The Updated Role of Ultrasound in the Assessment of Knee Osteoarthritis

Thesis

A Thesis Submitted For Partial Fullfilment Of Master Degree In Radiology

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2019

بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

Acknowledgement

First and foremost,I feel always indebted to ALLAH,the most kind and most merciful.

I would like to express my deepest gratitude and appreciation to **Prof. Dr.Khalid Esmat Alaam** for his sincere encouragement,constant advise and valuable guidance throughout our work.

Special thanks and gratitude to **Lecturer Dr. Hazem Ibrahim Abd El Rahman** for his supervision and continuous advise during performance of this work.

Finally I thank my professors, for the support and encouragement.

Nouran Saieed Ahmed Ahmed

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List of Abbreviations

ACL	:	Anterior cruciate ligament
ACR	:	American Collegue of Radiology
BMI	:	Body mass index
DAMPs	:	Damage-associated molecular patterns
ECM	:	Extracellular matrix
EFF	:	Effusion
F	:	Femur
FAC	:	Femoral articular cartilage
GCM	:	Gastrocnemius muscle
HPF	:	Hoffa pad of fat
JSN	:	Joint space narrowing
K&L	:	Kellgren and Lawrence grade
KOA	:	Knee osteoarthritis
LCL	:	Lateral collateral ligament
LFC	:	Lateral femoral condyle
LM	:	Lateral meniscus
MCL	:	Medial collateral ligament
MG	:	Medial head of Gastrocnemius
MM	:	Medial meniscus
OA	:	Osteoarthritis
P	:	Patella
PCL	:	Posterior cruciate ligament
PD	:	Power Doppler
PDUS	:	Pulsed Doppler ultrasound
PFJ	:	Patellofemoral joint
PHMM	:	Posterior horn of medial meniscus
QT	:	Quadricepis tendon
SH	:	Synovial hypertrophy
SM	:	Semimembranosus tendon
TFJ	:	Tibio-femoral joint.
TT	:	Tibial tuberosity

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Abstract

Background: Osteoarthritis (OA) of the knee is the most common form of knee arthritis and a leading cause of chronic disability.

Objective: The aim of the current study is to reassess the utility of the updated ultrasound in the patients with knee osteoarthritis and outline its clinical application**.**

Patients and Methods: The studied group included 36 patient 23females and 13 males with their ages ranged between 39 and 58 years (average age 44 years). The patients were referred to US examination fulfilling the ACR clinical criteria for knee OA after orthopedic and /or rheumatologist consultation. The study was performed in Radiodiagnosis department Ain Shams University Hospitals (20 patients) and at one private center (16 patients).

Results: There was a discrepancy between the results obtained by clinical examination and those demonstrated by ultrasonography . Clinical examination detected 22 (61.1%) of our cases. Prevalence of US findings in our cases were femoral articular degeneration in 28 (77.7%) patients, Tibiofemoral osteophytes were seen in 26 patients (72.2%), knee effusion in 22 patients (61.1%),meniscal extrusion in 22 patients (61.1%) meniscal degeneration in 17 patients (47.2%) and synovial hypertrophy in 15patients (41.6%). Baker's cysts were demonstrated in 14patients (38.8%) while pes anserine syndrome was demonstrated in 4 cases. Meniscal degeneration and meniscal extrusion were correlated significantly with femoral cartilage degeneration *($P<.001$).* Although knee effusion did not correlate with advanced knee effusion did significantly ($P>0.05$). Baker's cysts is statistically related to the presence and severity of mensical changes and also related to the degree of femoral articular cartilage degeneration.

Conclusion: US is a valuable technique that can assess soft tissue structures within the knee and their involvement in the osteoarthritic process .US enables in guiding and monitoring therapy through detection of knee structural damage.

Keywords:

Osteoarthritis,Ultrasound,Osteophytes,Synovialhypertrophyhypertrophy.

INTRODUCTION

Osteoarthritis (OA) is the most common form of arthritis and a leading cause of chronic disability, in large part due to lower extremity involvement. The knee is one of the most common joints involved in OA. The prevalence of symptomatic knee OA is reported to be as high as 16% in the elderly population **(Alves et al;2016).**

Plain radiography is the imaging modality most frequently used for assessing joint involvement. However, the articular cartilage cannot be shown by plain radiographs. In addition, this technique lacks the ability to visualize synovial recesses, menisci and other soft tissues involved in OA (**Bevers et al;2014).**

Although the cornerstones of imaging evaluation of the knee is magnetic resonance (MR) imaging, ultrasonography (US) is less expensive than MR imaging, easily available, and of comparable accuracy in the evaluation of certain pathologic conditions of the knee (**Vohra et al;2011).**

The benefits of US include portability, low cost, high spatial resolution, dynamic imaging, and ability to guide percutaneous interventions when indicated. US also allows direct patient contact, facilitating immediate clinical correlation and the ability to compare with the contralateral knee. US evaluation of the knee can be targeted to a specific region on the basis of the complaint or be a comprehensive review (**Oo et al;2017).**

Because of recent improvement in technology, ultrasound has the ability to demonstrate and assess the minimal structural abnormalities, which involve the pathophysiology and progression of OA, such as synovial tissue, bony cortex, and other soft tissue (**Ekim;2018).**

Nowadays, ultrasonography is a promising technique for assessing soft tissue abnormalities such as joint effusion, synovial hypertrophy, Baker cyst. Ultrasonography not only possesses diagnostic potential in knee OA but also reveals long-term predictability for disease progress as imaging biomarker. Ultrasonography has also been proven as a useful tool in guiding therapeutic interventions and monitoring treatment effectiveness. **(Oo and Bo; 2016).**

Inflammation plays a major role in arthritic disease; however, inflammatory events have also been linked to OA, and synovial hypertrophy is very common and seems to be related to pain and progression of structural damage (**Lee and Chow;2007).**

Color Doppler ultrasound has proved to be a suitable imaging tool by providing information about the presence and the extent of pathologically active synovitis in arthritis and OA of the knee Where power Doppler US findings demonstrate a strong correlation to histopathology in such cases.Overall, there was a significantly lower total colour Doppler score in OA patients presenting with a non-inflammatory knee condition compared with patients with inflammatory arthritis (**Abbasi et al;2017)**

Ultrasound of the knee is best suited for the evaluation of tendons, fluid collections and effusion, synovitis, periarticular soft tissue masses, muscles, and the collateral ligaments The availability of dynamic imaging in addition to the ability to visualize the microanatomy (fibrillar pattern)of tendons, ligaments,, and muscles are important advantages of ultrasound when applied to knee examination (**Beitinger et al;2013).**

The primary limitation of US of the knee is that it is operator dependent and requires proper training and experience for accurate image acquisition and interpretation. Further, limitations of US include incomplete evaluation of the deep structures of the knee, particularly the cruciate ligaments, the menisci, and the majority of the articular cartilage.. US, unlike MR imaging, cannot evaluate bone marrow edema or intramedullary bone lesions **(Robert et al; 2009)**.

AIM OF the WORK

The aim of the current study is to reassess the utility of the updated ultrasound in the patients with osteoarthritis of the knee and outline its clinical application.

REVIEW OF LITERATURE
ANATOMY OF THE KNEE JOINT

The knee is the largest synovial joint in the body and one of the most complex modified hinge joint. A comprehensive understanding of the anatomy and physiology of the structures of the knee is necessary for accurate diagnoses and informed decisions regarding treatment plans.

The knee is a complex modified hinge joint which can be conceptualized as consisting of 2 joints: a tibiofemoral and a patellofemoral joint. The tibiofemoral joint allows transmission of body weight from the femur to the tibia while providing hinge-like, sagittal plane joint rotation along with a small degree of tibial axial rotation.The patellofemoral joint creates a frictionless transfer over the knee of the forces generated by contraction of the quadriceps femoris muscle **(Flandry and Hommel;2011)**.

The knee can move in three different planes,offering a six degrees of freedom range of motion**,(Fig.1)** including the sagittal plane(flexion, extension), the transverse plane (internal, external rotation) and the frontal plane (varus, and valgus stress). The position of the knee between the two longest lever arms of the body, the femur and tibia, and its role in weight bearing renders it susceptible to injuries **(Saavedraa et al.;2012).**