Metaphyseal Burst Sign; the First Case Report of Subchondral Insufficiency Fracture of the Knee in Iran

Reza Noktehsanj1,2, Hamid-Reza Aslani3, Seyyed-Mohsen Hosseininejad4,5,* and Mohammad-Amin Aslani6

1 Department of Orthopedics, Fatemi Hospital, Ardabil University of Medical Sciences, Ardabil, Iran
2 Bone, Joint, and Related Tissues Research Center, Akhtiar Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran
3 Sport Medicine and Knee Research Center, Milad Hospital, Tehran, Iran
4 School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran
5 Joint, Bone, and Connective Tissue Rheumatology Research Center, Golestan University of Medical Sciences, Gorgan, Iran
6 Tehran University of Medical Sciences, Tehran, Iran

* Corresponding author: Seyyed-Mohsen Hosseininejad, Joint, Bone, and Connective Tissue Rheumatology Research Center, Golestan University of Medical Sciences, Gorgan, Iran. Email: Hosseininejad.s.mohsen@gmail.com

Received 2020 August 21; Revised 2020 October 04; Accepted 2020 October 19.

Abstract

Introduction: Metaphyseal burst sign, which is soft tissue edema in the metaepiphysial region, is defined as a novel initial sign of subchondral insufficiency fracture of the knee (SIFK).

Case Presentation: We reported the first Iranian case of the SIFK in femoral medial condyle characterized by a metaphyseal burst sign which could be an early sign of the SIFK. Early diagnosis and treatment could dramatically relieve the sign and symptoms of patients with significant improvement of the MRI scan.

Conclusion: The metaphyseal burst sign as the initial specific sign of SIFK could be helpful for the early diagnose and management of the osteonecrosis of the affected area. The SIFK could potentially progress into severe joints degenerative changes in a short time; therefore, it seems that an early diagnosis and treatment thereafter could help resolve the clinicoradiological signs and symptoms of SIFK. This could postpone knee osteoarthritis and the need for joint arthroplasty.

Keywords: Magnetic resonance imaging (MRI), Medial femoral condyle, Metaphyseal burst sign, Osteonecrosis, Subchondral insufficiency fracture

1. Introduction

Subchondral insufficiency fracture of the knee (SIFK), which has replaced the entity of spontaneous osteonecrosis of the knee (SONK) in the latest literature (1, 2), is characterized as severe knee pain in the absence of trauma or following a minor trauma usually in people above 65 years of age (3, 4). The most common location of SIFK is in the medial femoral condyle; however, it has been reported in the lateral femoral condyle and the tibial condyles as well (5, 6).

Exact etiology of the SIFK is still a matter of debate; nevertheless, the current popular etiology is that these insufficiency fractures result in the accumulation of fluid in the bone marrow, leading to focal ischemia and subsequent bone necrosis (3, 7, 8). It is important to keep in mind that this condition can potentially lead to the rapid deterioration of osteoarthritis and functional disabilities (9).

The clinicoradiological classification system was expressed in four stages by Soucacos in 1997. The first stage is characterized by bone marrow edema alone while the second includes progression to initial flattening of the femoral condyle. These first two stages are diagnosed by magnetic resonance imaging (MRI) as significant changes are not detectable on plain radiographs. The third and fourth stages are classified as the ‘crescent sign’ and the collapse of the subchondral bone, respectively (8-12).

The early diagnosis in the first two stages is important as conservative therapy is usually effective (11,13). The most frequently used diagnostic criteria on MRI are an area of bone marrow edema in affected condyle associated with subchondral bone changes (4, 5, 9, 13-19). Treatment of SIFK in the initial stages consists of protected weight-bearing, non-steroidal anti-inflammatory medications (NSAIDs), analgesic agents, and bisphosphonates (17, 20). The metaphyseal burst sign, edema, is defined as an increased signal on fluid sensitive sequences that involve the soft tissues overlaying the epimetaphyseal cortex of the affected condyle (21).

The present study aimed to present the first case of the SIFK in Iran with an additional early MRI sign of SIFK (i.e., the metaphyseal burst sign) which can be helpful for an earlier diagnosis.

2. Case Presentation

The case is a 45-year-old otherwise healthy male medical doctor with a complaint of pain in the right knee. He described a moderate pain in the medial aspect of the knee which became worse with weight bearing. He also complained of pain at rest; however, there was no report of knee locking and giving way.
Figure 1. Initial plain radiography and MRI evaluation of the right knee anteroposterior (a), lateral (b), and X-rays showed no significant abnormality. Coronal T2 (c) depicted intact posterior horns of the meniscus, and coronal T1 (d), sagittal T2 (e), and axial T2 (f) illustrated edematous change involving the medial femoral condyle. Coronal STIR (g) portrayed the typical pattern of bone marrow edema and metaphyseal burst sign.

His body mass index was 32 kg/m² and he had no history of previous trauma, knee surgery, coagulopathy, or steroids reception. He was an ex-smoker and consumed alcohol occasionally. On Physical examination, he had medial femoral condyle point tenderness. Mild knee effusion was detected as well. The range of motion of the knee was not remarkable; nevertheless, full knee flexion was painful. McMurray, pivot shift, and varus/valgus stress tests were normal.

Plain radiographs of the affected knee were normal (Figure 1). MRI was requested which showed extensive edema in the medial femoral condyle extended to the intercondylar notch and the lateral condyle besides metaphyseal subperiosteal edema of the distal femur “metaphyseal burst sign” (Figure 2). No malalignment was noticed in the lower limb X-ray alignment view.

The patient was ordered to decrease physical activities with protected weight bearing by crutches and take Celexib 100 mg capsule twice a day plus alendronate (Osteofos) 70 mg tablet weekly for 6 weeks. On the next follow-up visit after 6 weeks, his signs and symptoms were relieved, his knee X-ray was normal, and the MRI illustrated a significant decrease of the edema of the distal femur (Figure 2).

The NSAID was discontinued while he was suggested to continue taking alendronate as before. He

Figure 2. Second MRI which was taken 6 weeks after conservative treatment, including non-weight bearing, non-steroidal anti-inflammatory medications, and bisphosphonates. Coronal T1 (a), sagittal T2 (b), axial T2 (c), and coronal STIR (d) weighted images showed a decrease in the bone marrow edema, compared to before. b and d illustrate the natural appearance of the focal linear subchondral hyperintensity in femoral medial condyle.
Figure 3. Coronal T1 (a), sagittal STIR (b), axial T2 (c), and coronal STIR (d) weighted images depict the significant decrease of medial condyle of femur bone marrow edema and subsidence of focal subchondral linear hyperintensity

continued to feel better as the pain significantly decreased and was able to walk without crutches. The second follow-up MRI after 3 months showed significant shrinkage of the edematous area (Figure 3).

3. Discussion

Extensive bone marrow edema extending from the subchondral bone plate into the epiphyseal region with variable involvement of the metaphysis on MRI without a traumatic event is suggestive of SIFK (22). However, it was not found in other conditions, such as a tumor, infection, acute osteochondral fracture, and osteoarthritis (21).

We reported the ‘metaphyseal burst sign’ (Figure 1) as an early sign of SIFK in a 45-year-old Iranian male. To the best of our knowledge, this is the first reported case in this regard in Iran. In this case, metaphyseal burst sign was present in combination with the unicondylar bone marrow edema. On MRI, it was recognized by edema of the tissues overlying the metaphyseal region of the affected condyle where the nutrient vessels perforate the bone to supply blood to the epimetaphysis and subchondral bone (23–25). These could be indicative of the vascular origin of the metaphyseal burst sign. They are related to the sudden increase of intraosseous pressure consequent to a subchondral insufficiency fracture. This fracture could cause the loss of the integrity of the subchondral bone plate leading to a retrograde raise of arterial and venous blood pressure with resultant extravasations.

There would be several differential diagnoses including previous traumatic injury to the knee, and/or meniscus, especially root avulsion, and ligament injuries which were not relevant to our case due to normal knee stability tests and negative history for recent trauma. Besides, the proximal tibia of the patient was not remarkable based on examination and MRI (21, 26). Treatment of such lesion consists of activity modification, NSAIDs, bisphosphonate, and regular follow-up visits. The definite treatment in case of severe degenerative changes would be joint arthroplasty (17).

In conclusion, the metaphyseal burst sign as the initial specific sign of SIFK could be helpful for the early diagnose and management of the osteonecrosis of the affected area. The SIFK could potentially progress into severe joints degenerative changes in a short time; therefore, it seems that an early diagnosis and treatment thereafter could help resolve the clinicoradiological signs and symptoms of SIFK. This could postpone knee osteoarthritis and the need for joint arthroplasty.

Acknowledgements

The authors would like to give their special thanks to the patient for his cooperation.

Footnotes

Conflict of Interests: The authors declare that there was no conflict of interest in this study.

Ethical considerations: Written informed consent was obtained from the patient and the study was conducted based on the Declaration of Helsinki.

References

3. Yamamoto T, Bulkough PG. Spontaneous osteonecrosis of the knee: the result of subchondral insufficiency fracture. JBJS.


