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The study on anatomy, risk factors, pathophysiology, treatment of osteoarthritis

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ABSTRACT

The review is to describe the osteoarthritis epidemiology, anatomy, pathophysiology, risk factors causing osteoarthritis are also explained and treatment of osteoarthritis. Knee and hip are weight bearing joints are mostly affected. Osteoarthritis of the knee is a condition characterized by the progressive destruction of the cartilage and review tried to explain the stages of the knee and treatment for knee and describe the total knee replacement. The goal of treatment for osteoarthritis of the knee include reduce pain and inflammation and update treatment also explained.

Keywords: Osteoarthritis, Total knee replacement, Risk factors, Treatment, Cartilage

INTRODUCTION

Definition

Arthritis is a general term used when there is inflammation with in the joints. Osteoarthritis said to be Osteoarthrosis (or) also known as degenerative joint disorderliness. Osteoarthritis is a benighted disease of cartilage degradation. Osteoarthritis is a long term chronic disease characterized by the breakdown of joint cartilage. [15]

It occur in any joint. Joints give the body flexibility and precision of movement and helps in supports the body weight. The joints most affect include the knees, hips and spine. However, it can also create damage in the neck, finger and thumb. It usually occurs when a joint experience excessive stress (or) previous injury. Underlying cartilage disorder (or) also trigger the condition.

Osteoarthritis occurs more in females compared to males. Osteoarthritis is a geriatric disease commonly affects the middle-aged and elderly due to lack of vitamin-D. Globally knee osteoarthritis is 4th most significant causes of incapability in women and 8th in men. [1]

Bones provides support to the body movement. The place where a 2-3 bones need called joints. Joints may be immovable joints, freely moveable. Synovial membrane surrounds movable joints inside the membrane synovial fluid lubricates and nourishes joints tissues such as cartilage. Articular cartilage is a tough slippery covering ends of bones which allows smooth joint movement. [6, 7]

EPIDEMIOLOGY

In India, osteoarthritis scores top 5 chronic disease, adult population affect about 4-6% of osteoarthritis. Osteoarthritis is a chronic, age related, degenerative which ultimately leads to joint failure. [19, 8]

According to WHO, the women aged over 60years was estimated 9.6% of men and 18.0% of women have symptomatic osteoarthritis worldwide. In rheumatology, osteoarthritis is the second most common disease. In India, the prevalence of joint disease was estimated as 22% to 39%. [16]

In globally suffer from osteoarthritis, 100 million people reported worldwide in cause of disability. [4] In the world, prevalence is more in osteoarthritis musculoskeletal disease. Globally knee osteoarthritis is 4th most significant causes of incapability in women and 8th in men. In osteoarthritis, the aged over 70years was estimated 40%, in which severe knee pain and disability shows nearly 2%.

ANATOMY AND PHYSIOLOGY OF KNEE

Three knee joint compartments are:

- ✓ Medial
- ✓ Lateral
- ✓ Patella - femoral.

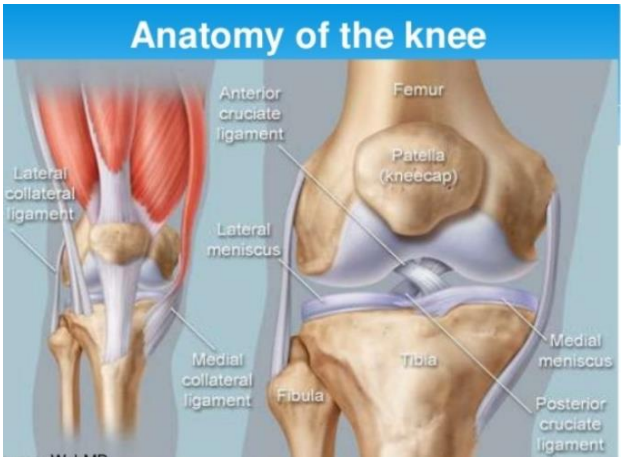

Figure: 1 Anatomy of the knee

The medial compartment: the medial compartment is on the inner aspect in the leg. it consists of the

- ✓ Medial femoral condyle
- ✓ The medial meniscus
- ✓ The medial tibia plateau.

The lateral compartment: it is on the outer aspect in the leg.

It consists of the:

- ✓ Lateral femoral condyle
- ✓ Lateral meniscus
- ✓ Lateral tibia plateau

The patella-femoral compartment:

- ✓ It consists of the articulation between the patella and the distal end in the femur.
- ✓ The patella glides in a groove in the lower part of the femur every time you bend or straighten in the knee.
- ✓ Arthritis is this part of the joint often presents as pain in the front in the knee when climbing stairs or slopes.

Osteoarthritis of knee joint is most common. Before going in to osteoarthritis we could revise synovial joint anatomy.

One knee joint is synovial joint osteoarthritis occurs commonly in synovial joints. Bones are form joint surrounded by periosteum. Periosteum has pain receptors. End of bones are surrounded by shiny substance called articular cartilage.

This cartilage helps in absorbing shocks and allows for lining between bones surrounding the synovial joints is the synovial membrane. The synovial membrane juices is known as synovial fluids. Surrounding synovial membrane have fibrous capsule which together with the synovial membrane forms known as articular capsule.

The blood vessel supply to articular cartilage help bringing immune cell and help bring blood vessel and also necessary for draining waste. This area is made of nerve fibers. Articular cartilage surrounding the ends of the bones.

Knee joint another cartilage a fibers collagen called meniscus. Meniscus is weight disc stuff between two bones and really help with the joints and help also in absorbing shocks at the joints. [18, 2]

STAGES OF KNEE OSTEOARTHRITIS

In healthy knee

The articular cartilage is smooth with no fissuring and bone smooth. The synovial fluid is viscous aids in lubrication. The knee moves full range of motion without pain. Overtime osteoarthritis will affect bone, cartilage, synovial fluid of the knee. [14]

With mild knee osteoarthritis

It begins with discomfort in the knee joint. Progression of disease may be slow in this stage. Now the joint space is no more the cartilage begins breakdown from combination of wear and tear and bone spurs known as osteophytes. They begin with the bone at the end of the joints.

Treatment

By increasing exercise and weight loss.

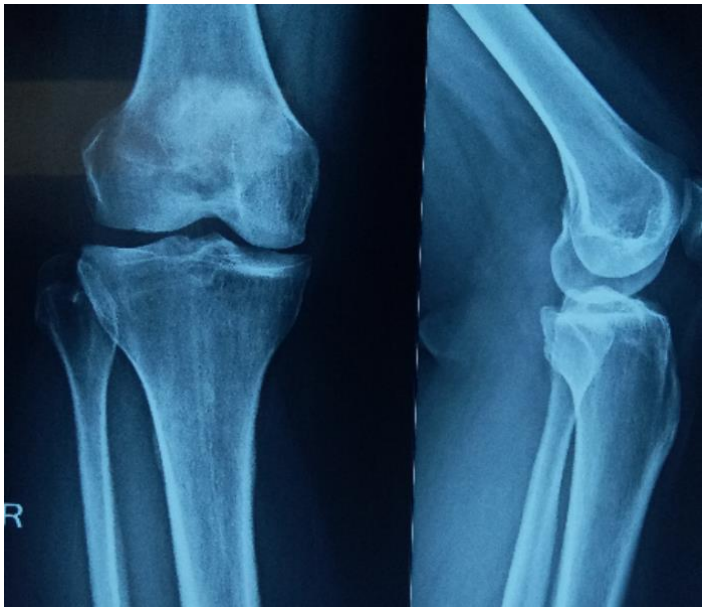

Figure (2.b): Mild knee osteoarthritis.

Moderate knee osteoarthritis

The cartilage surface between bones begins to reduce narrowing gap between femur and tibia. Hyaluronic acid which help the fluid lubricant the joint becoming less viscous, elastic, concentrated. Osteoarthritis often effect Subchondral bone located just underneath cartilage. [23] Sub Chondral bone provide hydration and oxygen to cartilage. Osteophyte grow is increase and size making the bone rougher. All these factors combined make joint pain become more severe with movement and rest.

Treatment

Weight loss, exercise, pain relievers, Hyaluronic acid, steroid injection.

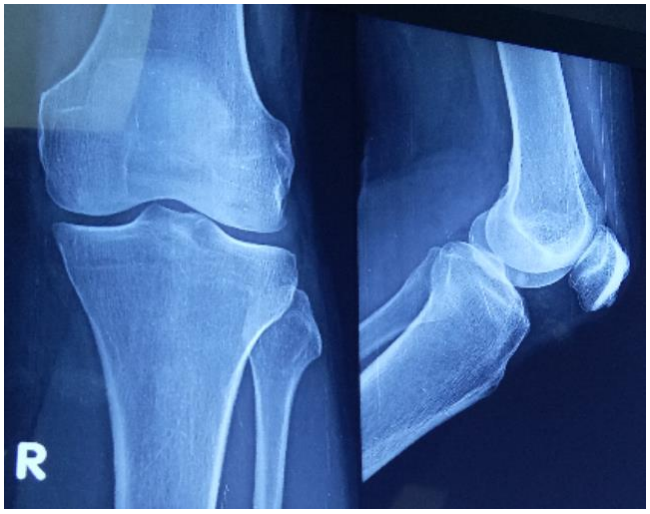

Figure (2.c): Moderate knee osteoarthritis.

Severe knee osteoarthritis

Joint space has narrowed causing more rapid and severe destruction of cartilage. The synovial fluid is decreases, increasing friction and pain with in synovial membrane destruction.

Protein are produced which produced degrade cartilage and soft tissue around knee .Osteophyte increase, bone move against bone in cartilage. Daily activities and quality of life are impacted.

Treatment

Surgery, partial/total knee replacement.

Figure (2.d): severe knee osteoarthritis.

Pathophysiology

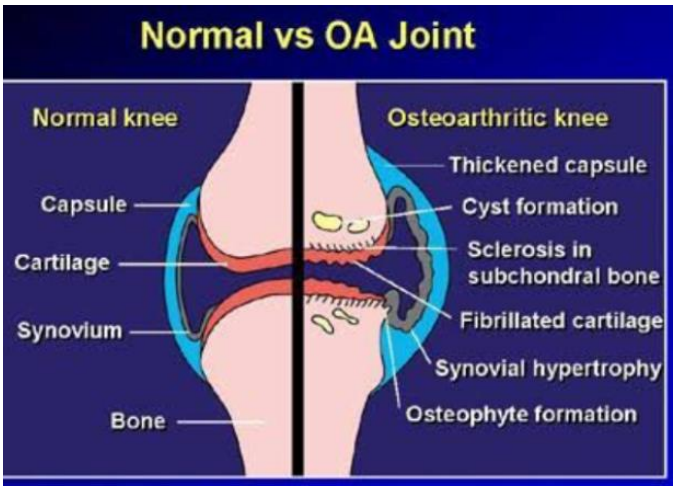

Figure (3): pathophysiology of knee

In Healthy joints of two bones. Articular cartilage which is type of connective synovial tissues two bones that lining each other essentially with friction with osteoarthritis. One particular joint, synovial joint along with articular cartilage another important component of synovial joints is Synovium, along with the surface of articular cartilage forms inner lining of joint space. In Synovium composed of connective tissues and blood vessels, lymphatic vessels on the surface type A cells that produced clear debris and type B cells that produced components of synovial fluid. Which are lubricant to articular cartilage surface. [20, 11]

The main issues in osteoarthritis is progressive loss of articular significant friction between them. which can generate inflammation and trigger pain to the nerve end in the joint space.

Maintaining articular cartilage is chondrocytes specialized cell process maintain cartilage. Chondrocytes produce a extra cellular matrix type-2 collagen structural support as well as proteoglycans is a protein and sugar molecular like hyaluronic acid and chondroitin Sulfate and keratin sulfate. All these extra cell can keep the cartilage elasticity.

The Chondrocytes with in the cartilage matrix also exhibit age related changes.it has been proposed that reactive oxygen species (free radicals) induced by stressors like mechanical or biological may lead to cell senescence.

The cell senescence is accompanied for unregulation of inflammation cytokine expression such as interleukin-I (Il -I), tumor necrosis factor alpha (TNTα) are drivers.

The cytokines also stimulate directly by production of other factors like pro-inflammatory including leukotriene inhibiting factors like: IL-VIII, IL-VI protease and prostaglandin E2 (PGE2). The net catabolic environment and loss of extra - cellular matrix is formed due to IL-1 and TNFα both cytokines increase MMP synthesis and decrease the inhibitors of MMP enzymes. Nitric oxide (NO) is a free radical and Nitric oxide synthesis are synthesized by chondrocytes. Proteoglycan synthesis and IGF-1 is inhibited by Nitric oxide on chondrocytes.

Articular cartilage damage, chondrocytes starts trying to pair the cartilage. Initial starts making loss of proteoglycans and more type 3 collagen and making different collagen type, type 1 collagens++.It does not interact with proteoglycans. In the same way decrease elasticity in cartilage and along with breakdown.

The apoptosis in chondrocytes and forms apoptotic bodies. Apoptotic bodies express catabolic properties. These may contribute to the observed abnormal Chondral calcification and osteophyte formation. Osteophyte or bone “spurs” form in an attempt to stabilize the joint and ultimately fuse it together. Bone spurs can injure nerve, blood vessels and connective tissues that is seen in osteoarthritis.

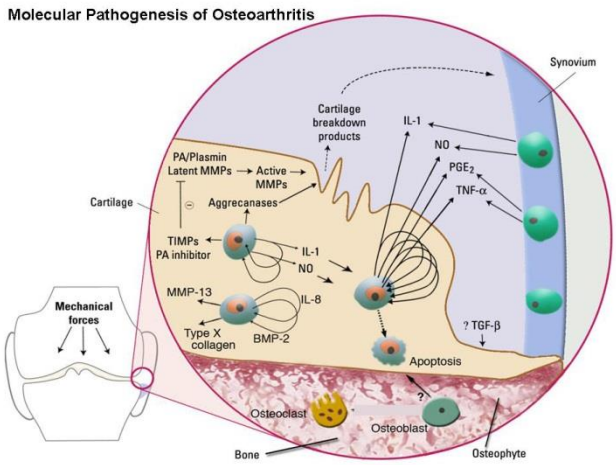

Figure (4): Molecular pathogenesis of osteoarthritis.

Symptoms of osteoarthritis

The most common symptoms is pain in the joints, especially after movement. This discomfort is often worse in the later hours of the day symptoms includes Joint pain, stiffness, swelling, instability, weakness, cracking (or) crunching.

Joint pain

First patient tell about pain that brings to the doctor for evaluation of pain ability to do activity no more activities. The pain is difficult to exhausted by activity released by rest. When osteoarthritis comes worse even small amount of activity can brings of the pain.

Stiffness

Some patients can experience on stiffness and the stiffness is feeling of just having the difficult time you getting joint going in morning. Typically for osteoarthritis, this stiffness better in 30minutes and loss for 1hour.

Swelling

Some time there is swelling, in swelling coming going swelling. Sometime changes in the weather can make the osteoarthritis symptoms reverse thus some patient reverse with cold weather and some patients do not any effect with cold weather changes.

Weakness

Typically because patient having pain, swelling. now patient can't walk in balance and loosing lot of strength in joint muscle.

Cracking (or) crunching

Some patients can experience cracking of joints. Patients are moving knee up just feel like crunch crunch crunch. [12]

Causes of osteoarthritis

Osteoarthritis can be caused by several factors such as: old age, improperly formed joints, being overweight and stress on the joints.as well as from certain activities (or) repeating movements over and over. Joint injury (like from sports can accidents) and ligament tears and strains. Including genetic defects in joint cartilage. People over the age of 50 have a higher risk of osteoarthritis.

RISK FACTORS

Age

Age is most consistently identified risk factor of osteoarthritis. More commonly men after 50 and women after 40 may suffer with osteoarthritis. Incidence of osteoarthritis increases with age due to additional wear and tear however its not a normal corollary of aging.

Obesity

Obesity is a very important risk factor in osteoarthritis. Increases load on joints particularly ankles, knees, hips, lumber spine, adipose tissues may produce chemicals that promote joint damage. The most common joint involvement in obese women is knee and hip (weight bearing joints).

Occupation

Farmers, sports and some occupation related to repetitive friction on joints may also cause osteoarthritis.[3]

Trauma

Repetitive injury may cause cartilage destruction and injuries are risk of getting osteoarthritis.

Injury

Musculoskeletal injuries (MVAS) weaken muscle and connective tissues, damage cartilage and lead to bio mechanical imbalance, injuries from overuse commonly seen in athletes and jobs with repetitive motions and excessive sitting.

Genetics

Osteoarthritis especially of the hands, has a hereditary link, inherited bone abnormalities (bow legs, short leg) can affect joints stability and function.

Heredity

Osteoarthritis is associated with heredity and some genetic factors.

Gender

Women more commonly have osteoarthritis than man. The cause may also related with hormones and sex hormones.

Diet

Low level of vitamin-D, C&K can increase the development of osteoarthritis.

Figure (5): risk factors of osteoarthritis.

DIAGNOSIS OF OSTEOARTHRITIS

- **Medical history** to establish possible genetic links, history of trauma, potential repetitive use issues.
- **Physical exam** to check for joint tenderness, swelling redness, flexibility and ROM.

Imaging tests

- **X-rays** help staging the joint damage and confirming the disease.it does not show cartilage image. But it shows narrowing of joint space.
- **Magnetic resonance imaging (MRI):** In MRI it shows bone and soft tissues and also cartilage.
- **Joint aspiration and blood test:** No blood test for osteoarthritis.
- test is determine for rheumatoid arthritis and gout (rheumatoid factor, elevated ESR ,high uric acid levels).[19,21]
- **Joint fluid analysis:** This test is determined whether pain is caused by gout or any infection rather than osteoarthritis.
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Management

- ✧ Pharmacological treatment
- ✧ Acupuncture
- ✧ Intra articular injection
- ✧ Surgical procedures
- ✧ Physical activity

Pharmacological treatment

Acetaminophen

Is used to treatment of osteoarthritis pain for mild to moderate stage.it is the first line medication for osteoarthritis pain. Acetaminophen is risk of liver damage. if over dose and long term use. Compared to NSAIDS acetaminophen has less side effect.

NSAIDS

Is a non-selective cyclooxygenase include ibuprofen, naproxen, aspirin is used for severe pain of osteoarthritis .risk of seriously problem in gastrointestine.it relieve pain and inflammation. Heart attack is the increase risk long term use of NSAIDS leads to joint destruction (or) degradation and cartilage damage. [20]

Cox-2 inhibitors

Is a selective NSAIDS such as Celebrex is used in treatment of osteoarthritis for shorter time in lowest possible dose.it is more expensive compared to diclofenac. COX-2 is risk of myocardial infarction stroke and lower risk of ulcer compared to non-selective NSAIDS.

Narcotics

Use of narcotics in severe pain in osteoarthritis. Narcotics drugs like opioids, opiates like morphine and codeine .acetaminophen with codeine is used to treat severe osteoarthritis pain. [5, 9]

Chondroitin and glucosamine sulphate

Is more effective in moderate to severe stage mainly in weight bearing joints like knee, hip in reducing pain and inflammation.

Intra-articular injection: corticosteroids

Include cortisone and prednisone are strong anti-inflammatory. Any steroid injection in to joints to reduce pain and inflammation in one week and infection effect last about 4-6 weeks per injection.

Sodium hyaluronate (or) hyaluronic injection

It help in improve the fluid in synovial joints, viscosity in short term. In osteoarthritis knee. it is safe and effective.it is also called viscosupplementation.it helps the lubricate the joints. these injection is safe for knee osteoarthritis in chronic stage.it help in inflammation and protect cartilage.

Platelet - rich plasma (PRP)

In this treatment, the plasma rich plasma injection use cells called platelets. The sample taken from the individual own blood and centrifuge in to a machine to pull out platelets and plasma from the blood when injected inside back in to the knee joint. These super-concentrated mixture contains substances help healing and blood clot. Plasma rich plasma injection may help to improve function and relieve osteoarthritis pain.[13]

Bone marrow aspirate concentrate

Bone marrow aspirate concentrate is same concept as mesenchymal stem cell. Doctors takes the cells from the individual own blood and the hope is that they use them to rise the healing process inside the knee joint. The main advantage in bone marrow aspirate concentrate is to obtain bone marrow easier than mesenchymal stem cell and other substances involved in bone marrow aspirate concentrate will give rise to cartilage regrowth and calming inflammation.

Autologous cultured chondrocytes

To repair injuries, the procedure is that doctors collect the cell from the individual own blood that form cartilage inside the knee joints, cells grows in a laboratory and then inject the collecting cells in to the knee.

Botox injection

Botulinum toxin is a produced by the bacterium clostridium botulism. Doctor can use the Botox injection to ease muscle spasm and botulism is to treat joint pain. These injection help permanently deaden nerves and relief the pain. But the knee structure would not affect in these theory. [17]

Water- cooled radio frequency ablation

This is another theory to treat pain, disability and help in lasting pain relief with minimal adverse

effect. The aim of the water cooled radio frequency is to disable the nerve that are causing pain by healing them.

To control the speed of warming the water cooling is the best way. these experimental studies in limited groups of peoples.

The bottom line

The bottom line is a new treatment are on the horizon. The treatment is effectiveness may depend on the cause and arthritis severity. Before entry in to these particularly treatment talk to your doctor about the treatment and read the fine print.

Acupuncture

It works effectively to treat osteoarthritis pain. A few clinical studies found that people with osteoarthritis experience better pain relief and Improvement in function from acupuncture than from certain NSAIDS.

Surgical options

Arthroscopic knee surgery

Surgeon examines and performs surgery on the inside of the knee with an arthroscope and special surgical instruments.

Arthroscopic camera

- ✧ The arthroscope is a tube about the size of a pencil with a camera and light on the end that is inserted in to the knee joint.
- ✧ The camera projects an image of the inside in the knee on to a tv monitor.
  - ✧ Arthroscopic instruments are also inserted in to the knee to perform the arthroscopic surgery.
  - ✧ These tools includes probes, graspers, cutting forceps, shavers and burrs.

The procedure

- The arthroscope and other surgical instruments are inserted in to the knee joint through 2 or 3 small incisions (cuts in the skin)
- As part of the surgery, several liters of sterile salt water solution are flushed though the joint.
- Depending on what sort of problems are found in the knee, various surgical treatments can be performed.
- After the surgery, the small incisions are closed with one or two stitches, or with small medical tapes.[20,22]

Osteotomy

Osteotomy used for suffering with high Tibial osteotomy for bow leg correction.7cm incision is maid. Pins are placed to plan oriented of osteotomy. Osteotomy performed with a saw. Osteotomy is completed with osteotomy. Osteotomy opened with spreader correcting the genus varus. Locking plate is inserted. Locking screw are also inserted. Bone graft is inserted. Insertion section be closed. This help in correct the bow leg deformity.it is very beneficial for varus and bowleg correction.

Stem cells therapy

The therapy to be study advance to treatment of knee osteoarthritis is proved to be effective. but the mesenchymal stem cell is produce long term risk therapy. The injection of mesenchymal stem cells take frequentness (or) recurrence timing and culturing technique.

Arthroplasty

Is also known as total knee replacement (or) total knee arthroplasty. The patient suffering from severe knee pain doctor may suggest total knee replacement.it is a surgical removal of knee joint surface and replace the damaged part by inserting with metal and plastic artifical joint.

Cement is coating on the artificial joint for faster pain relief.

Artificial knee is called prosthesis. It is made up of 3 main parts

Femoral component is placed end of the femur, femoral component is made of narrow and femoral component shape matches the femoral condyles. These are part of natural knee joint.

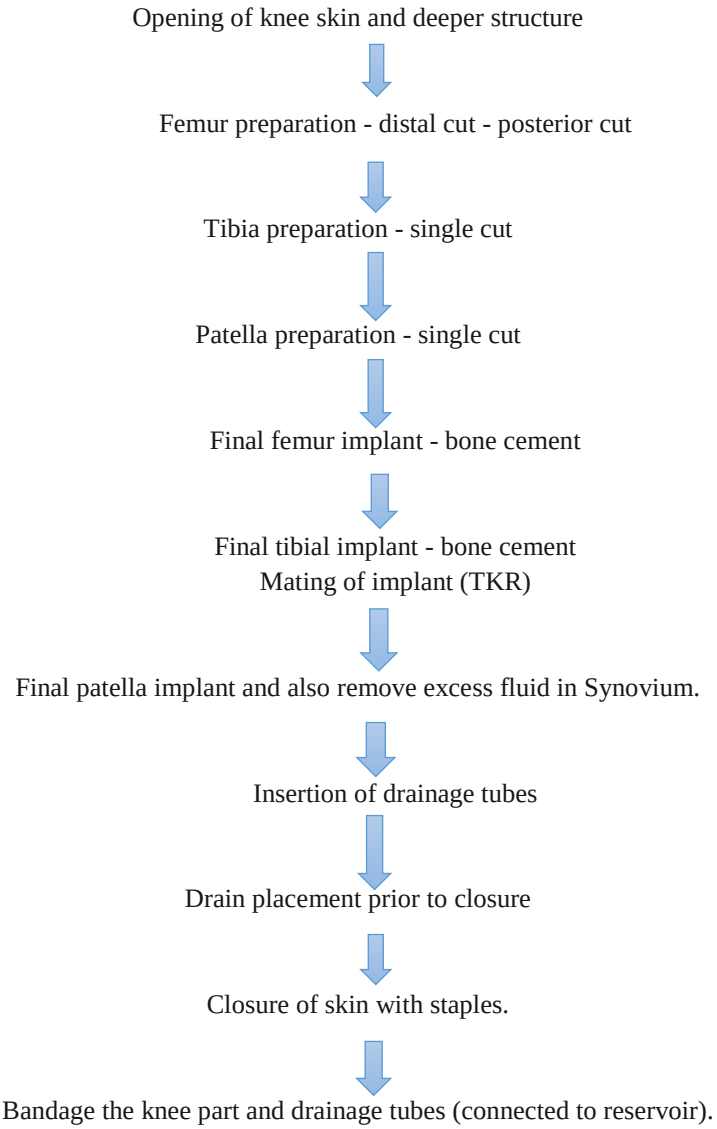
Tibia component is place top surface of tibia. Tibia component made of plastic and metal.

Patella component is placed in back surface of patella knee cap. patella component is made of plastic patella-femoral grove.

Prior to procedure

- ❖ IV fluid, antibiotics and medication.
- ❖ Catheter may be placed in bladder.
- ❖ General anesthesia and breathing tube.
- ❖ Donated blood prepare.

Total knee replacement procedure



After separation muscle and ligament around knee, in surgery inserted knee cap and using specialized tools, surgical can remove damage bone and cartilage on the end of the femur and tibia and most cases remove the entire part of patella. And replace prosthesis. and close the skin with staples. Total knee replacement take mostly 2hrs.

After the procedure

- Splint applied, Monitered in recovery area, May receive blood transfusion, Iv antibiotics, Given pain medication as needed, To prevent blood clot forming in leg. blood thinner will be given.

Figure (6.a): Normal knee, Before surgery

Figure (6.b): After knee replacement surgery.

Physical Activity

By doing physical activity we can Reduce pain, Weight control

Improve sleep.

- Improve quality of life, Improve function and mobility, By doing exercise ask the doctors about pain. Depending on the cause and severity of patient pain.
- **Different types of activities**: **Areobic activities:** It is also help for cardio. and keep joints healthy but avoid in severe Joint pain.
- **Vigorous Intensity** Running/jogging, Swimming

Moderate intensity

Brisk walking**,** Bicycling**,** Swimming**,** Tai chi**,** Yoga

Joint friendly low impact aerobic exercise

- Aerobic activities such as walking, swimming, bicycling, and water aerobics are easier on the joints.

Tai chi and yoga

DISCUSSION AND CONCLUSION

From this study, it is concluded that – reduce pain and inflammation by the pharmacological management of osteoarthritis. And pathologically by localized loss of cartilage, remodeling of adjacent bone and inflammation. The current update on the pharmacological management of osteoarthritis.it contain recommendation on new evidence about the use of nutraceuticals, hyaluronans and acupuncture and surgery in the management of osteoarthritis. the use of paracetamol and fixed dose combination of NSAIDS (non-steroidal anti-inflammatory drugs) plus gastroprotective agents in the management of osteoarthritis.

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