REVIEW ON KNEE IMPLANT IN HUMAN BODY

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ABSTRACT

As per Zihlmann et al. stated in 2005 about 440,000 total knee replacements (TKR) were carried out worldwide every year, also number of TKR implantations will increase in the future. Thus this study has shown that anatomy of knee joint, causes due to which knee joint collapse, need of artificial knee prosthesis in human body, material used for artificial knee prosthesis etc. so that study will help full for the implant invent in order to improve their understanding regarding knee region and also able to prevent common difficulties.

Key words - Knee implant, Causes of knee replacement, Bio-material

1.0 INTRODUCTION

Human body is made for motion. Motion gets to the human body form skeleton system. A skeleton system of human body is made by bones and joints (when ends of the two bones come in contact with each other It known as joint) In human body some joints are fixed i.e immovable joints such as skull, some joint are slightly movable joints e.g. vertebral, and few joints are freely movable joints such as hip joint, knee joint etc.Each joint has its own importance in skeleton system, but freely movable joint has more importance because they give motion and support to the body, they balance the body when it is in motion.

1.1 KNEE JOINT

Knee joint is most complex and important joint in human body. It is also known as synovial hinged joint (The synovial joint has synovial membrane which produces synovial fluid around the knee joint to lubricate it). It is articulated by four bones femur (thigh bone), tibia (grater bone of the lower part of leg), patella (Knee cap), and fibula (outer and thinner bone extending from knee to ankle) as shown in fig. [1] The main movements of the knee joint occur between the femur, patella and tibia. [2]

Fig. 1. Anatomy of Knee Joint

The ligaments enveloping the knee joint to strengthen its structure and hold its bones in the proper alignment. Also ligament assist to maintain optimal knee stability in different positions. Ligaments which surround the knee joint are Medial Collateral Ligament (MCL), Lateral Collateral Ligament (LCL), Anterior Cruciate Ligament (ACL), Posterior Cruciate Ligament (PCL) etc

Inside the knee, there are two shock absorbing crescent-shaped pieces of cartilage called as menisci. The meniscus is thickened pad of cartilage to be found in between femur and tibia. It act as shock absorbers for the

knee when body above the knee is standing, preventing the bones from rubbing on each other and also allowing correct weight distribution between the tibia and the femur. [3]

There are two major muscle groups namely quadriceps and hamstring muscle which balanced and allow movement of the knee joint. The muscles become active when knee bend or straighten also these muscles play a major role in walking. [4]

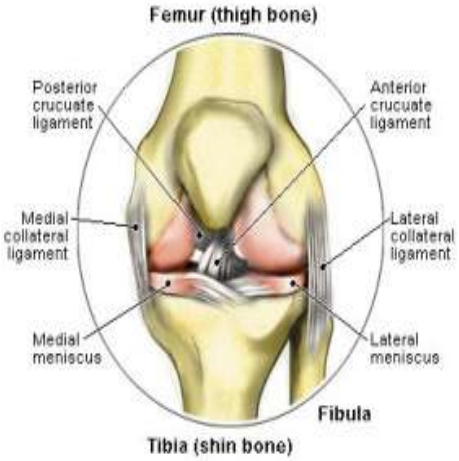

Fig. 2. Ligaments of Knee Joint

2.0 CAUSE OF KNEE REPLACEMENT

2.1 OSTEOARTHRITIS (OA): - It also called as degenerative joint diseases. It occurs when knee joint cartilage which lines the bones has an injury. These cartilages injury is a result of sudden accident or sport injuries or ordinary wear and tear, due to which bones ends are sensational and allowing them rub to adjacent bone, and patients often experience pain, stiffness, disability and loss of movement. There are many cause of OA including trauma, obesity, genetic and many other factors. [6]

Fig. 3. Osteoarthritis of Knee Joint

2.2 Rheumatoid arthritis (RA): - Rheumatoid arthritis is an autoimmune arthritis in which immune system mistakenly attack and wipe out healthy body tissue then spread to muscles and joints etc. it may result in abnormal growth of organ and change organ function. The process of rheumatoid swells the cartilage, muscles, tendons and ligaments which can misshape the joints, corrode the cartilage and eventually lead to destruction of bone. Although rheumatoid arthritis affects the joints symmetrically it means it tends to affect the same joints on both side of body. [7]

Fig. 4. Rheumatoid arthritis of Knee Joint

2.3 Gout: - Gout is also a common form of arthritis of the knee joint. It is caused by buildup of uric acid which forms crystal that deposited in joint. These crystals cause irritation and sever pain in knee joint. Other arthritis such as infection arthritis occurs when bacteria, virus, or fungi enter the body. These foreign matters settle in the joint and causes fever, inflammation, and destruction of joint.

Fig. 5. Traumatic Injury of Knee Joint

2.4 Knee Effusion: - knee effusion may cause due to injury or any form of arthritis. It buildup inside the knee, usually from inflammation.

2.5 Meniscal Tear: - The cartilage which acts as cushions to the knee may damage, it's frequently occurs with twisting the knee. Large tears may cause the knee to lock.

Fig.6. Meniscal Tear of Knee Joint

2.6 Traumatic injury: - The knee can be injured in many numbers of ways, including during sports, a fall from height, the quick and unexpected twisting or reposition of the joint can damage the cartilage or ligaments.

2.7 Ligaments Facture: - if ligaments might strain or tear, then it results pain, swelling, and knee instability [8].

The root explore above show the way of severe disability. So people are discovering key to get relief from pain and remain their knee joint function appropriately. Thus people relies artificial knee is the solution, to get relief from pain and keep their joint properly.

Many types of prosthesis are used for total knee arthroplasty and the advancement of knee arthroplasty has an ancient history, involves repetitious cycles of failure and development. In 1860 Verneuil proposed interposition arthroplasty involving the insertion of soft tissue in order to reconstruct the joint surface, hence pig bladder, nylon, femoral sheath, anterior bursa of the knee, cellophane, and many other materials have been used, but results was disappointing. In 1861 Ferguson [9] attempted resection arthroplasty for severe deformity caused by disease or infection. This procedure involved resecting cartilage from the knee joint and allowing knee joint movement along the subchondral surface. When too little bone was removed, knees suddenly fused, but it has poor stability. In late 1930s the metallic interposition arthoplastry used, campbell and Smith-Peterson proposed metal femoral mold arthroplasty [10.], and McKeever and Mac Intosh proposed hemiarthroplasty of the tibia, but they fail to minimise pain therefore rate of failure of the interposition was high.

In the 1950s, Walldius developed a hinged prosthesis to replace the joint surfaces of the femur and tibia. Simultaneously many surgeons carried out modification in basic hinged prosthesis, still this method could not be widely used because this type of prosthesis cannot replace the complex movements of the knee joint which result in early loosening the prosthesis due to overloading and rate of failure was high. [11]

In 1971, Gunston developed polycentric knee arthroplasty. This was developed from the concept of hip arthroplasty adopt by Charnley. These components fixed the bones with bone cement, and replaced the complex movements of knee joint. This design was initially successful due to improved mobility and movement range, but the fixation it provided was not Sufficient [12]. In 1972 Geomedic knee arthroplasty was introduced by oventry M. B, Finerman G. A et al. at the Mayo clinic, but this design has limited joint mobility which causes rapid and excessive loosening [13].

In 1976, Ranawart et al developed the duocondylar prosthesis which conserved the anterior and posterior cruciate ligaments, provided stability to the knee joint, and used bone cement for fixation to bone. Thus this design became the early model for today posterior cruciate ligament substitution knee arthroplasty [14]. The duopatellar prosthesis was developed kinematic condylar prosthesis, which used in the 1980s. But total condylar prostheses did not allow roll-back movement in the flexed position, which reduced the mobility range [15]. To solvethis problem, Insall J. N and Burstein A. H. added a cam to the femoral prosthesis and a post to the tibia prosthesis for posterior cruciate ligament to accelerate the posterior location of the femoral prosthesis, thus enhancing flexion. These Insall-Burstein and kinematic interpositions became the foundation of modern knee arthroplasty [16]

In the early 1970s, several authors reported for unicompartmental knee arthroplasties has unsatisfactory results, but its result is improved when diseased is confined to one compartment and using better surgical technique. [17.] Thus in 1999 Repicci J. A and Eberle R. W developed minimally invasive techniques, this technique was good surgical option because it has good results.

3 BIOMATERIALS

In object made from non living material to replace the human bone for a significant period of time in order to perform a specific function. [18] A variety of materials used as biomaterials such as Metals (gold, tantalum,

Ti6Al4V, SS316L, Co-Cr Alloys, titanium alloys), Ceramics (alumina, zirconia, carbon, titania, bioglass), Composite (Silica/SR, CF/UHMWPE, CF/PTFE, HA/PE, CF/epoxy, CF/PEEK, CF/C, Al_2O_3/PTFE), Polymers (Ultra high molecular weight polyethylene (UHMWPE). [19]

Researchers characterized materials into bioinert, bioactive, and biodegradable, etc. Bioinert material is that which hold its structure in the body after implantation and does not provoke any immunologic host reactions. Bioactive materials made direct chemical bonds with bone, even with soft tissue of a living organism. Bioresorbable is the materials which degrade in the body while they are being replaced by regenerating natural tissue. [20]

The primary requirement for the biomaterial is its acceptability by the human body. The success of a biomaterial is reliant on three aspects (i) The properties of the biomaterial (mechanical, chemical and tribological) (ii) biocompatibility of the implant and (iii) health condition of the recipient [21]

A material should be biocompatible means it must not adversely affect the bone, soft tissues, ionic composition of plasma, as well as intra and extracellular fluids [22] Also it should be non-carinogenic, non-pyrogenic, non-toxic, non-allergenic, blood compatible, non-inflammatory.

CONCLUSION

Present study will provide illumination about knee joint. Furthermore, spectrums of designs for total knee arthroplasty. Also apple to prevent implant from universal complications like stress shielding, micro-motion, prosthetic loosening etc. The present study makes available chronology regarding knee prostheses evolution which follows a repetitive course of development and failure.

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