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List of Abbreviations

ACL ..... Anterior cruciate ligament

ACR..... American college of Rheumatology

ADAMTS ..... Aggrecanases disintegrin and metalloproteases with thrombospondin motifs

AGES..... Advanced glycation end products

BMI ..... Body mass index

cAMP..... Cyclic adenosine mono phosphate

CMC..... Carpometacarpal joint

COL2A1..... Chains of type 1 procollagens

COX ..... Cyclooxagenase

DIP ..... Distal interphalangeal joint

DRG ..... Dorsal root ganglion

DRUJ..... Distal radioulnar joint

ECM..... Extracellular cartilage matrix

EP..... E prostanoid

Fn-f..... Fibronictin fragment

GRF..... Ground reaction force

IGF1 ..... Insulin like growth factor 1

IL ..... Interleukin

IL1..... Interleukin-1

IL17 ..... Interleukin-17

IL1ra..... Interleukin-1 receptor antagonist

IL1β Interleukin-1β

IL6..... Interleukin-6

IL8..... Interleukin-8

iNOS ..... Inducible nitric oxide synthase

JSN ..... Joint space narrowing

List of Abbreviations(Cont.)

LIF..... Leukemia inducing factor

MCP..... Metacarpophalageal joint

MMPS..... Matrix metalloproteinases

MRI..... Magnetic resonance imaging

MTP..... Metatarsophalangeal joint

NSAID..... Non steroidal anti inflammatory drugs

OA..... Osteoarthritis

PAI-1..... Plasminogin activator inhibitor-1

PCL..... Posterior cruciate ligament

PGD2..... Prostagladin D2

PGE2..... Prostaglandin E2

PGF2..... Prostaglandin F2

PGI2..... Prostaglandin I2

PIP..... Proximal interphalangeal joint

SEV..... Standig extended view

STT..... Scaphotrapezum-trapizoid joint

TNFR1..... Tumor necrosis factor receptor 1

TNFR2..... Tumor necrosis factor receptor 2

TNF-α..... Tumor necrosis α

US..... Ultra sonography

VAS..... Visual analogue scale

WOMAC..... Western Ontario and McMaster Universities Osteoarthritis Index

WOMAC-PF.....Western Ontario and McMaster Universities Osteoarthritis Index Physical functioning subscale scores

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INTRODUCTION

OA, the most common form of arthritis, is a degenerative joint disease characterized by joint pain and dysfunction caused by a progressive and irreversible loss of articular cartilage***(Boileau et al., 2008).***

OA affecting nearly 27 million Americans or 12.1% of the adult population of the United States ***(Lawrence et al., 2008).***

OA is one of the common chronic medical conditions encountered with old age, and a major cause of disability which leads to a decline in physical function that may ultimately require joint replacement surgery ***(Powell et al., 2005).***

OA can be defined by symptoms or pathology. The pathology of osteoarthritis involves the whole joint in a disease process that includes focal and progressive hyaline articular cartilage loss with concomitant changes in the bone underneath the cartilage, including development of marginal outgrowths, osteophytes and increased thickness of the bony envelop (bony sclerosis). Many people with pathologic and radiographic evidence of osteoarthritis have no symptoms. From a clinical perspective, the most compelling definition of disease is one that combines the pathology of the disease with pain that occurs with joint use ***(Jordan et al., 2000).***

Radiographic OA is usually defined as the presence of a definite osteophyte on the radiograph. Some subjects with radiographic OA have symptoms and others do not. Symptomatic OA is usually defined as the presence of symptoms and radiographic evidence of OA ***(Felson, 2004).***

Epidemiological studies have estimated that symptomatic radiographic knee OA affects 10% of adults >55 years of age ***(Peat et al.,2001).***

Osteoarthritis is one of the leading causes of chronic disability. Recent estimates suggest that symptomatic knee OA occurs in 13% of persons age 60 and over. The prevalence is expected to increase further as the population ages ***(Dieppe and Lohmander, 2005).***

Clinically, the condition is characterized by joint pain, tenderness, limitation of movement, crepitus, occasional effusion, and variable degrees of local inflammation ***(Dieppe, 1999).***

The most widely used classification schemes for OA are based on the radiological appearance of the joint. The radiological hallmarks of OA are osteophyte formation, joint space narrowing, and sclerosis and cyst formation. Severity may be graded based on the 0-4 scale developed by Kellgren and Lawrence ***(Kellgren and Lawrence, 1957).***

Assessing the relationship between radiographic features of knee OA, pain and disability is complex. Previously, a lack of correlation between symptoms and radiographs has been found probably related to the joint views taken ***(Hannan et al., 2000).***

Aim of the Work

The aim of this work is to find possible association of knee osteoarthritis and concurrent joints pain in primary osteoarthritic patients.

Chapter (1): Anatomy and Physiology of the Knee Joint

The knee is a compound condylar joint with three articulations: the patellofemoral, the lateral and medial tibiofemoral condyles with their fibrocartilagenous menisci ***(Press et al., 1999).***

Functions of the knee:

Extension is for propulsion, and flexion is used prior to this and also absorbs the shock (by quadriceps) in landing. This active rotation is different from passive and inevitable rotation that occurs in straightening of the knee in the screw-home mechanism "The medial condyle is l/2inch longer than the lateral condyle, which permits the femur to screw home on full extension and this stabilizes the joint". During all movements the knee is adapted to be weight bearing and stable in any position ***(Last, 1986).***

Bony articulations:

The knee joint consists of three bones: the femur, the tibia and the patella. The two major articulations within the knee are the tibiofemoral and patellofemoral joints.

Tibiofemoral articulation:

This portion of the knee joint is made by the articulation of the upper thigh bone (femur) with the lower leg bone (tibia). The end of the femur has two rounded structures known as the femoral condyles. The lateral femoral condyle is on the outside part of the knee while

the medial femoral condyle is on the inside. The medial condyle is larger and more symmetrical than the lateral condyle. Between the two condyles is an area known as the intercondylar notch. This area houses the femoral attachment of the cruciate ligaments.

The anterior cruciate ligament (ACL) originates from the lateral side of the notch and the posterior cruciate ligament (PCL) attaches to the medial side. The roof of the notch is generally rounded but in some patients the notch has a triangular, stenotic configuration that may place them at risk for injuring the ACL ***(Last, 1986).***

The upper end of the tibia is formed by the medial and lateral tibial plateaus. Two tibial spines are located in the central portion between the tibial plateaus and these help contribute to stability of the knee. The ACL inserts on the tibia in this area. The tibial tubercle is located past the knee joint in the front part of the tibia. This serves as the attachment site for the patellar tendon which connects the kneecap to the lower leg bone ***(Iwaki et al., 2000).***

Patellofemoral Articulation:

The patella (knee cap) lies within the strong thigh muscle known as the quadriceps. The cartilage on the undersurface of the kneecap is the thickest in the human body. The kneecap glides up and down on the front surface of the femur bone as the knee flexes and extends.

Articular capsule:

The articular capsule consists of a thin, but strong, fibrous membrane which is strengthened in almost its

entire extent by bands inseparably connected with it. Above and in front, beneath the tendon of the quadriceps femoris, it is represented only by the synovial membrane.

Its chief strengthening bands are derived from the fascia lata and from the tendons surrounding the joint. In front, expansions from the vasti and from the fascia lata and its iliotibial band fill in the intervals between the anterior and collateral ligaments, constituting the medial and lateral patellar retinacula ***(Reider et al.,1981).***

Ligaments:

a) Ligamentum patellae: is the central portion of the common tendon of the quadriceps femoris, which is continued from the patella to the tuberosity of the tibia. It is a strong, flat, ligamentous band, about 8 cm. in length. It is attached; above, to the apex and adjoining margins of the patella and the rough depression on its posterior surface: below, to the tuberosity of the tibia. Its superficial fibers are continuous over the front of the patella with those of the tendon of the quadriceps femoris. The posterior surface of the ligamentum patellae is separated from the synovial membrane of the joint by a large infrapatellar pad of fat, and from the tibia by a bursa ***(Starok et al., 1997).***

b) Oblique Popliteal Ligament:is a broad, flat, fibrous band, formed of fasciculi separated from one another by apertures for the passage of vessels and nerves. It is attached above to the upper margin of the intercondylar fossa and posterior surface of the femur

close to the articular margins of the condyles, and below to the posterior margin of the head of the tibia. The oblique popliteal ligament forms part of the floor of the popliteal fossa, and the popliteal artery rests upon it ***(Warwick and Williams, 1999).***

c) Transverse Ligament:connects the anterior convex margin of the lateral meniscus to the anterior end of the medial meniscus; its thickness varies considerably in different subjects, and it is sometimes absent ***(Sanders et al.,1999).***

d) Coronary ligaments: are merely portions of the capsule, which connect the periphery of each meniscus with the margin of the head of the tibia ***(Moore et al.,2006).***

e) Tibial collateral ligament: also known as the medial collateral ligament: is a broad, flat, membranous band, situated nearer to the back than to the front of the joint. It is attached, above, to the medial condyle of the femur immediately below the adductor tubercle; below, to the medial condyle and medial surface of the body of the tibia above the groove for the semimembranosus muscle. It is crossed, at its lower part, by the tendons of the sartorius, gracilis, and semitendinosus muscles, a bursa being interposed. Its deep surface covers the inferior medial genicular vessels and nerve and the anterior portion of the tendon of the semimembranosus muscle, with which it is connected by a few fibers; it is intimately adherent to the medial meniscus ***(Laprade et al.,2000).***

f) Fibular collateral ligament: also known as the lateral collateral ligament: is a strong, rounded, fibrous cord, attached, above, to the back part of the lateral condyle of the femur, immediately above the groove for the tendon of the popliteus muscle; below, to the lateral side of the head of the fibula, in front of the styloid process. The greater part of its lateral surface is covered by the tendon of the biceps femoris muscle; the tendon, however, divides at its insertion into two parts, which are separated by the ligament. Deep to the ligament are the tendon of the popliteus muscle, and the inferior lateral genicular vessels and nerve. The ligament has no attachment to the lateral meniscus ***(Vohra et al., 2011).***

g) Short fibular collateral ligament*:* is a bundle of fibers, attached above, to the lower and back part of the lateral condyle of the femur and below, to the summit of the styloid process of the fibula. Passing deep to it are the tendon of the popliteus muscle, and the inferior lateral genicular vessels and nerve ***(Poliacu Prose et al.,2000).***

h) Cruciate ligaments: are of considerable strength, situated in the middle of the joint, nearer to its posterior than to its anterior surface. They are called cruciate because they cross each other somewhat like the lines of the letter X; and have received the names anterior and posterior, from the position of their attachments to the tibia ***(Walmsley, 1999).***

1. Anterior cruciate ligament: is attached to the depression in front of the intercondylar eminence of the tibia, being blended with the anterior extremity of the lateral meniscus; it passes upward, backward, and laterally, and is fixed into the medial and back part of the lateral condyle of the femur ***(Lee et al., 1999).***
2. Posterior cruciate ligament:is stronger, but shorter and less oblique in its direction, than the anterior. It is attached to the posterior intercondylar fossa of the tibia and to the posterior extremity of the lateral meniscus; and passes upward, forward, and medially, to be fixed into the lateral and front part of the medial condyle of the femur ***(Amis et al.,2006).***

Menisci:

The menisci are two crescentic lamellae, which serve to deepen the surfaces of the head of the tibia for articulation with the condyles of the femur.

1. Medial meniscus: is nearly semicircular in form, a little elongated from before backward and pointed, is attached to the anterior intercondylar fossa of the tibia, in front of the anteriorcruciate ligament; its posterior end is fixed to the posterior intercondylar fossa of the tibia, between the attachments of the lateral meniscus and the posterior cruciate ligament ***(Brantigan and Voshell,2001).***