



MSSS

Musculoskeletal System

Doctor 2019 | Medicine | JU

NO.

PBL

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PBL Lumbar Spine

In this sheet we will have a problem-based learning related to the lumbar spine and this scenario is done by Dr. Muhammad from faculty of medicine he will explain some clinical issues related to the vertebral spine.

The Scenario,

One time in the clinic you were sitting on the desk and then you have a **45-year-old female patient**, this lady is complaining of severe **low back pain** since 10 weeks and this low back pain is **radiated to the to her right leg**.

so we start to think about that, asking ourselves what we will do ?and after that we realized that in order to understand the problem of the patient, we should talk with the patient. In clinical life to talk with the patient is important and the most important part of that talk is to **take a good, detailed history from the patient**.

From the history of that patient, we noticed that the **pain increases with coughing** and it is associated with **decreased sensation on the dorsal aspect of her foot and on the medial shin of the leg** (I mean both right foot and right medial shin) and she had a **difficulty lifting the front part of the foot** while she is walking.

taking more history from the patient

Pain increase with coughing

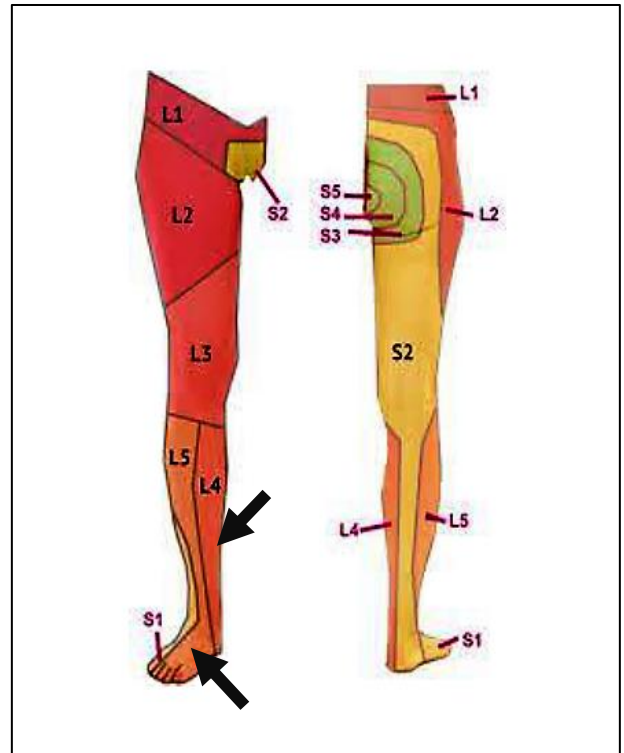
The pain associated with parasthesia (decreased sensation) on the dorsal aspect of her foot and medial shin

Difficulty lifting the front part of the foot while walking

To make that easier from a practical point of view :

We noticed that the patient had the decreased sensation which is called **paresthesia** on this area **the shin of the foot & the leg** and we know from basic knowledge that these areas, the skin over the lower limb, is supplied by dermatomes by nerve roots and so we know that this area I mean the shin of the **tibia is supplied by L4** near root, while the **dorsum of the foot at this area is supplied by L5** nerve root. So because the patient had low back pain, we start to think that there is something **compressing that nerve in the back** and sending a radiation pain to these areas.

- This means : at the beginning we are thinking that there is a compression on the L4 and L5 nerve roots which causes these paresthesia.



Now note how this patient is walking, our patient she's a female but she had the same walk and the same gait of this guy. look how he is hiking to lift her leg in order to be able to walk. Why ?

because she **cannot dorsiflex her ankle and it is always going in a plantar reflection** when she is elevating it. So he or she do more hip reflection to cheat for walking, the patient is **hiking their hip and flexing their knee to clear the foot that has weakness.**



What should we do next ?

Now we should transfer **from just taking history to examining the patient**. Once we concluded that we have a nerve root that causes decrease in sensation (especially the L4 & L5), we should examine now the motor part. We should examine this **and prove that we have real paresthesia**. It's not enough that the patient tells you "I have a decreased sensation", you should prove that with a physical exam means.

So when we exam former roots because we are thinking that it is disrupted or there is something wrong with them, **we should examine three things in order to know which nerve root is affected and to prove it**. We should examine :

1. the **sensory tract** and so we do a sensory examination.
2. the **motor tracts** ,spinal tracts and the motor supply of the nerve, plus the muscle powers
3. we should examine the **reflexes**.

➤ **Examine the sensory part**, using a cotton piece or **cotton swab** and a **needle**, because these are two **different pain sensations**. how to examine that?

we go to the dorsum of the foot using that cotton and examine it on **the right side which is the abnormal one**, then examine the same area of the foot on **the left side the normal one**.

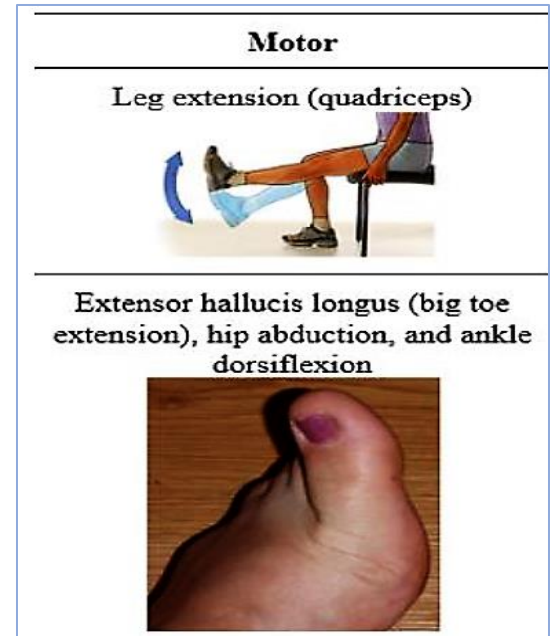
If there is a decreased sensation on the right side, it means that this area is really affected. Ask the patient do you have the same sensation of cotton on the right and left?? he **will tell you no I can feel it lightly or I can feel nothing on the right but I cannot feel it well on the left side**. So that we conclude, L4 root is affected and the same for L5. After that we do the same with the needle break (this needle is not that much hard but I it will do pricking).

Sensory



- **Examining the power of the muscles**, we know that **L4 root** is important for **extending the knee and extending the ankle (dorsiflexion)** and it is done by **tibialis anterior**. If these two moves are weak, I know that L4 nerve is affected. We also know that **L5 is important in supplying extensor hallucis longus** which does extension on the big toe.

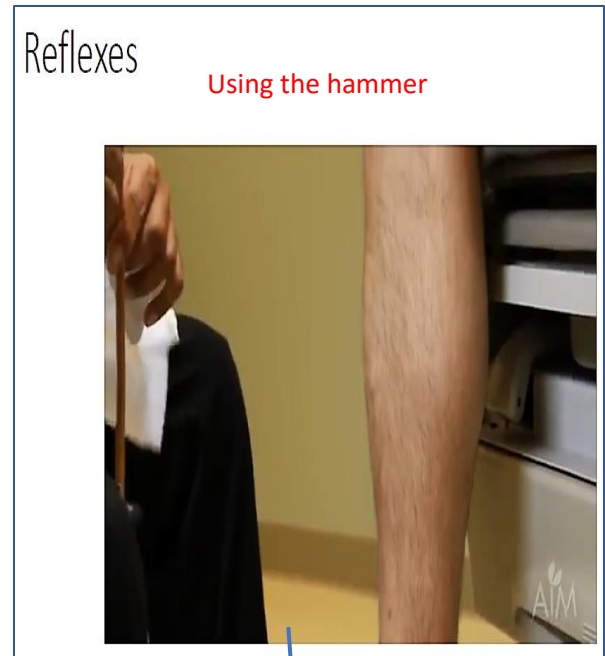
so in our patients when we examine that, we notice that she had a **weakness in the dorsiflexion of the ankle had a weakness in extension of the knee and had a weakness of extension of the big toe on the right side while all these findings were fantastically good on the left side** which means that these both nerve roots are affected.



- **Examination of reflexes**, we know that the reflex of the knee is controlled by L4 nerve roots, so do a knee reflex for the knee to check if that if that nerve is working or not. **If there's a compression in L4, there is no reflexes** on the knee but if we don't have compression, we will have a normal reflex of the knee.

* the reflexes had other issues also with something called **upper motor neural issues** (if I have a CVA and did that work, the reflexes will be exaggerated .While if it is just due to compression in a low spinal cord, these reflexes will be decreased).

We examine the reflexes using a hammer and we hit the **patellar tendon**, you will notice that **the leg will kick**.

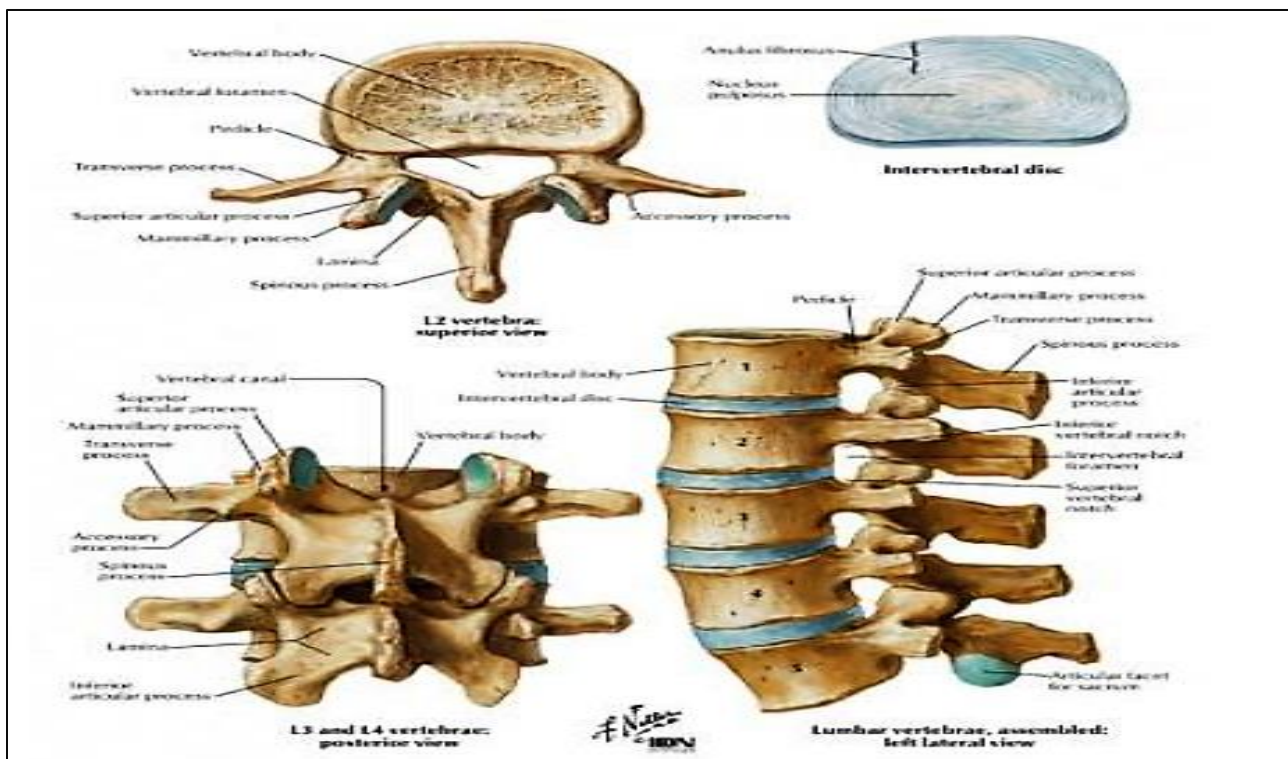


“look to this patient sitting and very relaxed, it's quite easy to hit the patellar tendon and notice a nice brisk contraction of the **quadriceps muscle** , be sure to expose the muscle you're looking at keep your eyes glued on them”

In our scenario about the right leg of our patient: we are now sure that the L4 nerve root is affected because of have **loss of knee reflex + loss of ankle dorsiflexion and knee extension (muscle weakness) in them + loss of sensation** in the distribution of L4 on the skin. so I'm pretty sure there is something compressing the L4 nerve root.

The next issue that we'll do an **investigation** about the cause what has happened to these nerve roots in the back that made them produce all these clinical findings. We have **two tests** for that investigation : the **x-ray** and the **MRI**.

Bone landmarks,
before we go further, let's review a little bit of the bony landmarks of the vertebra.



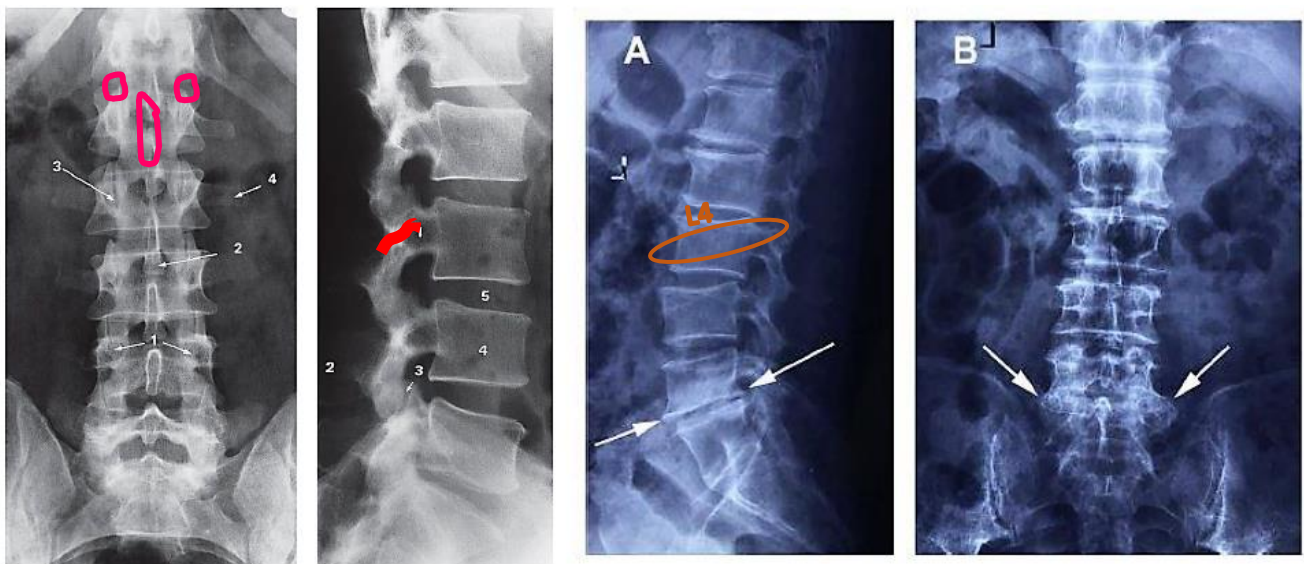
- ✓ this is the lumbar vertebrae L1-L5, between these vertebrae there is a whitish or yellowish structure which is called **the desk** (intervertebral discs)
- ✓ the vertebra as a whole is composed of the **body anteriorly** and the **arch in the posterior** part the body, that body is connected with two small pieces which are **the pedicles**.

- ✓ then we have **transverse arches**, then we have these what is called the **facet processes**, the superior and inferior processes that cause this is a **facet joint**.
- ✓ then we have **the laminae** and then after that we have the **spinous process**
- ✓ in the lateral profile: you can notice some circles which are **the foramens** that the nerves go out from them.
- ✓ and inside here there is a medullary canal for spinal cord.

X-ray

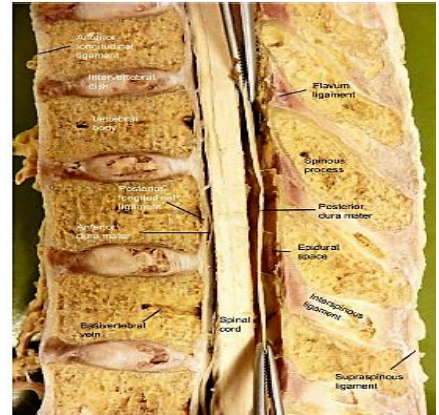
look to this lateral profile below, we can see vertebral bodies and we can see a **radiolucent area** between two dense areas which is **the place of the disk**.

- ✚ you can also notice that we have two dense areas and there is a **line** this line that is the facet joint between the superior process between and inferior process. And you can notice these projections, it's **like the peak of the owl (منقار البوم)**, it's spinous processes but this is on the av view the spinal cord processes.
- ✚ you can see it on the lateral view this is the **spinous process**. If you imagine well the vertebra, you can notice that that an **owl is looking to us** through his eyes. so these circles **these circles are the pedicles** of the spine, when you look at the pedicle on the x-ray you can see it as a circle.



✚ The first two pictures (on the right) in this x-ray you can see that **the space is decreased**, why this radiolucency decreased because the **disc there is collapsed** so I have a **disc disease**.

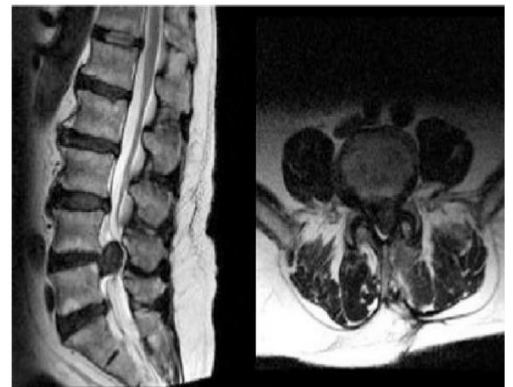
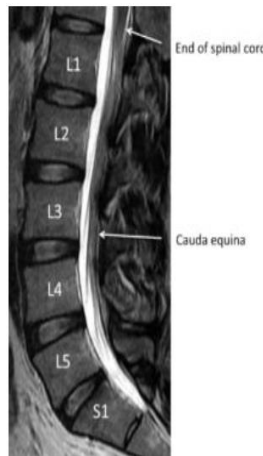
➤ This is a cadaveric view and you can see here the **vertebral bodies** and you can see here **the discs** and you can see behind is the **spinal cord**. you know how much the disc and vertebral bodies are just near to the spinal cord in the medullary canal this is very important.



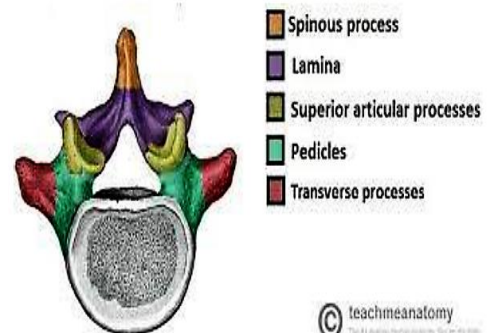
MRI

To understand how to see the problem in MRI and how to explain it, here in the photo the vertebral bodies and between them the discs, there is medullary canal and **inside the medullary canal is something black which is the nerve roots**.

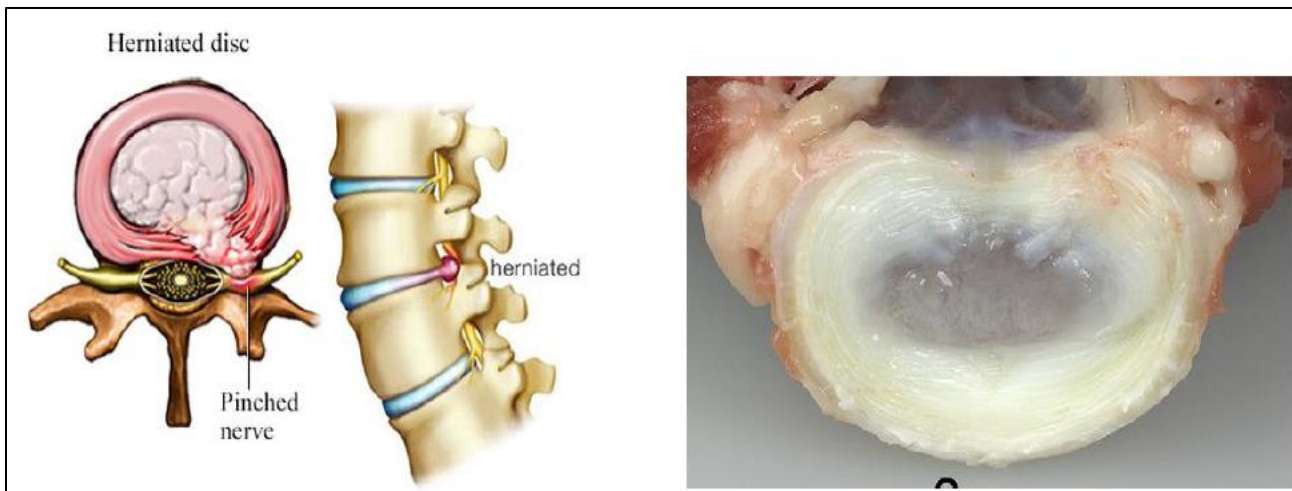
✚ we can see something different; you can notice that **the discs between L3 and L4 had some something abnormal** and **between L4 and L5 there's even something much more abnormal**. Looks like something has protruded into the medullary canal and compressing the black structures (the nerves). we call this case **protruded disks or prolapsed disks that are compressing the nerve roots**.



combining clinical knowledge with anatomical knowledge: you know now that the vertebra had pedicels which are in a green had superior process that is in the yellow had transverse processes that is in red and had a lemony that is violet and had spinous process that is an orange color.

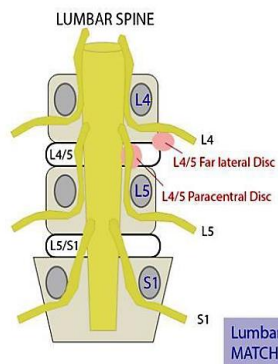


- ✚ This is the structure of the disc, it's composed of two important parts the one that is **outer** is called **annulus pulposus** or annulus fiber process. The one that is **inside** is called the **nucleus pulposus** which is steering annulus fiber process and cause its material to bulge and press the nerve root.
- you can see this is a cadaveric view (on right) that we have an annulus fiber process and a nucleus pulposus.

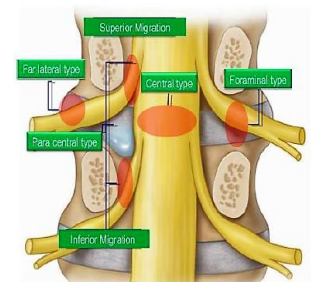


- local nucleus pulposus process is more like a **jelly material** but the annulus fibrosis it's a fibrous tissue. so this jelly material is just invading the fibrous one and going out of it protrudes compressing the nerve root.

We should know also from anatomy that there is a relationship **between the nerve roots and the laminae**, **nerve roots are coming below the same laminae** for example if we are speaking about L5 it is starting from **above L5 laminae** then **it's coming below L5**, so if we have a disk between the vertebra of L4 and L5 and that disk is in the central area **it will compress the L5 and it will not compress the L4 because L4 is just coming below the L4 laminae so it is not reaching to the L45 desk.**



Various types of lumbar disc herniation



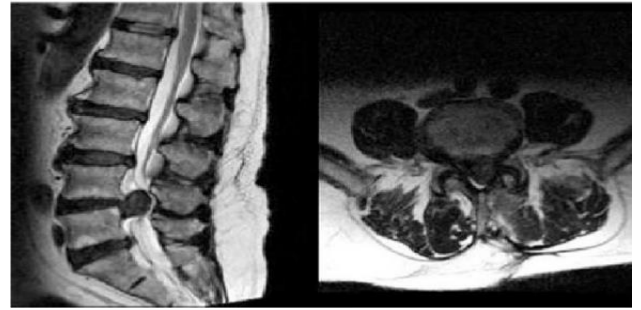
- We have a **paracentral disc**, that **will compress the nerve that is below it** between L3-L4, which is L4.

the disc between L5 and this one which nerve root that will compress ? now if that this is a paracentral one it will compress the s1 nerve root but if I

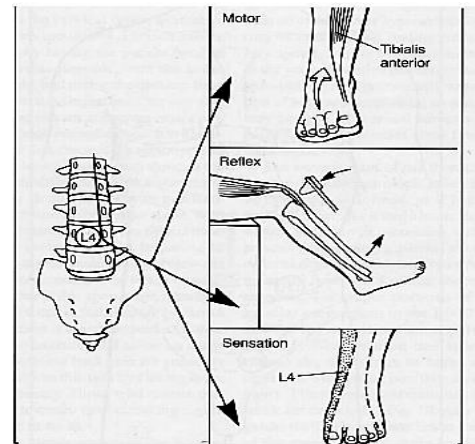
- We also have a **far lateral disc**, it will **compress the same nerve root of the same level**. I mean if we are in L4- L5 desk so if it is for lateral it will compress L4 if it is paracentric it will compress L5.

Back to our patient

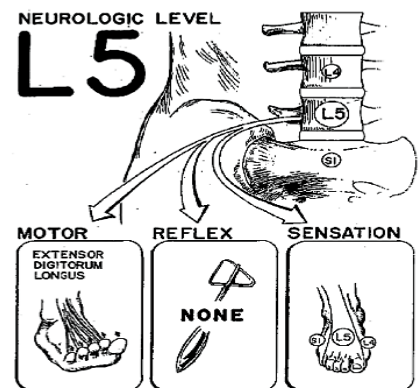
Now we know why our patient had this loss of sensation this muscle weakness that gait (walk) which we call it a **drop foot gait or high stability gait** and we know the cause of that and we even know the cause of low back pain because **we have two desks between L3 - L4 this is the first disc and L4-L5 this is the second disc.**



so in summary we concluded that L4 root was giving me the dorsiflexion of the ankle and the version using tibialis anterior because supplies tibialis anterior and decrease reflex, because L4 is compressed we have decreased reflex because the knee reflex is controlled by ill-former fruit and we have decreased sensation on the ill-for distribution area which is mainly on the shin of the tibia and on the medial side maybe of the foot.



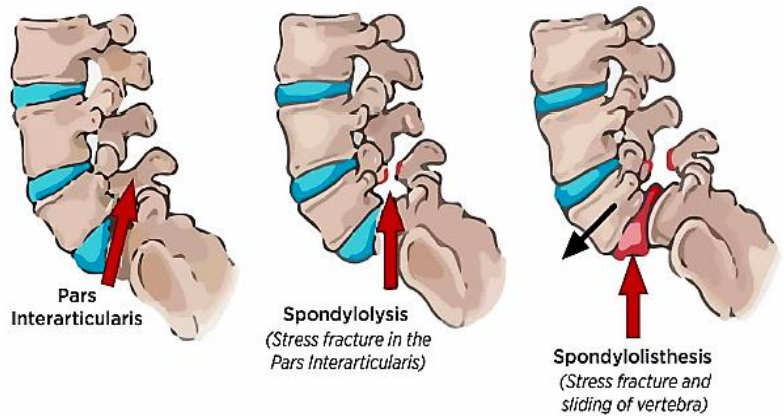
and the same for L5 we lost the extension of big toe motor wise there is and we lost the sensation over the dorsum of the foot and really L5 does not give any reflexes so we cannot test in five new route with reflexes.



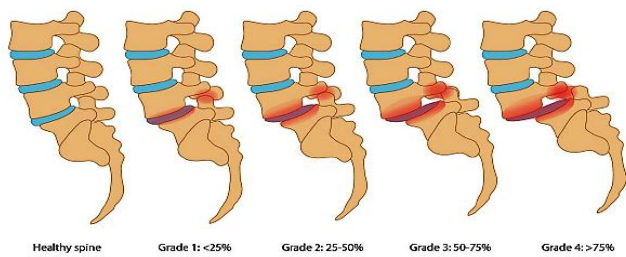
Diagnosis, < after all this long story>

so my diagnosis at the end is **L3-L4 disk prolapse that affecting L4 nerve and L4-L5 disc prolapse that affecting L5 near root.** so what can doctors do??

doctors can do a lot **by removing this disc that compressing that nerve** and this process is called **Discectomy** and it has many ways to be done, we go through incisions in these bones reaching to the disc and removing the disc material which is the **nucleus pulposus** that is protruded.



SPONDYLOLISTHESIS STAGES

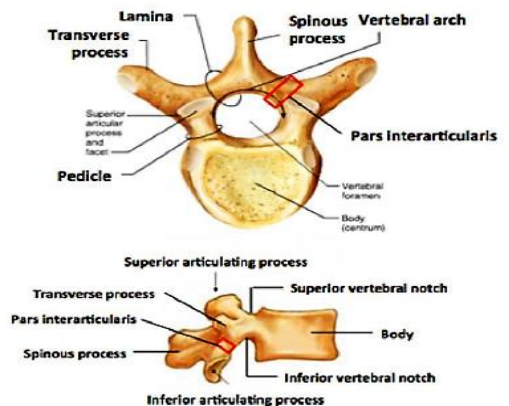


Anatomy related conditions, you can see here that we have a spine and the L5 vertebra is just **sliding over the S1 vertebra** this situation is called **spondylolisthesis**.

- here in the x-ray we can see here the vertebral bodies and if we draw a line here and the line here we can see that this vertebra is just going more anterior than this vertebra and this is called spondylolisthesis.

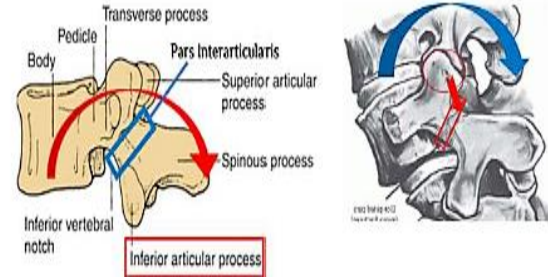
why the spondylolisthesis happens?

because of a defect in an area called **pars-interarticularis**, it is the area between the **pedicle and the lamina**. and at the lower part of the figure you see that it's the area between the **superior process that make a facet above and the inferior process that make a facet joint below**. so this is the **pars-interarticularis** when we have a **defect in this here and there this vertebra will slide over the vertebra below**. if we have a defect **without sliding** we

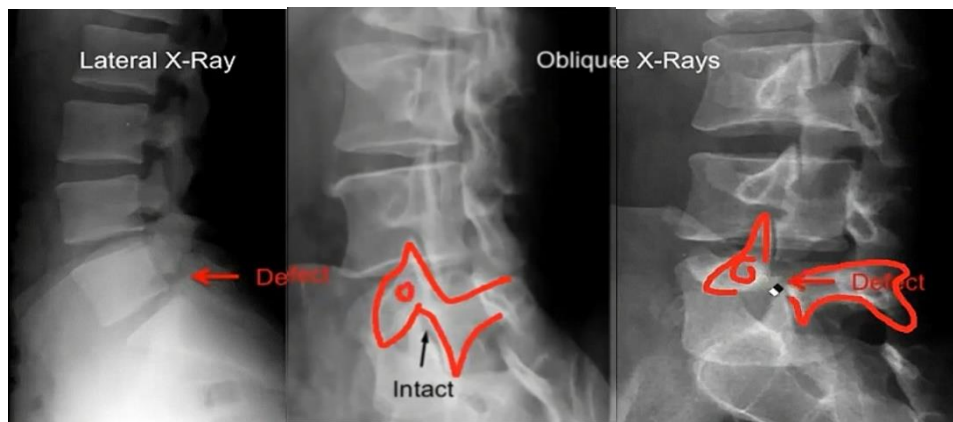


call this condition **spondylolysis** but if we have a sliding of vertebra above over the vertebra below we call this condition **spondylolisthesis**.

we can see the fracture as a dog so we call this sign **a scotty dog appearance** and you can see that **his neck his neck is the pars-interarticularis** area and only and if we have a fracture in the neck of that dog we call it a **pars-interarticularis defect**.

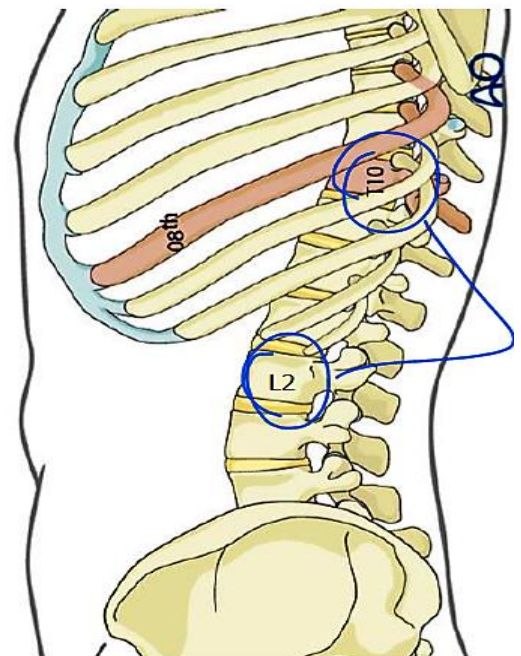


so pars-interarticularis defect will look on x-ray like a defect in the neck of the Scottie dog, his neck will be longer on x-rays. now so this is the defect in pars-interarticularis and because the vertebra **is not sliding we call this condition spondylolysis**.



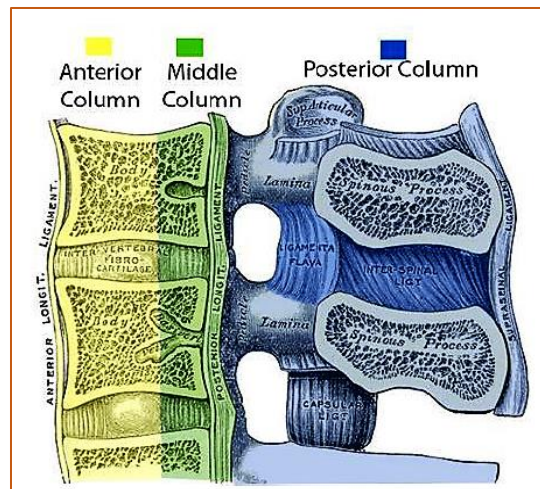
Thoracic vertebra fracture,

Our last issue is the vertebral fracture. The **junction between thoracic and lumbar vertebra is really a transitional area** because you know the thoracic spine is just fixed with a combination of ribs so it is a **rigid** one, while lumbar spine had no combination for anything so the movement in lumbar spine is very high. If we have a **trauma in this transitional area between T10 and L2**, there's a very high risk to have a **fracture** because it is the transitional area between very rigid vertebra and easily mobile vertebra.

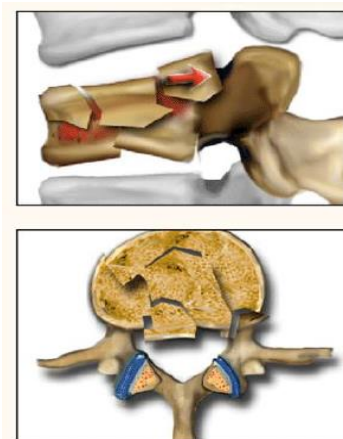


✚ A cross-section of our spine is divided into three columns:

1. the **anterior column** till the two thirds of the vertebral body and two thirds of the annulus at the disc annulus fibrous. It has the anterior longitudinal ligament.
2. the **middle column** which is taking a posterior one third of the vertebra and posterior one third of the annulus fibrous with the posterior longitudinal ligament
3. the **posterior column** which is composed of all the other structures.



➤ these columns are important because if we have a fractures in the **anterior column we have no danger on the medullary canal** which holds the spinal cord but if we have a fractures in **the middle column this fractures will retro pulse into the canal** and will cause **nerve compressions**, as in the picture, after the fraction a piece will enter into the canal and compress the nerves and do paralysis for and weakness for the patient.



✚ we have many types of fractures like: **compression fracture** which is in the anterior column which is a simple and **needs no surgery**. The **burst fracture** which involves **the middle column so it may have a propulsion into the canal** and may need surgery. The fractures that involve the posterior part like **flexion distraction** involves the posterior part and even the middle column and the anterior column which **needs surgery**. **Fracture with dislocation** also involves all the three columns and **need**



Compression



Burst



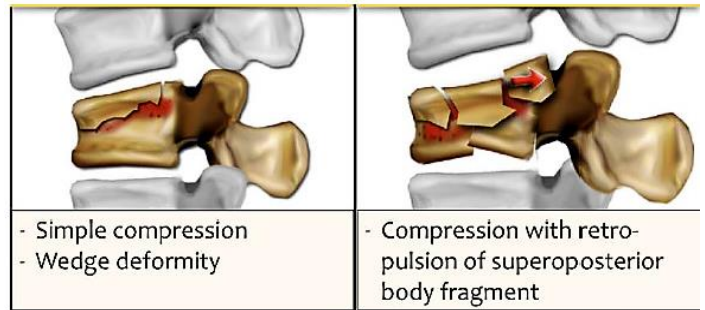
Flexion-Distraction



Fracture-Dislocation

surgery to fix them otherwise the spinal cord will be transected and the patient will end with a **paraplegia**.

- ❖ this is a **compression fracture (left)** and it affects only the anterior column and it does not affect the medullary canal while this is a **burst fracture (right)** that had the propulsion of piece of that fracture into the medullary canal and it may cause neurological problems.



- ❖ This is a **CT scan** (computer tomography) for these fractions, we can see a **compression fracture** (left) because the posterior column is intact. we can see a **burst fracture** with a piece that's propelled into the medullary canal and causing pressure on the nerve.

