

Early Stage Spontaneous Osteonecrosis of the Knee: MR Imaging Findings



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ABSTRACT

To evaluate the MR imaging findings of early stage spontaneous osteonecrosis of the knee. This study includes 21 spontaneous osteonecrosis cases (12 men, 9 women; mean age, 56.9 years) consulting to a radiology clinic for MR imaging of knee joint. Antero-posterior and lateral knee radiographies of all patients were obtained. 25 lesions observed on MRI in 21 patients were analysed. MR images were analysed for the localization and dimension of the lesion, the presence of hypointensity in the subchondral bone, the presence of focal contour depression and the presence of additional meniscal pathology. As a means of medical treatment intravenous iloprost was applied. There was no specific pathological finding on plain radiography. In 16 cases, the lesions were localized on the medial femoral condyle. Nine lesions were defined as small sized (36 %), and 16 as large (64 %). Subchondral hypointense focus was seen in 11 lesions. Contour depression was found on medial weight bearing joint surfaces in 2 cases. In 15 cases, grade 2 meniscal degeneration was found on the posterior horn of the medial meniscus. MR imaging can be applied as an effective modality for the diagnosis of early stage spontaneous osteonecrosis.

Key words: Knee joint, magnetic resonance imaging, osteonecrosis.

Diz ekleminin erken evre spontan osteonekrozunun MR görüntüleme bulgularını değerlendirmek

ÖZET

Bu çalışma diz MR incelemesi için radyoloji kliniğine konsülte edilen 21 spontan osteonekroz olgusunu (12 erkek, 9 kadın; ortalama yaş 56.9 yıl) içermektedir. Tüm olgularda antero-posteriyör ve lateral diz radyografileri elde edildi. MR görüntülemesinde 21 olguda 25 lezyon saptandı. MR görüntülerinde lezyonların boyutu, lokalizasyonu, subkondral hipointensite varlığı, fokal kontur depresyonu varlığı ve ilave meniskal patoloji varlığı değerlendirildi. Medikal tedavi olarak intravenöz iloprost verildi. Olgularda radyografik olarak spesifik patolojik bulgu saptanmadı. 16 olguda lezyon medial femoral kondilde lokalize idi. 9 lezyon (%36) küçük boyutlu, 16 lezyon (%64) büyük boyutlu olarak değerlendirildi. Subkondral hipointens odak 11 olguda görüldü. Kontur depresyonu, medialde ağırlık taşıyan eklem yüzeylerinde 2 olguda saptandı. 15 olguda medial menisküs posteriyör boynuzda grade 2 meniskal dejenerasyon saptandı. MR görüntüleme, erken evre spontan osteonekroz tanısında efektif bir modalite olarak kullanılabilir.

Anahtar kelimeler: Diz eklemi, magnetik rezonans görüntüleme, osteonekroz

INTRODUCTION

Spontaneous osteonecrosis of the knee which is often seen in middle aged and elderly females was first described by Ahlback et al. (1) in 1968. The most common symptom is pain which is localized to the affected condyle. The medial femoral condyle is typically affected, the lateral femoral condyle, medial tibial plateau and patella may also be involved (2-4). It is difficult to distinguish between spontaneous osteonecrosis and other

types of intraarticular pathologies on the basis of symptoms. Often unnecessary arthroscopic attempts are applied to these cases. Magnetic Resonance Imaging (MRI) is a sensitive method for the early diagnosis of spontaneous osteonecrosis. The extension, dimension, signal characteristics, collapses and other accompanying pathologies of a lesion can be clearly identified on MRI (5). In this article, MRI findings of spontaneous osteonecrosis in the knee are presented.

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MATERIALS AND METHODS

Patients who attended to our radiology clinic for knee MRI between March 2009 and February 2011 retrospectively evaluated. This study includes 21 spontaneous osteonecrosis patients who were diagnosed with clinical, radiological and laboratory findings. There were 12 male and 9 female. Their mean age was 56.9 years (45-75 years). Antero-posterior and lateral knee radiographies of all patients were obtained. Patients with history of trauma, use of steroids or any known predisposing systemic illness were excluded. Radiologic images were evaluated by two experienced musculoskeletal radiologists together.

MR Imaging

The images were taken with 1.5T Philips Intera (Philips, Best, the Netherlands) and 1.5 T Siemens Magnetom Avanto MRI scanner. 1.5T Philips Intera (Philips, Best, the Netherlands) MRI imaging parameters; Sagittal and coronal plane proton density weighted turbo spin-echo (PDW TSE) (TR/TE:1240/18), sagittal and coronal plane T2 weighted fast field echo (T2W FFE) (TR/TE:500/14) and axial plane T2 weighted turbo spin-echo spectral presaturation inversion recovery (T2W TSE SPIR) (TR/TE:3200/70) images were obtained. Field of view 15cm, matrix 320x320, number of excitation 2, and slice thickness 3mm. 1.5 T Siemens Magnetom Avanto MRI imaging parameters; Sagittal, coronal and axial plane proton density weighted turbo spin-echo fat saturation (PDW TSE FS) (TR/TE:2340/24), sagittal and coronal plane T1 weighted turbo spin-echo (T1W TSE) (TR/TE:555/20) images were obtained. Field of view 15cm, matrix 320x320, number of excitation 2, and slice thickness 3mm.

The images were analysed for the localization and dimension of the lesion, the presence of hypointensity in the subchondral bone, the presence of focal contour depression and the presence of additional meniscal pathology. Lesion localization was defined as medial or lateral according to femoral (or tibial) condyle. Lesion dimensions were analysed on axial images. Lesions which covered less than 50 % of the femoral condyle or tibial plateau were regarded as small while those covering more than 50 % were classified as large. Lesions were analysed for the presence of hypointensity in the subchondral bone on PDW TSE FS and T2W FFE images.

Focal contour depression was defined as presence of concavity on femoral or tibial joint surfaces. The images were analysed for the presence of additional meniscal degeneration or tear. As a means of medical treatment, intravenous iloprost was applied for all cases.

RESULTS

The average length of pain before presentation was 6 weeks. Ten patients were initially diagnosed clinically as having meniscal tears. There was no pathological finding on blood tests in all cases. The average time from presentation to an orthopaedic surgeon and MRI was 12 days. 25 lesions observed on MRI in 21 patients were analysed. On radiography, there was no specific pathological finding. On MRI the most common localization was found to be on the medial femoral condyle (17/25, 68%) (Figure 1b,c). Additional lesions were determined in one of these cases on the medial tibial plateau, and in another two cases on lateral femoral condyle. In three of the cases lesions were detected on only the lateral femoral condyle (Figure 2b,c), and in two cases on only the medial tibial plateau. The size of 9 lesions were defined as small (36 %), and 16 as large (64 %). In 11 lesions, in which the subchondral hypointense focus was seen on PDW TSE FS and T2W FFE images (Figure 3). Contour depression was found on medial weight bearing joint surfaces in 2 cases (Figure 4). In 15 cases, grade 2 meniscal degeneration was found on the posterior horn of the medial meniscus and in one of these cases, grade 2 meniscal degeneration was found on the posterior horn of the lateral meniscus. In five cases, grade 3a meniscal tear was found on posterior horn of the medial meniscus. In one case, there was no meniscal pathology.

DISCUSSION

Osteonecrosis is related to ischemia resulting from the occlusion of the arteries and veins. Patel et al. (6) divided osteonecrosis into two categories: 1. Spontaneous (primary or idiopathic) osteonecrosis, 2. Secondary osteonecrosis (systemic diseases such as Gaucher disease, SLE, hemoglobinopathy, alcoholism or steroid treatment). It is generally bilateral and more than one bone is involved. Secondary osteonecrosis generally appears in patients younger than 55 years of age and the lateral condyle is affected in 60 % of cases. Bilateral or multifocal involvement may be seen. The etiology of primary

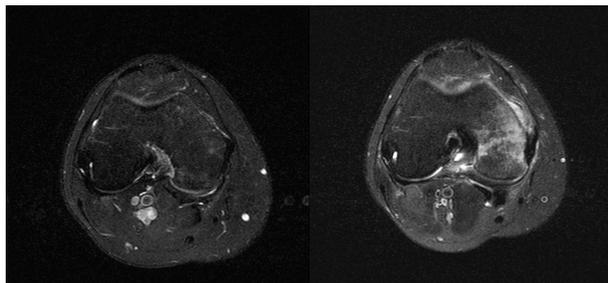


Figure 1. (A) T2W TSE SPIR axial image demonstrates bone marrow oedema at medial femoral condyle which covered less than 50 % of the medial femoral condyle. (B) T2W TSE SPIR axial image, obtained 6 months later shows that the bone marrow oedema at medial femoral condyle has resolved.

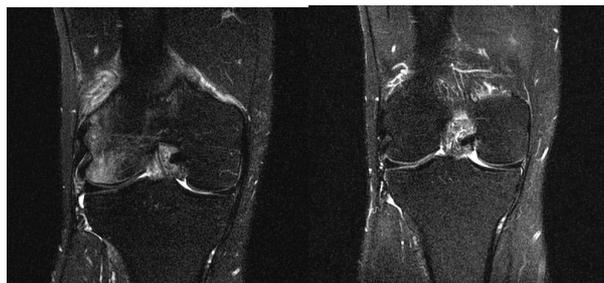


Figure 2. (A) T2W TSE SPIR coronal image, demonstrates bone marrow oedema at lateral femoral condyle. (B) T2W TSE SPIR axial image, obtained 6 months later shows that the bone marrow oedema at lateral femoral condyle has resolved.

osteonecrosis is not clear (7). It is widely accepted that an embolus reduces the blood flow in the bone marrow and promotes oedema development due to a reduction of the microcirculation. Others suggest that repetitive micro-traumas causing microfracture and oedema in the subchondral bone plays an important role (3). Some reports suggest that arthroscopic attempts may play a role in the pathogenesis of spontaneous osteonecrosis (8). In our cases, no etiologic factor was seen.

Spontaneous osteonecrosis is generally seen in middle aged and elderly women. But gender is not always a decisive factor for diagnosis. In this study, 12 cases (57 %) were male and 9 cases (43 %) were female. In accordance with the literature, most of the lesions were

localized on the medial femoral condyle (17/25, 68 %). Five lesions were localized on the lateral femoral condyle. Of the 25 lesions, 9 lesions were regarded as small (36 %) and 16 as large (64 %). In the literature, it is reported that a large sized lesion is a bad prognostic criterion (9). Nevertheless, Mont et al. (10) reported that there was no link between the size of lesion and prognosis. Although most (64%) of the lesions in this study were large but the final clinical outcome was good for large lesions. Plain radiography is not sensitive in the early stages when there is no sclerosis or bone collapse. On magnetic resonance imaging, hypointensity takes the place of fat-related normal hyperintensity of the bone marrow on T1 weighted images in the early stages. On

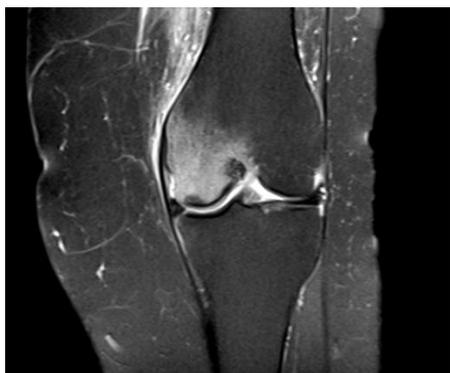


Figure 3. 75 year old woman. PDW TSE FS coronal image shows bone marrow oedema and subchondral hypointensity at medial femoral condyle.

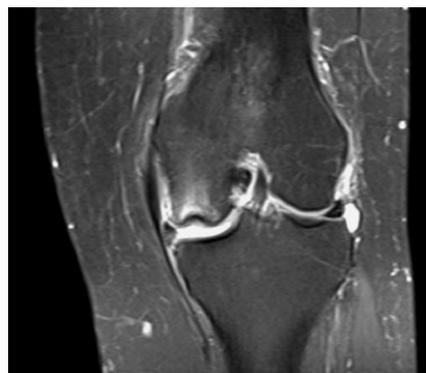


Figure 4. 64 year old woman. PDW TSE FS coronal image shows focal contour depression at medial femoral condyle.

T2 weighted images, hyperintensity is seen in the affected area. In some cases, hypointense osteonecrotic focus may appear in the subchondral bone on T1 and T2 weighted images. Therefore MR imaging is gaining more importance as its sensitivity is higher (5,10-12). MR imaging is a modern and commonly used modality for the diagnosis and follow-up of the early stages of osteonecrosis in which there is no radiographic findings (13). Although scintigraphic examination is useful for the diagnosis of spontaneous osteonecrosis, Yates et al. (13) argued that scintigraphy is not necessary for diagnosis when clinical findings and MR findings are together analyzed. Bone scanning is sensitive but not specific for the detection of bone marrow oedema syndromes. Scintigraphy is very useful in differentiating bone marrow oedema syndromes from stress fractures, osteomyelitis, metastasis.

Lecouvet et al. (5) studied prognostic MR imaging criteria on early irreversible osteonecrosis versus transient lesions. They reported that the presence of subchondral hypointense area on T2 weighted images indicated a bad prognostic value. However, later on subchondral hypointensity has been reported in reversible lesions (13). Also in our study subchondral hypointensity was not a bad prognostic factor and the treatment response according to clinical outcomes. In the literature it is reported that wide radial tears are seen more common in the menisci of spontaneous osteonecrotic patients (14). In this study, the most common meniscal pathology was found to be grade 2 meniscal degeneration in the medial meniscus posterior horn in 15 cases. In these cases, no radial tear was found. We suggest that grade 2 meniscal degeneration, which was the most common finding, has no relation with osteonecrosis, because osteonecrosis is bone marrow pathology and our cases were aged 41 years and above and in these cases meniscal degeneration is often encountered during routine MR examinations. In daily practice, it is difficult to distinguish between early stage spontaneous osteonecrosis and meniscal pathologies on the basis of symptoms. In these cases ten patients were initially diagnosed clinically as having meniscal tears. In the differential diagnosis of spontaneous osteonecrosis, pathologies are defined under the title of oedema in bone marrow (transient osteoporosis, regional migratory osteoporosis, reflex sympathetic dystrophy) and pathologies which cause bone marrow oedema such as osteochondritis dissecans (OCD), trauma and arthritis. In various studies,

it is commonly stated that it is difficult to differentiate early spontaneous osteonecrosis and bone marrow oedema syndromes (13,14). Yates et al. (13) reported that the most significant difference between early stage spontaneous osteonecrosis and bone marrow oedema syndromes is the presence of focal subchondral lesions on MR images. In this study focal subchondral lesion was found in 11 cases. In other 8 cases (5 female, 3 male), medial joint surfaces were affected typically. The lateral surface of the femoral condyle is generally involved in osteochondritis dissecans, whereas in spontaneous osteonecrosis the weight bearing medial surface of the femoral condyle and tibial plateau are involved (14). Contour depression was found on medial weight bearing joint surfaces in 2 cases. Contour flattening is important for differentiation between spontaneous osteonecrosis and other bone marrow oedema syndromes (15). Lateral femoral condyle was affected in 2 males (41 and 49 age). Transient osteoporosis and regional migratory osteoporosis are usually seen in the third trimester of pregnancy and middle aged males. Oedema is seen at femoral head and neck, intertrochanteric area in these disease. Also recurrence in the same joint or migration of the disease to the contralateral femoral head may be seen. In these 2 male cases, transient osteoporosis and regional migratory osteoporosis were excluded because lesions were described at lateral femoral condyle and no history of migration. The other condition that must be considered for differential diagnosis of spontaneous osteonecrosis is reflex sympathetic dystrophy. The history of trauma and the presence of skin atrophy, sensorimotor alterations and contractures may be helpful to distinguish reflex sympathetic dystrophy from the other bone marrow oedema syndromes. In this study patients with history of trauma were excluded. Clinical findings were not appropriate for reflex sympathetic dystrophy. Treatment is decided according to the age of the patient, the stage of osteonecrotic lesion and the localization of the lesion. According to Aglietti (9) radiographic classification system, stage 1; no radiographic findings, stage 2; slight flattening of the condyle, stage 3; subchondral radiolucent lesion, stage 4; sclerotic halo and early collapse, stage 5; further collapse and secondary degenerative changes. Usually, stages 1, 2, 3 are considered to be early stages. The treatment options are conservative in the early stages and are analgesic, non-steroidal anti-inflammatory agents, reducing the load bearing and physical therapy applications. Stages 4 and 5 are

considered to be advanced stages and for advanced lesions, surgical treatment options include such methods as arthroscopic debridement, osteotomy, drilling, bone graft applications and total knee arthroplasty. For our cases, as all of the patients were, medication (Iloprost-intravenous) was applied. In the literature, nonsteroidal anti-inflammatory agents are applied more commonly for treatment and there are limited reports for iloprost. Iloprost is an analogue for prostacyclin (PGI₂) and leads to an increase in vascularity. Follow-up examinations were not mentioned here, because evaluating the efficacy of iloprost was not the purpose of this study.

The prognosis in spontaneous osteonecrosis may have a wide spectrum from osteoarthritis, collapse of joints to complete recuperation. In these cases, if an early diagnosis is made and timely surgical treatment, optimal results may be obtained. For the patient who has bone marrow oedema on medial weight bearing area of knee joint, normal laboratory results, no history of trauma and who is middle or elderly patient, spontaneous osteonecrosis must be taken into consideration. In conclusion, MRI can be applied as an effective modality for the diagnosis of early stage spontaneous osteonecrosis, and for the differential diagnosis of other intraarticular and bone marrow pathologies.

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