Case Report

Subchondral Microfracture of the Knee Without Osteonecrosis After Arthroscopic Medial Meniscectomy

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Abstract: We report a case of an osteonecrosis-like lesion of the knee that developed shortly after an arthroscopic medial meniscectomy. Clinical presentation, physical findings, and imaging of the knee including magnetic resonance imaging were similar to those of the cases that have been reported as osteonecrosis after meniscectomy. However, histologic analysis of the lesion revealed that there was no osteonecrosis but rather a subchondral microfracture with active callus formation. **Key Words:** Meniscectomy—Osteonecrosis—Magnetic resonance imaging—Arthroscopy.

Osteonecrosis of the knee developing after arthroscopic meniscectomy has been previously reported.[1-4] In these studies, the diagnosis of the lesions has been based mostly on clinical findings and imaging studies of the knee. Specifically, the usefulness of magnetic resonance imaging (MRI) has been shown for the diagnosis.[4,5] On the other hand, few studies have reported a histologic analysis of the lesion. We present a case of a patient who developed an osteonecrosis-like lesion in the medial femoral condyle (MFC) after arthroscopic medial meniscectomy detected by radiograph and MRI. However, histologic analysis revealed no osteonecrosis but rather a subchondral microfracture.

CASE REPORT

A 64-year-old man visited our clinic in September 1998 with a complaint of swelling and pain on the medial side of the left knee of 4 months duration without specific trauma. Physical examination revealed swelling of the left knee and the normal range of motion. There was tenderness on the medial joint line and a positive McMurray test. An anteroposterior radiograph showed no bony lesion (Fig 1A). MRI, however, revealed a lesion with increased signal intensity at the posterior horn of the medial meniscus, suggesting a meniscal tear (Fig 1B, arrow). There was no abnormal change in the bone marrow of the MFC (Fig 1B). Arthroscopy confirmed a degenerative tear of the medial meniscus at the posterior horn, and the lesion was excised. At the time of surgery, there was no apparent chondral damage at the MFC (Fig 2). After surgery, the patient followed a normal protocol of rehabilitation with muscle strengthening and range of motion exercises. Three days after surgery, the patient started to have persistent joint swelling. One month later, the patient complained of recurrent episodes of joint swelling, with sharp pain during daily activity. At 3 months after surgery, because of persistence of the symptoms, radiography and MRI were performed. Radiographs revealed a subchondral flattening and collapse of the MFC. The lesion contained both radiolucent and sclerotic areas with a sclerotic halo (Fig 3A). The MRI T1-weighted image showed a diffuse low signal intensity area in the MFC (Fig 3B),

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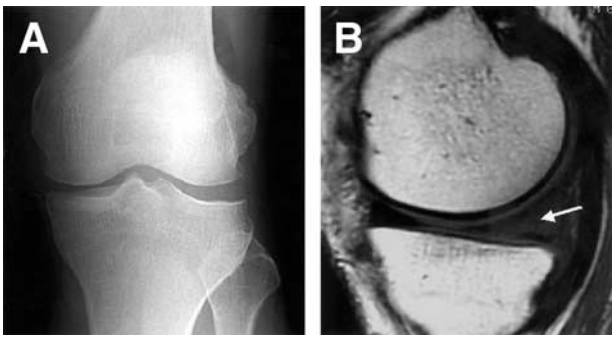

FIGURE 1. (A) Anteroposterior radiograph of the right knee made 1 month before meniscectomy. No abnormal finding in the MFC. (B) T1-weighted MRI made 2 weeks premeniscectomy shows a lesion with higher signal intensity in the posterior horn of the medial meniscus. Note that bone marrow in the MFC appeared normal.

and the T2-weighted image showed a localized low signal intensity area surrounded by a high signal intensity area in the corresponding region (Fig 3C). Based on these findings, we suspected the presence of an osteonecrotic lesion in the MFC, and the patient received a total knee arthroplasty at 6 months after meniscectomy (Fig 4A). Operative findings showed that the MFC lesion occupied the majority of the weight-bearing area (Fig 4B and C). Histologic analysis revealed a subchondral microfracture (Fig 5A, arrow) with associated fracture callus, reactive cartilage, and granulation tissue (Fig 5B). No histologic evidence of antecedent osteonecrosis was observed (Fig 5C).

DISCUSSION

Previous reports on postmeniscectomy osteonecrosis have shown the importance of imaging in the diagnosis of osteonecrosis in addition to the physical examination. Among the several imaging methods, the usefulness of MRI has been focused on by these studies.[1-4] The criteria for the diagnosis of osteonecrosis by MRI has been widely reported as normal intensity on T1-weighted images replaced by a discrete area of low signal intensity in the affected region, and T2-weighted images typically show high signal intensity in the corresponding area with an associated focal area of low signal intensity in the center of the lesion.[5-7] It has been suggested that MRI is advantageous over radiography and bone scan because it allows not only a sensitive assessment of the pathology but also a good estimation of the size of the lesion.[4] Because the size of the lesion is considered extremely important to the prognosis,[6,8] the MRI has been important for determining the most appropriate treatment for these patients. In the present case, we planned a total knee arthroplasty because the MRI showed that the lesion occupied the majority of the weight-bearing portion of MFC. Pathologic analysis of the resected lesion, however, revealed no evidence for osteonecrosis. The only bony change we observed was microfracture of the subchondral bone, with an associated fracture callus, reactive cartilage, and granulation tissue. These pathologic findings suggest that the typical MRI changes of osteonecrosis could be present in the absence of osteonecrosis. Such changes in MRI signal intensity are presumably from bone marrow edema secondary to subchondral microfracture. Yamamoto and Bullough[9] analyzed the histology of lesions that were diagnosed as spontaneous osteonecrosis of the knee and concluded that the principal pathology of the lesion was a subchondral insufficiency fracture and that the associated osteonecrotic change was the result of the fracture. It remains unclear whether spontaneous osteonecrosis of the knee and postmeniscectomy osteonecrosis-like lesions are of similar pathogenesis. The similarity in MRI findings and pathology, however, suggests that the primary event that occurred in the present case may also have been microfracturing of the subchondral bone. It has been shown that even partial meniscectomy could cause increased contact pressure at joint surface.[10,11] Therefore, arthroscopic meniscectomy might have increased peak stresses on the MFC above the threshold for failure of the sunchondral plate, leading to microfractures.

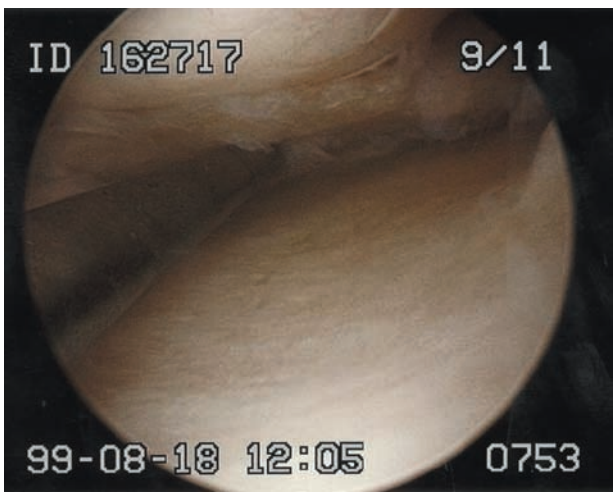

FIGURE 2. Medial meniscus at arthroscopy. Degenerative tear of posterior horn is observed.

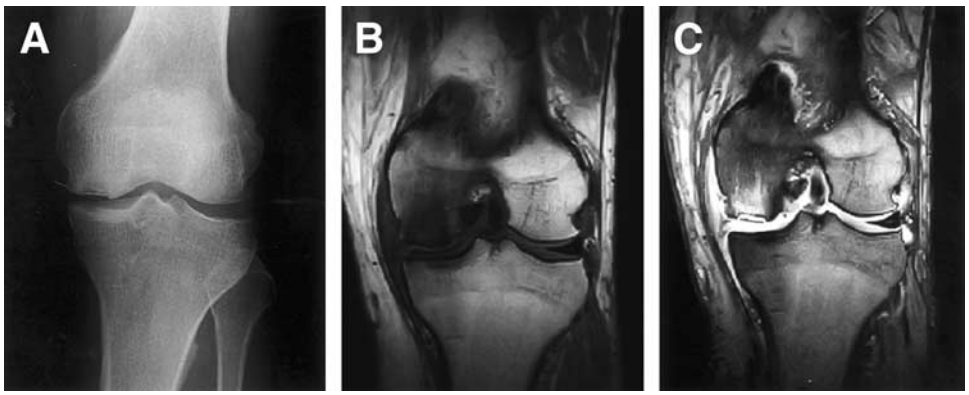

FIGURE 3. Radiograph and MRIs 3 months after meniscectomy. (A) Anteroposterior radiograph of the right knee shows subchondral flattening and collapse of the MFC. The lesion contained both radiolucent and sclerotic areas with a sclerotic halo. (B) T1-weighted MRI shows diffuse low signal intensity area in the MFC. (C) T2-weighted MRI shows localized low signal intensity area surrounded by high signal intensity area in the corresponding region.

In summary, when clinicians are assessing a patient with worsening symptoms after arthroscopic meniscectomy of the knee, subchondral fracture should be considered in the differential diagnosis, and an early MRI should be made. In the present case, there was already subchondral collapse that had developed when the radiographs and MRI were obtained. The lack of immobilization and continued weight bearing after

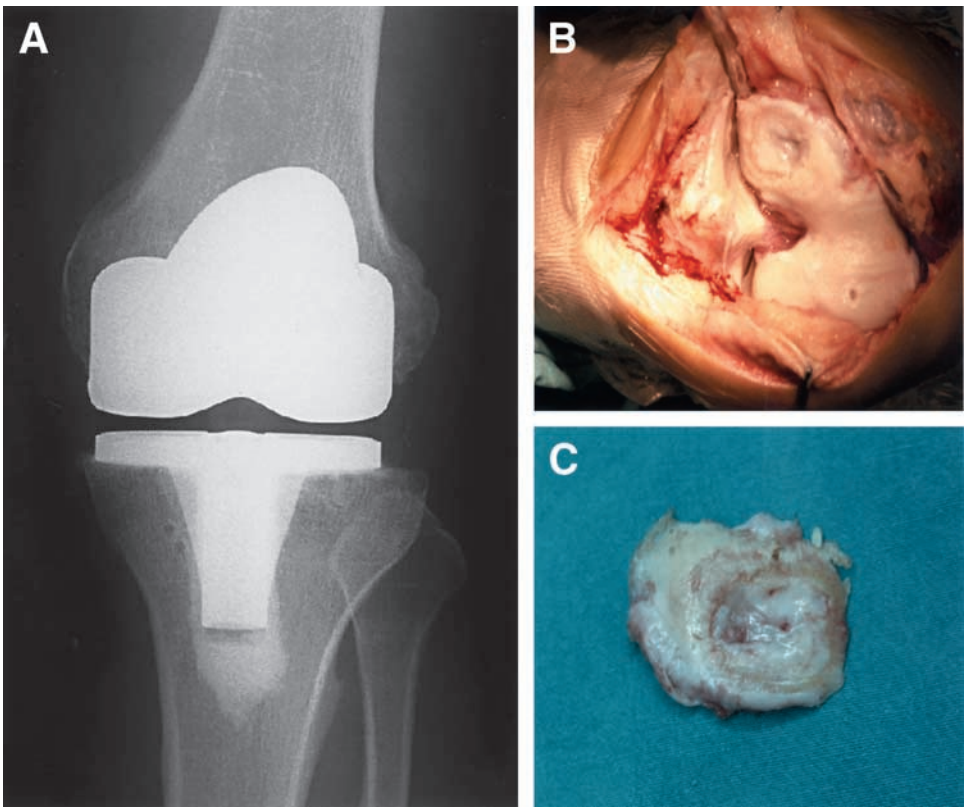

FIGURE 4. (A) Anteroposterior radiograph of the right knee after a total knee arthroplasty. (B) Operative finding of the femoral condyles. Note the MFC lesion covers most of the weight-bearing part. (C) The resected lesion.

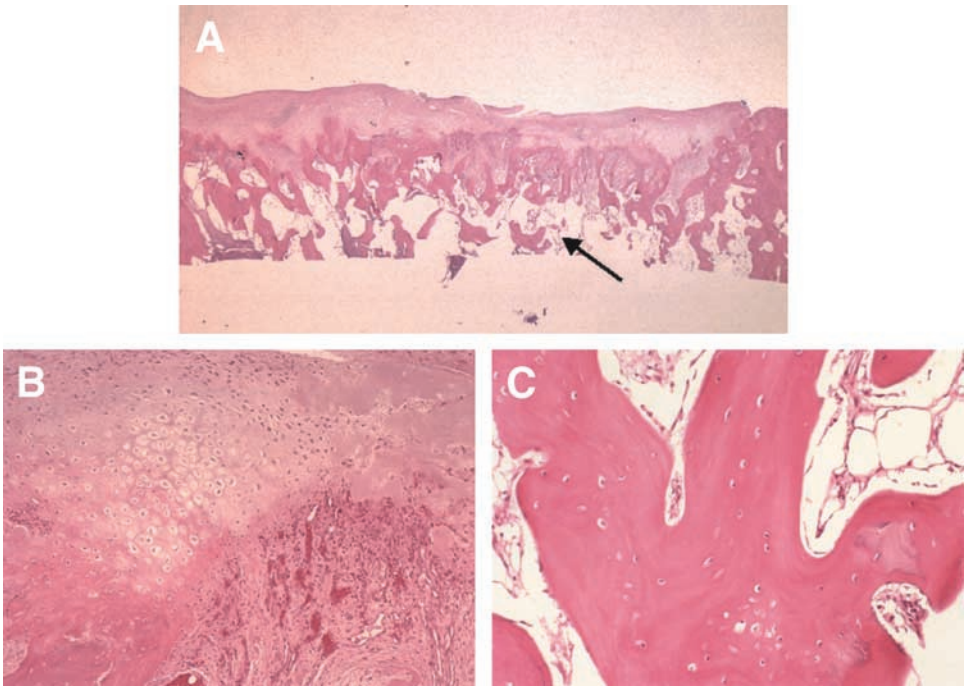

FIGURE 5. H&E staining of the osteonecrosis-like lesion. (A) Entire view of the lesion. Subchondral fracture is observed (arrow) (original magnification ×40). (B) Associated fracture callus and vascular granulation tissue beside fracture area (original magnification ×100). (C) Fractured bone trabeculae without any evidence of antecedent osteonecrosis (original magnification ×100).

subchondral microfracture could have eventually resulted in the collapse. Thus, early diagnosis of the lesion before radiographic changes have developed could potentially help prevent this from occurring.

CONCLUSION

This case represents a postmeniscectomy, osteonecrosis-like lesion of the knee. Histologic analysis suggests that the principal pathology of this condition is subchondral microfracture without osteonecrosis.

REFERENCES

1. Santori N, Condello V, Adriani E, Mariani PP. Osteonecrosis after arthroscopic medial meniscectomy. *Arthroscopy* 1995; 11:220-224.
2. Muscolo DL, Costa-Paz M, Makino A, Ayerza MA. Osteonecrosis of the knee following arthroscopic meniscectomy in patients over 50-years old. *Arthroscopy* 1996;12:273-279.
3. Prues-Latour V, Bonvin JC, Fritschy D. Nine cases of osteonecrosis in elderly patients following arthroscopic meniscectomy. *Knee Surg Sports Traumatol Arthrosc* 1998;6:142-147.
4. Johnson TC, Evans JA, Gilley JA, DeLee JC. Osteonecrosis of the knee after arthroscopic surgery for meniscal tears and chondral lesions. *Arthroscopy* 2000;16:254-261.
5. Pollack MS, Dalinka MK, Kressel HY, Lotke PA, Spritzer CE. Magnetic resonance imaging in the evaluation of suspected osteonecrosis of the knee. *Skeletal Radiol* 1987;16:121-127.
6. Lotke PA, Ecker ML. Osteonecrosis of the knee. *J Bone Joint Surg Am* 1988;70:470-473.
7. Brahme SK, Fox JM, Ferkel RD, Friedman MJ, Flannigan BD, Resnick DL. Osteonecrosis of the knee after arthroscopic surgery: Diagnosis with MR imaging. *Radiology* 1991;178: 851-853.
8. Ahlback S, Bauer GC, Bohne WH. Spontaneous osteonecrosis of the knee. *Arthritis Rheum* 1968;11:705-733.
9. Yamamoto T, Bullough PG. Spontaneous osteonecrosis of the knee: The result of subchondral insufficiency fracture. *J Bone Joint Surg Am* 2000;82:858-866.
10. Baratz ME, Fu FH, Mengato R. Meniscal tears: The effect of meniscectomy and of repair on intraarticular contact areas and stress in the human knee. A preliminary report. *Am J Sports Med* 1986;14:270-275.
11. Ahmed AM. The road-bearing role of the knee menisci. In: Mow VC, Arnoczky SP, Jackson DW (eds). Knee Meniscus—*Basic and Clinical Foundations*. New York: Raven Press, 1992;59-73.