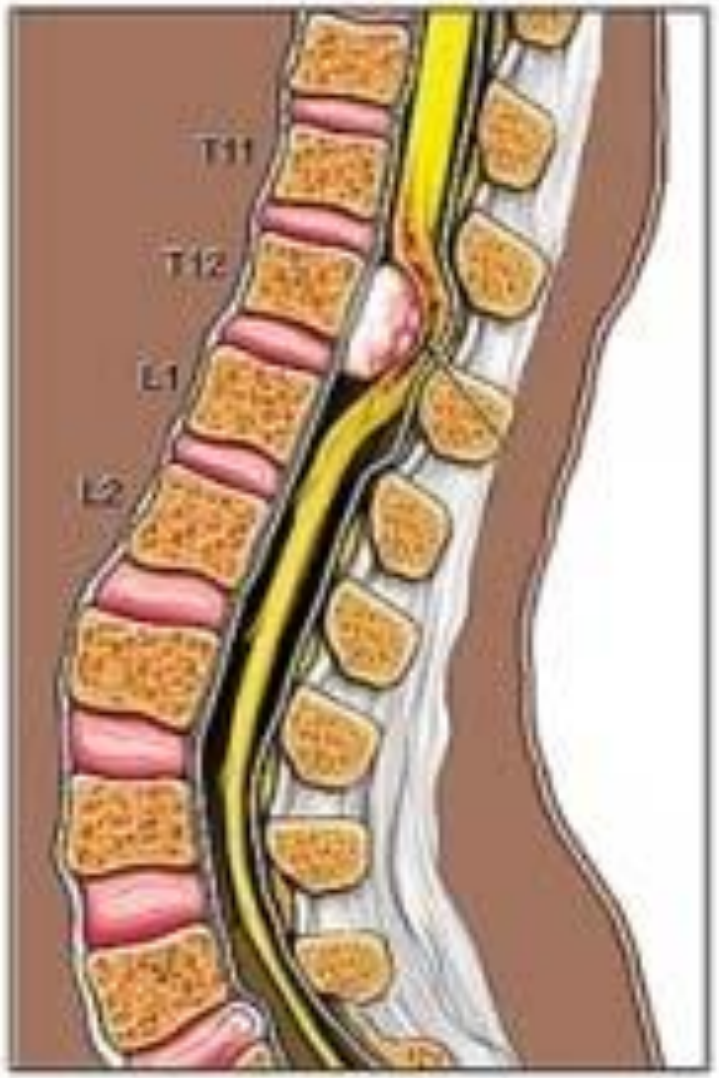
-Neurofibroma→ arise from spinal root.

- Lipoma, chondromas, dermoid cyst.

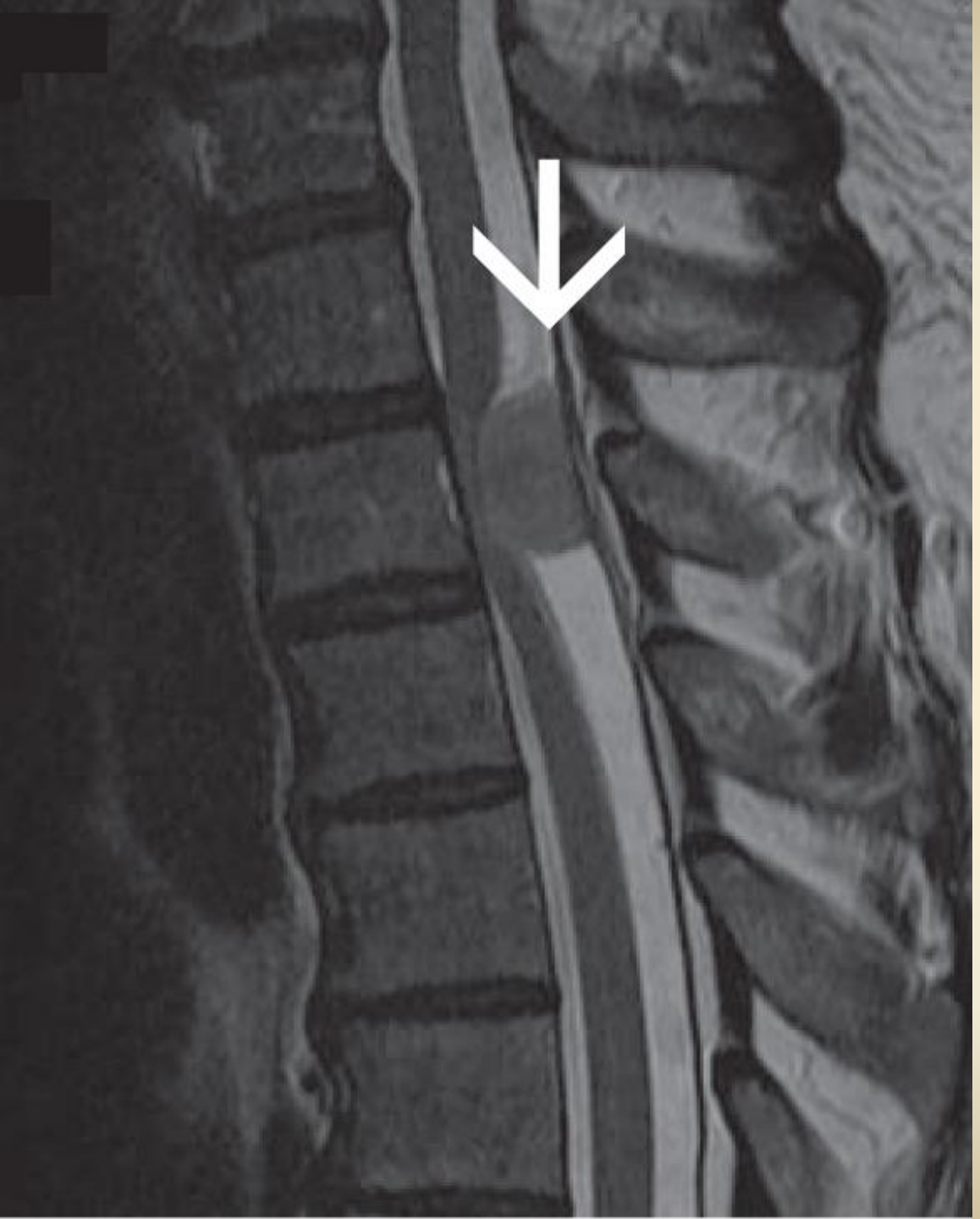
3- Arachinoid cyst→ usually of developmental origin.

4- Parasitic cyst→ hydatid cyst or cysticercus's cyst.





Meningioma



Meningioma

Causes of Paraplegia

C- Intramedullary causes:

1- Inflammatory causes:

- Transverse myelitis. - MS - Post infectious, post vaccine.

2- Neoplasm of the cord:

- Ependymomas -Oligodendrogliomas - Leukaemic deposits

- Medulloblastomas - Intramedullary metastasis

3- Degenerative: - Syringomyelia. -Neural tube defects.

4- Vascular: - Anterior spinal artery occlusion.

5- Radiation myelopathy.

6- Electrical current & lightening injury of the cord.

7- Toxic myelopathy e.g. nitrous oxide.

8- Hemorrhage into the spinal cord "hematomyelia"→ may be 2ry to trauma or 1ry from bleeding diseases, vascular malformations or anticoagulants.

9- Decompression sickness “Caisson disease".

Causes of Paraplegia

D- systemic & disseminated causes:

Hereditary spastic paraplegia.
Heridofamilial ataxia.
Motor neuron diseases.
Collagen vascular diseases.
Cerebral palsy.
Subacute combined deg.
Demyelinating diseases.
AIDS vascular myelopathy.

Regarding onset of paraplegia in relation to etiology:

- **Acute onset paraplegia are mostly common with:**

- Inflammatory causes
-Vascular causes
- Paraneoplastic myelitis
-Traumatic causes
-Acute demyelinating exacerbation
-Acute toxic causes

- **Chronic paraplegia are encountered with:**

-Most of vertebral causes
- Neoplasm
- Hereditary causes
-Motor neuron disease

Clinical presentation of paraplegia

Characteristic triad:

1- Weakness or paralysis of both LL of UMNL features.

2- Sensory level below which sensations are lost or impaired.

3- Sphincteric disturbances.

1- Mode of onset

a) In extramedullary causes, the onset is painful, gradual, with long course but may be rapid in tumors or acute in trauma with the following:

Localized back pain, tenderness, ±swelling, ±deformity in vertebral causes.

Root pain radiated to the same area supplied by the affected root.

Impaired sensation in the dermatome supplied by the diseased root.

LMN features of the muscles supplied by the affected root (weakness, wasting, hypotonia, lost reflexes)

Clinical presentation of paraplegia

b) In intramedullary causes, the onset is usually not painful, more rapid, with short course.

c) In acute causes, the patient pass through shock stage "2-6ws", sudden paralysis of both LL, complete loss of tone, reflexes and retention of urine.

2- Motor symptoms and signs in the LLs:

Weakness will be in both LLs, nearly symmetrical in intramedullary paraplegia and nearly asymmetrical in extramedullary causes.

Weakness will be:

-Distal more than proximal.

- Flexors more than extensors.

*Deep reflexes :

-Exaggerated deep tendon reflexes (After the shock stage).

- Clonus (patellar & ankle) is usually present with hyperreflexia.

Clinical presentation of paraplegia

*Hypertonia: spastic LLs , more in extensors and the LL are held in the extended position (after the shock stage).

*Superficial reflexes:

- Lost or diminished abdominal reflexes (level).
- Lost or diminished cremasteric reflexes.
- Bilateral +ve babiniski sign

*Gait: if the patient can still walk, spastic or scissor like gait.

With progression of the lesion, the extra pyramidal fibers are involved (complete cord affection), and the flexors will be more hypertonic (paraplegia in flexion), the mass reflex can be elicited→ by scratching the skin over the medial aspect of the thigh→ spontaneous urination, defecation, even erection and ejaculation.

Clinical presentation of paraplegia

3- Sensory manifestation in the LLs:

***Impaired sensations in both LL with level according to the diseased segment.**

***The sensory level may be defined by the patient as a sense of belt or tightness, encircle his trunk, below which there is impaired sensations**

***In cases of extramedullary lesions→ all types of sensation are impaired with early loss of sensation in the saddle area.**

***In cases of intramedullary lesions→ jacket sensory loss of dissociative nature (loss of pain, temperature, with preservation of touch) with sparing of the saddle area (or late affection)**

***Lhermitt's sign: in cases of cervical cord lesions either extramedullary or intramedullary→ pain, numbness, electric shock in the back and limbs on flexing or extending the neck.**

To detect the vertebral level: S (segment) = V (vertebrae) - X.

Clinical presentation of paraplegia

4- Sphincteric disturbance:

***In acute lesions→ early affected, retention of urine in shock stage.**

***In gradual lesions→ not usually early affected, especially in extramedullary lesions, precipitancy, hesitancy, retention or automatic bladder.**

***Constipation is common, fecal incontinence may occur in severe paraplegia.**

***Sphincters are affected early and sever in caudaequina and conus medullaris lesions than higher cord level lesions.**

5- Other manifestations:

- **Autonomic symptoms: excessive sweating, cyanosis, edema & coldness due to interruption of sympathetic flow.**
- **Papilloedema: complication of spinal tumors, ↑CSF protein.**

Differential diagnosis of spinal paraplegia

1- Cerebral causes→ higher cerebral functions disorders.
2- Brain stem causes→ cranial nerves affection.
3- Gillian Barrie syndrome→ LMN lesion, no sensory level, no sphincteric disturbance, NCS.
4- Motor neuron disease→ no sensory, no sphincteric.
5- Hereditary spastic paraplegia→ no sensory, no sphincteric.
6- Poliomyelitis→ pure motor, young age, no sphincteric disturbances, EMG findings.
7- Peroneal muscle atrophy→ marked distal wasting, distal sensory loss, no sphincteric, NCS & EMG.
8- Hysterical causes.

How to investigate a case of paraplegia:

1) Plain radiography :-

Is obligatory in all cases of paraplegia, in vertebral lesions it is highly informative:-

- **Vertebral destruction in cases of TB, $ osteitis, tumors.**
- **Vertebral fractures, dislocation.**
- **Degenerative changes in the spine e.g.**

- Spondylosis **- Spondylolisthesis.**

-Narrow disc space in disc prolapse.

2) Myelogrphy.

3) CT scanning of the spine : (plain & with contrast myelograghy):

- Metastasis **- Soft tissues swellings**

-Prolapsed discs **- Cord tumors**

- Fractures **- Spinal cord stenosis**

How to investigate a case of paraplegia:

4)MRI of the spine :-

Is superior to other investigations in identifying soft tissues masses, tumors, hge, intrinsic & cystic lesions.

5)CSF study :-

May be of diagnostic value in some inflammatory & demyelinating causes→ increased CSF proteins with increased mononuclear cells in extramedullary cord compression, xanthochromia (yellowish discoloration of the CSF).

6)Electrophysiological studies :-

Recording spinal & cortical sensory evoked potentials→ distinguishing organic from hysterical cases.

EMG & NCS→ diagnosis of muscle wasting and radiculopathy.

7)Spinal cord angiography:- in spinal vascular malformations.

Transverse myelitis

Definition:

Acute inflammatory lesions (infective or non infective) of spinal cord segments, common in adults & women.

Aetiology:

1-Myelitis due to viruses: Poliomyelitis, HZ, Herpes simplex, AIDS.

2-Myelitis due to bacterial, fungal, and parasitic diseases:

- Syphilitic myelitis
- Tuberculous myelitis
- Lyme disease
- Pyogenic (suppurative) myelitis
- Parasitic or fungal infection of the meninges

3-Myelitis due to non infectious inflammatory causes .

- Post infectious
- Acute relapsing multiple sclerosis
- Acute or subacute necrotizing myelitis
- Device's disease (neuromyelitis optica)
- Radiation myelopathy
- Post vaccinal
- Vasculitis
- Paraneoplastic myelitis

Transverse myelitis

Clinical picture:

Preceding paraplegia→ >1/3 patients may report upper respiratory tract infections, GIT infections, localized LBP.

Acute onset of→ flaccid paralysis, complete loss of tone, power, reflexes and sensation with retention of urine (shock stage).

Spastic paraplegia will evolve 2-6 weeks later.

Investigations:

Radiological investigations (CT or MRI) → exclude other causes, may show mild cord swelling.

CSF examination:

- **↑ mononuclear cells**
- **↑ proteins**

- In about 40% of cases→ no specific etiology can be detected.

Transverse myelitis

Differential diagnosis:

- Traumatic causes.
- Anterior spinal artery occlusion.
- Haematomyelia.

Management:

1- Care of paraplegic patient.

2- In non infectious inflammatory myelitis→ high dose of intravenous methyl predinsolone may be highly effective.

Syringomyelia

Definition:

Chronic disease characterized by the presence of long cavities, surrounded by gliosis, situated in the central part of the spinal cord, often extending to the medulla (syringobulbia).

Low signal cavity within the upper cervical cord, with mild Arnold–Chiari malformation.

Etiology:

1) **Non communicating (less common):**

- Spinal trauma, tumors, arachinoditis.

2) **Communicating (common variety):**

- Chiari type 1 anomaly (congenital extension of the cerebellar tonsils below the foreman magnum)
- Craniovertebral developmental anomalies.
- Basal arachinoditis (post traumatic, post meningitic, S.A.H).
- Dandy Walker syndrome → closure of the foremen of the magendi, preventing intermittently the cross of CSF from the 4th ventricle into the subarachinoid space, pressure of CSF will be forced down into the central canal of the cord →become dilated
- Spinal cord injury &tumors.

Clinical picture:

- The disease is common in males than females.
- Usually appears between the age of 25 – 40 years old.
- The disease process is most frequently situated in lower cervical, and upper dorsal segment, may extend up to medulla and pons, even as high as the internal capsule.
- The onset is usually gradual with :

- Wasting, weakness of LMN features of small muscles of the hands due to destructions of the AHC.
- Cutanous analgesia and trophic changes in the hands due to destructions of the decussating sensory fibers (jacket sensory loss).

Clinical picture:

- Compression of the corticospinal tract in the spinal cord leads to weakness of both LL of UMN features (paraplegia).
- Compression of the lateral spinothalamic tract → diminished or lost superficial sensations in LL with sometimes an area of normal sensation over the abdomen.
- The posterior columns are usually the last to be affected → dissociative sensory loss.
- Different skeletal deformities may be associated.

Differential Diagnosis:

- ✓ **Other causes of spinal paraplegia:**
  - ***Intra medullary.***
  - ***Extra medullary.***
- ✓ **Cervical spondylosis.**
- ✓ **Motor neurone disease.**
- ✓ **Cervical rib.**
- ✓ **Peroneal muscle atrophy.**

Investigation

MRI → most diagnostic.

CT Myelography.

Treatment

Physiotherapy: for weakness & spasticity.

Analgesic & muscle relaxants.

Surgical decompression of the cavities may be needed.

Spinal degenerative diseases

Anatomical considerations

Each spinal nerve is composed of

dorsal root "*sensory* “ ventral root "*motor*"

the two roots unit → to form the spinal nerves

The intervertebral disc consists of :

central semifluid portion "*nucleur pulposus*

surrounded by strong fibro cartilaginous band "*annulur fibrosus* ".

Age, trauma

1.Annular fibrosis become weak and the central nuclear pulposus herniate

2.New bone formations called osteophytes "spondylosis"

narrowing of the intervertebral foramen causing radiculopathy

or compress the cord causing spondylotic myelopathy.

Clinical picture of radiculopathy

1) Sensory symptoms :

Lesions of the dorsal root will cause radicular or root pain which has the following characters:

-Lancinating , electric , burning.

-Abrupt, sharp , well localized. ↑at night

-Referred to a specific dermatome .

-Precipitated or ↑ by ; coughing

2) Motor symptoms & signs:

Due to ventral root lesions , there is weakness & wasting of the muscles supplied by the affected root, fasciculation may be present in the affected muscle

3) Reflex signs:

Lesions of the dorsal or ventral roots may interrupt the afferent or efferent, causing diminished or lost reflexes of the muscles supplied by the same root.

Cervical radiculopathy & myelopathy

Cervical Spondylosis

Usually the symptoms are sub acute or insidious with radicular pain in the neck, radiated to the dermatome supplied by the affected segment

-There may be localized area of tenderness in the corresponding Para spinal muscle.

myelopathy

features of bilateral pyramidal tract lesions in both lower limbs which are usually asymmetrical

radiculopathy

the symptoms may be mainly sensory on lesions of the dorsal root or mainly motor on lesions of ventral root or both.

Neurologic signs &symptoms according to root or disc lesion

4) Lesions of C4:

-Sensory: Lower neck.

-Motor: Paresis of -Trapezius.-Rhomboid.± Infra & supraspinatus.± Diaphragmatic paresis.

5) Lesions of C5:

-Sensory: shoulders & upper lateral arm.

-Motor: paresis of muscles of elbow flexion & shoulder abduction:

- Biceps -Deltoid. -Bracheo radialis. -Serratus anterior. -Supra& infraspinatus.

-Reflexes,,-lost or diminshed biceps and brachioradialis reflexes

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6) Lesions of C6:

-Sensory :lateral arm, lateral forearm, lateral hand

-Motor: paresis of muscles of elbow flexions.& wrist extension.

-Extensor carpi radialis longus .- Extensor carpi radialis brevis. -Biceps. -Serratus anterior -Flexor carpi radialis

-Reflexes, diminished biceps& brachioradialis reflexes

N.B, C6 lesion is the commonest one after C7 lesions.

7) Lesions of C7:

-The commonest of cervical lesions.

-Sensory: - Middle forearm. - Middle palm. -3rd&4th digits.

-Motor :Paresis of muscles of extension to wrist & elbow.

-Reflex Triceps reflex may be depressed.

8) Lesions of C8:

-Sensory: Medial arm ,forearm ,5th digit.

-Motor : Paresis mainly in small muscles of the hand flexors of fingers

Lumbosacral spinal lesions:

1) Lesions of L1:

-Sensory: In the inguinal region,anterior medial upper 1/3 of the thigh.

-Motor : lower abdominal muscles→difficult to be demonstrated.

2) Lesions of L2:

-Sensory: Anterior medial middle 1/3 of the thigh.

-Motor: Paresis of -Iliopsoas →thigh flexion. -Pectineus→thigh adductions &flexion. -Sartorius→ thigh flexion.

-Quadriceps→leg extension.-Thigh adductors.

-Reflex: Cremasteric reflex may be depressed.

3) Lesions of L3:

-Sensory: - Lower 1/3 of the anterior medial aspect of the thigh .

-Motor: -as L2.

-Reflex: the knee reflex may be depressed.

4) Lesions of L4:

-Sensory: lower back, buttock, anterolateral thigh , knee, anterior medial leg

-Motor: Paresis of -Quadriceps→leg extension. -Sartorius→thigh flexion & exersion.

-Tibialis anterior → foot dorsiflexion.

-Reflex : The knee reflex may be depressed.

5) Lesions of L5:

-Sensory: Lower back ,buttock,lateral thigh ,lateral leg & calf,

dorsimedial foot , big toe.

-Motor : -Hamstring muscles→knee flexion.

-Tibialis posterior→foot planter flexions & inversion.

-Peronei →eversion & plantar flexion of the foot

-Gluteus minimus & medius →thigh abduction

-Extensors of the toes.

Lesions of S1

-Sensory: Lower back,_buttock,_lateral thigh, _calf,_little toe,and sole of the foot .

-Motor: Paresis of -Gluteus maximus→hip extension.

-Biceps femoris →knee flexion.

-Calf muscle→foot plantar flexion

-Flexors of the toes. – Small muscles of the foot

Lesions of S2, S5:-

-Sensory: calf, posterior thigh ,buttock & perianal region.

-Bladder & bowel control may be impaired.


Thank You