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Knee Cartigram - A Prognostic Factor for Joint Replacement

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Abstract **Original Research Article**

Knee osteo-arthritis increases the global burden and adds morbidity to the patient. Total knee replacement is on the rise with patients presenting at stage of advanced knee arthritis increasing surgical morbidity on the patient. Knee cartigram, helps to diagnose early cartilage damage with normal knee radiographs. Addressing cartilage loss at an early stage can preserve the innate knee delaying the onset of arthritis and prevent knee replacement.

Keywords: Cartigram, T2 MRI, Osteo-arthritis, Meniscal extrusion, WORMS score.

INTRODUCTION

One of the crucial structures involved in degenerative joint disease is articular cartilage. The preferred imaging technique for identifying knee articular cartilage defects is MRI [1]. The extracellular cartilage matrix's structural and biochemical changes can be detected by T2 mapping. T2 can identify early OA biochemical alterations in collagen orientation, collagen content and tissue hydration.

Damage to the collagen-proteoglycan matrix and an increase in the water content of the cartilage occur before cartilage loss and clinical symptoms. Using a sensitive technique, MRI can accurately visualize all tissues involved in the process, including articular cartilage, while identifying structural and functional changes during the early stages of OA. There are surgical and non-surgical methods for maintaining and improving cartilage health. Cartilage damage in lesions can result in pain, functional impairment, and, eventually, OA. The ICRS classification for macroscopic cartilage lesions. The depth of cartilage lesions can be determined using MRI. Pain has been linked to elevated T2 levels in the early stages of OA.

The goal of this research is to determine the value of an MRI cartigram in the diagnosis of early cartilage lesions.

METHODS

Articles published in PubMed and Scopus indexing agencies are considered. Between 2012 and 2022, 8 articles were obtained based on the preceding literature.

Luyten *et al.,* [2] proposed an early OA of the knee. Early OA of the knee, according to this definition, can be defined based on clinical and radiographic findings.

(I) knee pain, (II) Kellgren-Lawrence (KL) [3] grade 0, I, or II (only osteophytes) using plain radiographs, and (III) cartilage lesion confirmed by arthroscopy and/or OA-related MRI findings such as cartilage and meniscus degenerations, and/or subchondral bone marrow lesions (BMLs).

The Boston Leeds Osteoarthritis Knee Score (BLOKS), the Whole Organ Magnetic Resonance Imaging Score (WORMS) [4] and their comparisons are used to determine MRI features of degenerative changes in the cartilage, BMLs, and/or meniscus. Specifically, at least two of the four items listed below must be met.

(I) Cartilage morphology scores of at least 3 (WORMS grades 3-6).
(II) Cartilage Score 1: a minimum of grade 2 (BLOKS grades 2 and 3).
(III) Grade 3 meniscal tears (BLOKS 3 and 4).
(IV) BML: WORMS grade 2 or higher.

Tibiofemoral OA requires MRI findings of definitive osteophytes or full-thickness cartilage lesions. If the patient only has one of these two features, two or more of the four features (BMLs, meniscal lesions,

partial thickness cartilage lesion, and/or bone attrition) should be present on MRI to meet the OA definition.

In order to diagnose patellofemoral OA, an MRI must show a definite osteophyte and a partial or full-thickness cartilage lesion.

Semi-quantitative scoring of knee OA features using MRI has been demonstrated to be a valid method, with a couple of scoring systems reported [5]. The WORMS was the first published scoring system, and it has been widely used in knee OA research for over a decade. Following that, three additional knee scoring systems were developed: the KOSS, the BLOKS, and the MRI Osteoarthritis Knee Score (MOAKS), which is a combination of the WORMS and BLOKS scoring tools.

The MOAKS refined the scoring of BMLs, articular cartilage, and meniscal morphology elements, and consists of the scoring of seven sub-regions such as BMLs, cartilage, osteophytes, synovitis, meniscus, ligament/tendon, and periarticular findings.

The main tissue involved in the OA process is articular cartilage. The movement of free water proton molecules within the cartilage matrix is reflected in T2. T2 relaxation times may be increased in patients with OA due to damage to the collagen-proteoglycan (PG) matrix and increased water content in degenerated cartilage [6, 7].

Proteoglycan loss is reflected in T1rho measurements. T1rho levels have been found to be elevated in OA patients. T1rho and T2 both investigate the slow motion of water protons, but they measure different MR relaxation mechanisms. In the case of T1rho and T2 [8], a recent systematic review and meta-analysis demonstrated that these cartilage compositional MRI techniques are reliable and can distinguish between subjects with OA and healthy cartilage.

It has been demonstrated that MRI-detected structural changes (e.g., osteophytes, meniscal damage, BMLs, and/or synovitis) may represent early OA in people who do not have radiographic OA and are linked to incident OA. In a population-based study, MRI and plain radiograph findings revealed that MRI detected structural knee OA more sensitively than the plain radiograph definition. A prospective cohort study of 895 participants found that 85% had MRI- detected osteophytes at baseline, while only 10% had radiograph-detected osteophytes.

Meniscal extrusion as a result of meniscal injuries or degeneration can hasten the onset and progression of knee OA [9, 10]. On MRI, extrusion would indicate a risk of developing knee OA. Englund *et al.,* discovered that 60% of patients had meniscal tears on MRI, but 23% had no radiographic evidence of OA. Meniscal lesions were frequently found in MRI scans of asymptomatic subjects aged 50 to 90 years old with no radiographic evidence of OA.

According to Javaid *et al.,* [11] MRI features of OA in only a few specific locations occurred before clinical symptoms in knees without significant symptoms or radiographic OA, implying that bony changes may be associated with the development of early knee pain. According to Felson *et al.,* [12] a significant volume of synovitis in the knee was an independent cause of the incident OA.

According to Liebl *et al.,* [13] increased baseline T2 values in articular cartilage, measured when radiographic changes are not yet visible, may be useful in predicting the development of radiographic tibiofemoral OA. Sharma *et al.,* [14] discovered a link between worsening MRI findings and concurrent incident radiographic OA and subsequent symptoms. Katsuragi *et al.,* [15] found that knees with osteophyte formation at the intercondylar notch, even those with a KL grade of 0 or 1 in radiographic assessments, were at risk of developing radiographic OA within 4 years.

CONCLUSION

MRI is a diagnostic tool that can help with early OA diagnosis. MRI Cartigram with colour mapping can be used to detect early cartilage lesions and timely intervention to avoid knee replacement in the stage of advanced arthritis.

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