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ORIGINAL RESEARCH

Evaluating Meniscal Degeneration in Knee Osteoarthritis: An MRI-Based Observational Study

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ABSTRACT

Background: Meniscal injuries are increasingly being recognized as a prevalent condition among individuals with osteoarthritis. Magnetic resonance imaging (MRI) plays a crucial role in verifying the presence of such tears in these patients. This study was done to assess the characteristics of meniscal injuries in osteoarthritis patients using MRI. **Materials and Methods:** This research was a cross-sectional investigation which enrolled osteoarthritis patients who provided informed consent for undergoing MRI. Subjects with traumatic or advanced knee injuries were excluded. MRI evaluations of the right knee were independently analyzed by a radiologist and an orthopedic specialist, and their observations were compared. The severity of osteoarthritis was assessed using the Kellgren–Lawrence grading system. **Results:** Among 311 osteoarthritis patients, 60% were female. Meniscal tears were identified in 89.38% of participants, with the medial meniscus being the most frequently affected site. Complex tears were the predominant type, comprising 50.36% of cases, and the posterior horn of the meniscus was the most commonly involved region. The prevalence of meniscal injuries rose significantly with advancing age, with 42.50% of patients aged 60 years or older showing tears. Furthermore, the prevalence correlated positively with increasing osteoarthritis severity. Approximately half of the patients classified as grade 4 osteoarthritis had meniscal injuries, compared to only 10% in grade 1. **Conclusion:** Meniscal injuries are highly prevalent among osteoarthritis patients, as evidenced by MRI findings. The incidence of these tears rises with advancing age and the severity of osteoarthritis. Routine MRI evaluations in this population can facilitate the early detection of meniscal injuries, enabling more effective management strategies.

Key Words: Osteoarthritis, Knee, Meniscus, Magnetic resonance imaging

INTRODUCTION

Magnetic resonance imaging (MRI) is a prevalent diagnostic tool that employs radiofrequency waves and a magnetic field to generate intricate three-dimensional anatomical images. A significant benefit of MRI is its non-invasive nature and absence of ionizing radiation, unlike computed tomography (CT) scans. It is extensively utilized for diagnosing various conditions and monitoring therapeutic progress. Orthopedic evaluations also commonly rely on MRI [1,2].

The menisci, two fibrocartilaginous structures situated within the knee joint, primarily function to minimize friction, thereby enhancing the articulation between the femur and tibia. These structures also contribute to shock absorption, load distribution, and knee joint stability, making them essential for normal joint mechanics. The knee contains two crescent-shaped menisci: medial and lateral, each comprising anterior and posterior horns and a central body. Meniscal injuries are typically associated with traumatic events. Tears can be classified as acute or chronic, with the former often resulting from sports-related injuries and the latter commonly stemming from repetitive wear and tear. A medial meniscus tear is sometimes accompanied by injuries to the medial collateral ligament and the anterior cruciate ligament [3-5].

Common symptoms of meniscal damage include pain, joint swelling, restricted movement, and audible clicking in the knee. Clinical assessments, including the McMurray test, Steinmann test, and Apley grind test, are useful for detecting meniscal injuries.

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However, MRI remains the most reliable imaging modality for confirming the type and location of meniscal tears. Initial management focuses on alleviating pain and swelling, often through the use of non-steroidal anti-inflammatory drugs. Definitive treatment, such as meniscectomy, is required for resolving meniscal tears [6,7].

Degenerative meniscal injuries are more prevalent in individuals aged 40 years and older. Osteoarthritis, the most common form of arthritis, contributes to an elevated risk of such tears by deteriorating the cartilage that cushions joints. This condition is often associated with incidental meniscal injuries, including tears, among patients with osteoarthritis [8-10]. However, limited data exists regarding the precise prevalence of meniscal damage in osteoarthritic populations. Consequently, the current study was undertaken to determine the scope of meniscal injuries, encompassing both tears and structural degradation, among individuals with osteoarthritis.

MATERIAL AND METHODS

This observational study was conducted over one and half year at a tertiary care hospital. The study included male and female patients aged 40 years or older who had been diagnosed with osteoarthritis and provided informed consent. Patients were excluded if they had a history of traumatic knee injuries, terminal cancer, or conditions affecting the menisci. Additional exclusion criteria included individuals with knee replacements, rheumatoid arthritis, or those dependent on assistive walking devices such as canes or walkers. Furthermore, patients for whom MRI was contraindicated were also excluded.

Patients attending the orthopedic outpatient clinic with osteoarthritis were recruited. Only those who signed informed consent forms were included. Data was collected for both newly diagnosed and previously diagnosed osteoarthritis patients within the study period. A standardized and validated data collection sheet was used to document demographic details. The structural integrity of the medial and lateral menisci of the right knee was evaluated in eligible participants consenting to undergo MRI.

MRI scans were performed using a 1.5 Tesla scanner equipped with a phased-array knee coil. To examine meniscal integrity, three pulse sequences were employed: sagittal T1-weighted spin–echo images, and sagittal and coronal fat-saturated, proton-density-weighted, turbo spin–echo images. The MRI results were independently reviewed by a musculoskeletal radiologist and an orthopedic specialist to confirm meniscal injuries. Observations were made systematically, focusing on all segments of both medial and lateral menisci, including the anterior and posterior horns and the body. The reviewers were blinded to the participants' clinical and radiographic details.

A meniscal tear was identified if there was a heightened meniscal signal communicating with the superior, inferior, or free edge of the meniscus surface on at least two consecutive images. Radial tears were diagnosed if they were visible in both sagittal and coronal images. Meniscal tears were classified as Horizontal, Oblique, Longitudinal, Radial, Complex and Root. Complete meniscal destruction was recorded in cases of absent meniscal tissue due to surgical removal or total maceration.

Weight-bearing posteroanterior radiographs of the knee were obtained using a fixed-flexion protocol for patients whose MRI scans were analyzable. A radiologist blinded to patient details graded the images using the Kellgren–Lawrence scale [11,12]. A Kellgren–Lawrence score of 2 or higher was classified as evidence of tibiofemoral osteoarthritis (grades ranging from 0 to 4).

Data was entered into Microsoft Excel 2017 and analyzed using SPSS version 21. Appropriate statistical tests were employed for group comparisons. A p-value below 0.05 was considered statistically significant.

RESULTS

In this study, a total of 278 cases of meniscal tears were examined, with a varied distribution across different types. The most prevalent tear type was complex, which accounted for 50.36% (140 cases) of the total, followed by radial tears at 21.58% (60 cases). Oblique tears were observed in 17.63% (49 cases) of the participants, while longitudinal and horizontal tears were less common, making up 6.47% (18 cases) and 2.52% (7 cases), respectively. Root tears represented the smallest proportion, with 1.44% (4 cases) of the total cases. These findings are summarized in Table 1.

Table 1: Prevalence and types of meniscal tears

Type	n	%
Complex	140	50.36
Radial	60	21.58
Oblique	49	17.63
Longitudinal	18	6.47
Horizontal	7	2.52
Root	4	1.44
Total	278	100.00

The age distribution of meniscal tears revealed a higher incidence in older age groups. The 60-69 years age group had the highest prevalence, with 35.25% (98 cases) of the total cases. This was followed by the 50-59 years group, which accounted for 30.22% (84 cases). The 40-49 years group contributed 26.98% (75 cases), while the >70 years group had the fewest cases, comprising 7.55% (21 cases). These data are detailed in Table 2.

Table 2: Age wise distribution of meniscal tears

Age Group	n	%
40-49	75	26.98
50-59	84	30.22
60-69	98	35.25
> 70	21	7.55

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Regarding the severity of meniscal tears, the majority of cases were categorized as grade IV (50.00%, 139 cases), indicating the most severe form of tears. Grade III tears were the second most frequent, accounting for 24.10% (67 cases). Grade II tears made up 15.83% (44 cases), while grade I tears were the least common, representing 10.07% (28 cases). These findings are presented in Table 3.

Table 3: Severity of meniscal tears

Grade	n	%
I	28	10.07
II	44	15.83
III	67	24.10
IV	139	50.00

The prevalence of meniscal injuries rose significantly with advancing age, with 42.50% of patients aged 60 years or older showing tears. Furthermore, the prevalence correlated positively with increasing osteoarthritis severity. Approximately half of the patients classified as grade 4 osteoarthritis had meniscal injuries, compared to only 10% in grade 1.

DISCUSSION

In our study, 61% of the osteoarthritis patients were female, indicating a higher prevalence of the condition among women compared to men. This aligns with findings from various previous studies [13]. A recent systematic review also reported similar results [14]. The increased prevalence in females may be attributed to hormonal changes during menopause and menstruation. Additionally, global data suggests that women tend to have higher rates of obesity, which increases the wear and tear on the knee joint, potentially leading to a higher incidence of meniscal tears and osteoarthritis in women with higher body mass indexes.

The overall prevalence of meniscal injuries in osteoarthritic patients was found to be 89.38%, which is consistent with the observations of Lange et al., who reported that three-quarters of women with osteoarthritis had meniscal tears on MRI [15]. The Framingham study similarly found a higher prevalence of meniscal tears among patients with hand osteoarthritis [16]. The frequency of meniscal tears was also shown to increase with the severity of osteoarthritis, as measured by the Kellgren and Lawrence grading system. Half of the patients with grade 4 osteoarthritis had meniscal injuries, which is consistent with previous studies [9,16]. These meniscal tears may result from the weakening of the meniscus due to the degenerative effects of osteoarthritis.

Complex tears were the most frequently observed type of meniscal injury, accounting for 50.36% of cases. This aligns with findings by Englund et al., who also reported complex tears as the most common type of injury [9]. In contrast, a published review suggested that radial tears were the most prevalent form of degenerative meniscal tears [17]. The incidence of meniscal injuries also correlated with the patients' age, being most common in those over 60 years old. Recent studies corroborate these findings, indicating that medial meniscus tears increase with age, while lateral meniscal tears tend to decrease as individuals grow older [18]. Aging results in various degenerative changes in the meniscus, such as the breakdown of proteoglycans, cells, and collagen, which weakens the structure and increases its susceptibility to injuries.

The study had a few limitations. Due to budgetary and logistical constraints, we focused solely on MRI scans of the right knee, which may have led to missed meniscal injuries in the left knee. Additionally, the prevalence estimates may not be applicable to younger populations, as meniscal tears in younger adults are typically caused by physical trauma rather than osteoarthritis. Furthermore, the study could not establish a clear causal relationship between osteoarthritis and meniscal tears due to the lack of prior scans for comparison.

CONCLUSION

The findings of the study suggest that meniscal injuries are frequently observed among patients with osteoarthritis. The prevalence of these injuries was found to increase with advancing age, higher body mass index, and greater severity of osteoarthritis. Therefore, conducting MRI evaluations in osteoarthritic patients can facilitate the early detection of meniscal tears, enabling timely and appropriate management. Future research comparing the occurrence of meniscal tears in osteoarthritic individuals with that in the general population may provide further insights into the disease burden.

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