# Problems in Musculoskeletal system

When a patient comes to you asking for your help, your job here is to ask him few questions and examine him in order to know the correct diagnosis to give him the most appropriate treatment to his problem (disease).

As a doctor, you should acquire and request some vital information from the patient to understand and diagnose correctly. These formations are:

1. Sex ( some diseases affect males specifically , some affect females and others might affect both)
2. History of the patient ;

- Drugs that might have been used
- When was the first time the patient experienced the pain
- How long it has been going on?
- The severity and the gradual increase in the pain they are suffering
- The occurrence of a previous disease

Rule of medicine: take history first, physical examinations, then investigations. (80% of diseases can be diagnosed by history and physical examinations only, the investigations are just to support your ideas).

As soon as you acquire the information and build up a base, you start to correlate and to expect the disease or the type of the pain, this is called “differential diagnosis” (expecting). Let’s say that you expected osteoarthritis, gout and rheumatoid arthritis*. After this diagnosis , you should support your ideas and your expectations by doing further examination to make sure that it is gout for example not the other two diseases.

The case that the doctor showed us is about a patient who is:

An old retired Male about 60 years old, complaining from pain in the knees during walking, that pain is aggravated by going up and down stairs but disappears when sitting and lying down. Further detailed history showed that the man was okay till 15 years, after that he started complaining from pain in the knees, gradually increasing with time from mild pain that he only felt after walking for more than two hours, to a severe pain that only started 6 months ago till now. This pain was associated with swelling in the knees and difficulty to move from one room to the other due to the feeling of pain. However; it is relieved when sitting or lying down, but the patient cannot pray properly (on his knees). Instead, he prays in sitting position.

After taking this information and the history from the patient, we examined him clinically and then asked for knee X-rays in order to diagnose the problem. What we found is that the patient has:

- Varus deformity of knees, atrophy of vastus medialis, flexion contracture of knees
- Tenderness on the joint line medially and laterally
- Range of motion limited from 10 -95 degrees
- Crepiation on motion
- Medial and lateral instability

After piling up all this information, we got some ideas of what the disease might be (expectations). So our differential diagnosis was either osteoarthritis, gouty arthritis, rheumatoid arthritis, or an infectious disease (suppurative arthritis). Now we start to support our ideas with clues that we obtained from the examinations that might either approve the disease or deny it:

1. **<u>Rheumatoid arthritis :</u>**
   Why did we expect that?

Because of the crank in the knees, Crepiation, continuous pain and because rheumatoid arthritis mainly affect the knees.

What is against it?

- Sex : this type of arthritis is most common in females and our patient is a male
- Age: The patient is 60 years old (noticing that R.A usually affect people between 20-40 years old)
- Character of the pain: because RA is an inflammatory arthritis which is usually relieved during walking and exacerbated during rest.

**So eventually it is not rheumatoid arthritis**

*An additional characteristic of R.A that the doctor mentioned is that it is either mono articular affecting one joint or poly articular affecting more than one joint.*

2. **Infection:**

why did we expect that?

- Edema and pain
- The knee joint is a superficial joint unlike the other joints which are deep, that is why it is more liable to get an infection.

What is against it?

- The pain that results from the infection is continuous during rest and movement.
- The pain has been going on for 15 years, which is unlikely for an infection to last this long.
- Infection means the presence of bacteria, and bacteria excretes pyrogens that produce interleukins (IL1, IL2, IL6) .The hypothalamus is sensitive to these interleukins, so when the interleukins activate the hypothalamus they will lead to elevation in the temperature of the hypothalamus which leads to fever (increase in the core temperature) and the difference between the superficial temperature and core temperature lead to chills,

and our patient is suffering from none of these symptoms. (Notice the Explanation below that is between ***).

***there are two types of temperatures, core temperature that is affected by the hypothalamus, and the surface temperature which is on the outside that stays the same (has nothing to do with the hypothalamus nor the interleukins). That's why a patient suffering from an infection is always shivering and suffers from chills (because the core temperature is high however the surface temperature is low). The easiest way to ease this situations is to decrease this difference by either elevating the surface temperature which is more preferable, or lowering the core temperature which is harder. We can elevate the superficial temperature by covering up with a blanket or by the involuntary muscle contractions that produce ATP which aid in elevation in the temperature. ***

**And that is why that patient is not suffering from an infectious disease ☺**

## 3. Gout:

Why did we expect that disease?

- swelling
- Gout can affect all ages so the patient might be suffering from it.
- It also could affect any joint but specifically the ankle, knee, big toe and the shoulder.

What is against it?

- Gout is unlikely to be bilateral, it usually affects one knee not the two knees at the same time, or one toe not both ((which is also an evidence that this case is not an infectious one because infections rarely hit both sides).

4. **<u>Osteoarthritis : (( which is the correct answer) )</u>**

   Why did we expect it?

- Age (60 years)
- It affects males and females equally
- Unlike rheumatoid arthritis the pain in osteoarthritis is a mechanical pain ( exacerbated on walking) in acute stages , but they are the same in the late stage
- Character of pain: the gradual increase in the severity of the pain from a mild pain that he only felt after walking for more than two hours, to a severe pain that only started 6 months ago.
- The hyaline cartilage in the x ray is in a destructive stage.
- Varus deformity (which is the most important evidence): because the articular cartilage is under destruction so the bones become more attached to each other). explanation below

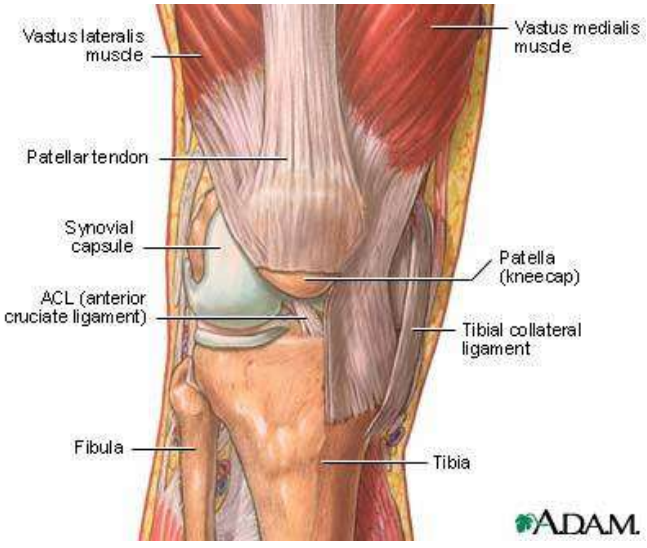
All the joints have a specific stability that is determined by the ligaments, muscles and the shape of the bone. For example the hip joint is a ball and socket joint so its shape gives it stability. Another example is the shoulder joint that is also ball and socket, however; the glenoid is shallow and the acetabulum is deep that is why most of the head is covered by the acetabulum not the glenoid which excludes the shape from giving stability to the shoulder. And that leaves us with ligaments and muscles, but because the ligaments in the shoulder are very thin and usually part of the capsule, we exclude them too, and since there are 3 layers of muscles on top of the shoulder joint (rotator cuff, trapezius, and deltoid) the stability is gained in the shoulder due to these muscles not the shape nor the ligaments. As a conclusion, the hip joint is more stable than the shoulder which is logical because the hip carries the trunk. As for the knee joint (which is important in our case) the ligaments give the stability because the two condyles from the femur and tibia are shallow so we exclude the shape of the bone, also the muscles are absent around the knee, however there are a lot of ligaments around it (medial collateral ligament, lateral collateral ligaments.. etc) which are the reasons behind the stability of the knee.

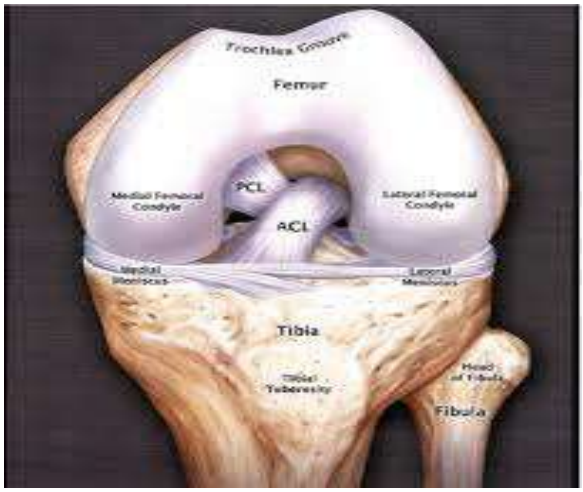
These ligaments have a certain tightness, but when a destruction to the cartilage or the bone occur, the bones become closer to each other and the joint become smaller, the tightness of the ligaments loosen (our weight is mostly on the medial side that is why these patients suffer from varus deformities.

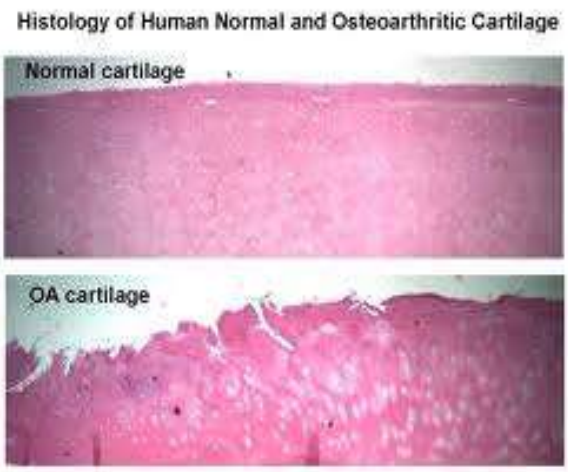
- Atrophy of the muscles: the fear of pain prevents the patient from moving his legs (moving his muscles) leading to muscle atrophy (not using his muscles). Since the vastus medialis is the weakest muscle especially its oblique head, it is the first one to get affected.
  ** When a student complains from pain in his leg and says that he cannot move his leg (in order not to go to school), we check if the vastus medialis is atrophied. If it is, then he is truly in significant pain. If it is not, then he might not be truthful.

- Limited range of motion: This is due to pain, deformities and swelling. (because when the synovial fluid fills the joint, it becomes like a balloon filled with fluid) , so if the patient bends his leg the pressure inside the capsule will increase leading to firing of the nerves ( C fibers ) that are in the capsule causing pain and limitation of the movements.

The picture illustrates the knee joint with its articulating surfaces (distal end of femur and upper end of tibia), meniscus, cartilages and the vastus medialis.






The hyaline cartilage in the 1st picture (slide #11) is shiny white because of the collagen and water that gives elasticity to the cartilage. (90% of the cartilage is made from water and with age dehydration occur, once the water is decreased the cartilage becomes harder, leading to simple trauma (very simple trauma caused by going up the stairs for example). Then, with time, leading to cartilage fissuring (يتسطح). This fissuring leads to destruction of the cartilage (destruction of the chondrocytes, which has lysosomal enzymes that lead to further destruction of the cartilage as seen in the picture number 2 or slide #15).

Imagine the knee with a balloon (synovial fluid) between the bones covered by a capsule. The rheumatoid arthritis is a disease of the synovium that leads to synovial hypertrophy, therefore; more cells are produced and hypertrophied , consequently producing more and more fluids, but later on, the lysosomal cells that are in the synovial cells will cause destruction to the cartilage then to the bone . However the osteoarthritis is a disease of the cartilage but eventually a destruction of the bone will occur (that is why osteoarthritis and rheumatoid are the same in late stages as mentioned above).

When the destruction is on the cartilage, we do not feel the pain, because the cartilages are avascular and anural and alymphatic, that is why the patient won't feel a thing until the destruction reaches the subcondral bone

leading to mild pain that exacerbate within time as the destruction increase. Check out slide # 16 that shows a fissure that is reaching for the subcondral bone.

Slide #17 we took a scope and put it inside the knee of the patient and noticed white substance which is the condyle of the femur, and the defected cartilage (the hole). When a patient reaches this stage (as in our mentioned case) we recommend physiotherapy and analgesics, but if it didn't work we have to replace the joints.

Slide #19 shows an X ray of the patient in a sleeping position, notice the decrease in joint's space medially compared with laterally, osteophytes formation and subcondral sclerosis.
Slide #20 shows an x ray of the same patient who is in a standing position. The condyles are directly on top of each other, the varus deformity is very clear, and the collateral ligaments have been attenuated (stripped) although we can't see it in an x ray but it is obvious.

This case is an advance osteoarthritis case. The best thing to do is to open the joint and excise the femoral condyle and the tibia, and then we should replace the femur and tibia with metallic part (total knee replacement with a metal and a plastic knee) as seen in slides #21, 22, 23

The doctor asked us to know the answers and cover these point in order to have a full understanding of the lecture objectives :-

- 1- What is the anatomical structure of knee joint?
- 2-Discuss the function of meniscus and collateral ligaments
- 3-Discuss how the cartilage gets its nutrition
- 4- Discuss how the cartilage degenerates
- 5-Discuss the pathophysiology of pain