Chapter 16
Tibial Cartilage Defects

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Case Presentation

History

A 56-year-old gentleman presented to the office with a chief complaint of several months of left, lateral knee pain. He states that the knee pain has been gradual in onset with no specific inciting event. Since its onset, the pain has been slowly worsening. The pain is generally localized to the lateral side of the knee with occasional episodes of medial-sided pain. He reports occasional swelling in the knee, often related to activity. He rates his average pain as 3/10 but states that the pain is worse with any sort of weight-bearing activities, especially with pivoting,

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twisting, and going up and down stairs. The pain is usually worse toward the end of the day after ambulating on it. He will occasionally feel catching or have locking symptoms while ambulating. The patient denies any pain behind the kneecap. Therefore his presentation could be summarized as unicompartmental, weight-bearing pain that is associated with swelling.

The patient was initially treated with anti-inflammatories as needed and underwent a series of hyaluronic acid injections as well. These resulted in some relief, but did not provide a satisfactory reduction in symptoms. He has not had any steroid injections or previous surgical procedures on his knee, and he has not engaged in any regimented physical therapy sessions.

Physical Examination

On physical examination, the patient was 5 feet, 9 inches tall, weighed 184 pounds (body mass index of 27.2), was in no apparent distress, and could ambulate without apparent difficulty. He had a mild effusion in the left knee with mild tenderness to palpation along the lateral joint line. He had active range of motion from 0° to 125° with no catching or clicking. The patient's motor strength was 5/5 in the quadriceps and had no visible atrophy. There was no tenderness to palpation along the lateral femoral condyle and only mild pain with lateral joint line palpation.

Diagnostic Imaging

X-rays were obtained and reviewed in the office and revealed well-preserved joint spaces with no evidence of medial or lateral joint space narrowing (Fig. 16.1). There was no evidence of patellofemoral arthrosis. MRI revealed a localized chondral defect in the lateral tibial plateau with evidence of subchondral edema (Fig. 16.2). The remaining structures including the lateral meniscus and femoral cartilage appeared intact.

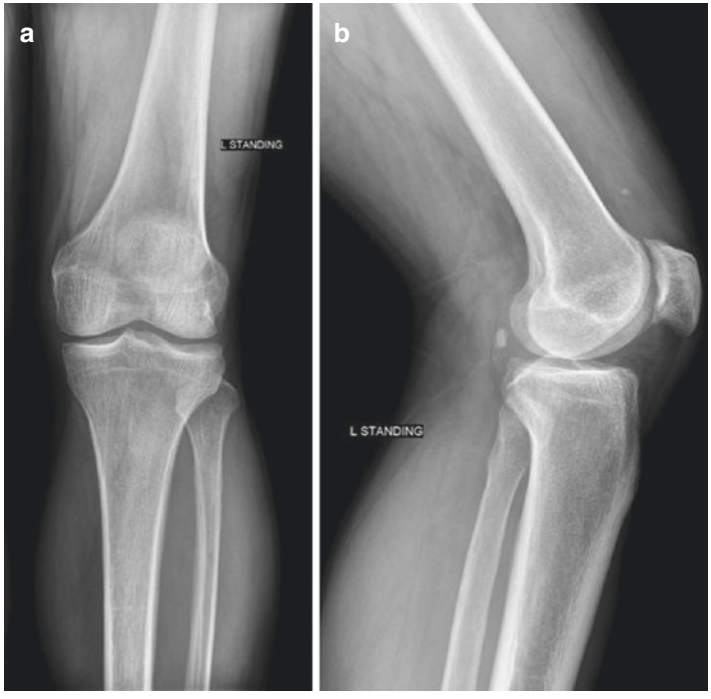

FIGURE 16.1 Preoperative plan standing AP (**a**) and lateral (**b**) radiography

Management and Treatment Options

The patient's findings were consistent with a localized chondral defect of the lateral tibial plateau. The location of this defect on imaging was consistent with the patient's clinical presentation and physical exam findings, and the possible treatment options, including continued conservative treatment, were discussed with the patient. The treatment plan was a diagnostic arthroscopy for index evaluation and, if the findings were consistent with an isolated tibial plateau defect, marrow stimulation of the defect with BioCartilage (Arthrex) and platelet-rich plasma (PRP) augmentation.

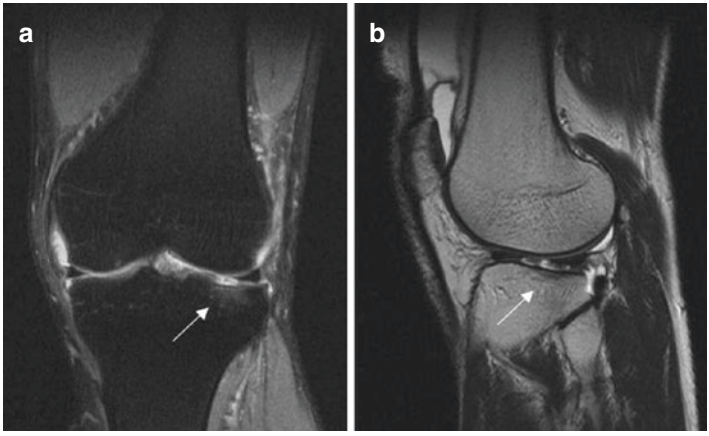

FIGURE 16.2 Preoperative coronal (**a**) and sagittal (**b**) magnetic resonance imaging demonstrating an isolated tibial plateau articular cartilage injury (white arrow) and associated bone edematous changes

Other treatment options for tibial plateau defects include microfracture alone, matrix-associated autologous chondrocyte implantation (MACI) with fibrin glue, and osteochondral allograft or autograft. MACI techniques should only be considered if the practitioner is comfortable using this treatment methodology for other indications, as it can be a technically challenging procedure that requires specialized equipment. In the tibial plateau, geometry, exposure, and access present challenging hurdles for osteochondral allograft or autograft applications, and practitioners should proceed with caution if considering these techniques. These also would typically require an open approach including takedown of the distal MCL.

In patients with articular cartilage defects of any kind, it is important to consider and address concomitant pathology when indicated. While the majority of published research for these indications addresses lesions of the femoral condyle, it is likely that similar principles apply in the treatment of tibial plateau lesions, and the following pathologies are concomitantly addressed in the senior author's practice. In tibial

lesions with a bipolar component, a corresponding femoral condyle cartilage defect, the bipolar pathology should be addressed. Additionally, patients with ligamentous instability and meniscal pathology should undergo concomitant ligament reconstruction or meniscal allograft transplantation (MAT) to improve the chance of a successful outcome.

Surgical Technique

Diagnostic Arthroscopy

The diagnostic arthroscopy was performed through standard inferomedial and inferolateral portals. The knee was examined for meniscal, ligamentous, and articular cartilage pathology. Specifically, the femoral condyle, meniscus, and tibial plateau were evaluated on the lateral side. A degenerative medial meniscal tear of about 10% was identified and debrided, and a degenerative lateral meniscal tear of between 10% and 20% was identified and debrided. A trochlear defect that was approximately 20 mm × 20 mm was identified. This was debrided to a stable rim but otherwise left untreated given its inconsistency with the patient's clinical presentation. An area of delamination was identified on the lateral tibial plateau and measured to be approximately 15 mm long and 6 mm wide (Fig. 16.3). This was debrided down to a stable rim utilizing a 4.5 mm rotary shaver and a curette.

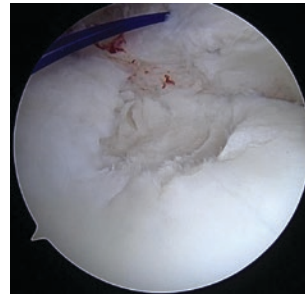

Figure 16.3 An intraoperative arthroscopic image of an isolated tibial plateau chondral defect prior to preparation of the defect

Marrow Stimulation

Prior to marrow stimulation, the calcified layer was debrided with an angled curette. The rim was debrided with a shaver to establish stable, vertical walls at the border of the defect. An arthroscopic K-wire was utilized to create atraumatic perforations in the subchondral plate to allow access to bone marrow mesenchymal stem cells. These holes were spaced 2–3 mm apart avoiding confluence to minimize the likelihood of ectopic bone formation (Fig. 16.4).

Application of BioCartilage and PRP

The microfracture site was dried with neurosurgical patties to optimize the adherence of the BioCartilage and PRP mixture (Fig. 16.5a). Blood pressure and tourniquet control were utilized to minimize bleeding into the area (Fig. 16.5b). The BioCartilage/PRP mixture was prepared outside of the knee and introduced within the defect taking care not to overfill the defect. A Freer elevator was utilized to flatten the surface of the BioCartilage/PRP mixture to lie slightly below the level of the surrounding articular cartilage. After appropriately applying the BioCartilage/PRP mixture, fibrin glue was applied over the top of the mixture taking care not to

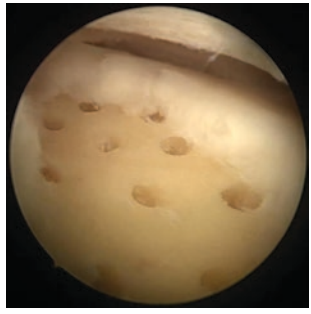

Figure 16.4 An arthroscopic image of a tibial plateau lesion after preparation via curettage and subchondral bone perforation via drilling

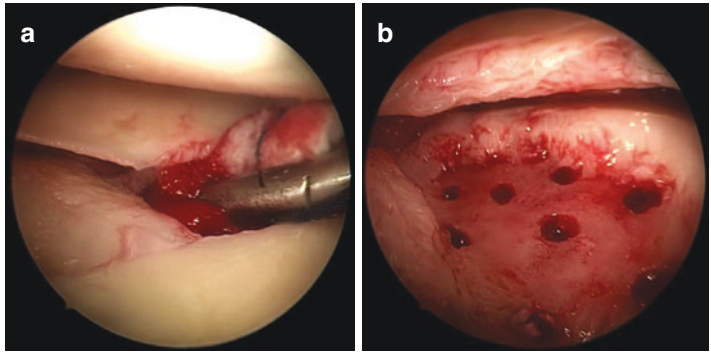

FIGURE 16.5 (**a**) An arthroscopic image of a tibial plateau chondral defect after preparation being adequately dried for optimal BioCartilage adhesion. (**b**) An arthroscopic image of a fully prepared tibial chondral lesion prior to BioCartilage application

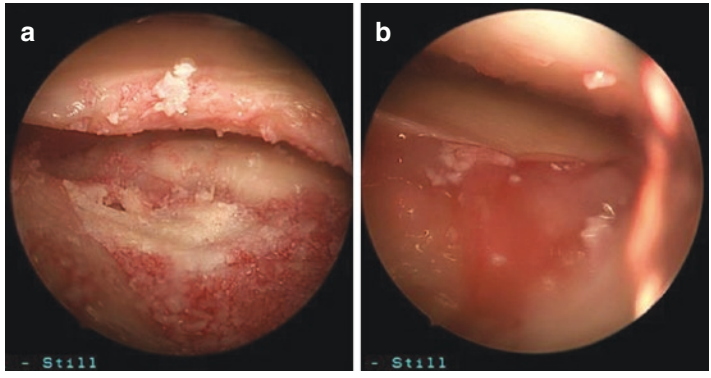

FIGURE 16.6 An arthroscopic image of an isolated tibial plateau lesion after being filled with the BioCartilage/PRP mixture (**a**) and after sealing the defect with fibrin glue (**b**)

over-apply the glue to reduce the risk of adherence to opposing surfaces. The fibrin glue was allowed to cure for 7 min prior to range of motion testing to minimize the risk of dislodgement (Fig. 16.6).

Postoperative Care

The patient was made nonweight-bearing immediately postoperatively with a 1-week delay in continuous passive motion (CPM) because of the application of BioCartilage. After 1 week, CPM was initiated for 6 hours a day with passive and active range-of-motion (ROM) exercises that were allowed as tolerated. At 6 weeks postoperatively, weight-bearing was slowly initiated with a steady increase of 25% weekly. Advanced strengthening exercises were initiated at 8 weeks postoperatively with further progression of weight-bearing activities as tolerated. Functional activity was started at 6 months postoperatively, and return to full activity was allowed at 8 months with physician clearance.

Literature Review

While there have been publications on the treatment methods and outcomes for treating cartilage lesions of the knee, these primarily focus on lesions of the femoral condyles and patellofemoral joint with few investigations specifically detailing treatment of the tibial plateau [1]. This paucity of available literature leaves surgeons with little clinical guidance on the treatment of these kinds of defects. While microfracture surgery is generally the first line of treatment for articular cartilage defects given its relative technical simplicity and low complication rates, the long-term outcomes have been questioned [2–4]. Additionally, osteochondral grafts (both autograft and allograft) have demonstrated success in cartilage defects of the knee, specifically for defect of the femoral head and patellofemoral joint involving the subchondral bone [5, 6], but the geometry and anatomical restrictions imposed by tibial plateau defects present unique challenges when pursuing these kinds of treatment [7–9]. While osteochondral grafts have shown positive outcomes for more severe tibial plateau cartilage defects, the technical challenges and potential for injury to surrounding structures when using these approaches necessitate caution.

In addition to direct treatment of the cartilage lesions, mechanical realignment may be an effective management strategy for tibial plateau defects, with high tibial osteotomy (HTO) used to reduce mechanical loading of diseased compartments [9]. A recent investigation has shown improved International Cartilage Repair Society (ICRS) cartilage grading in 34.6% of medial tibial plateau cartilage lesions in patients treated with HTO alone. Patient-reported outcome scores were also significantly improved in these patients at final follow-up; however, these did not correlate with the ICRS grading [10]. This literature suggests that HTO, both in isolation and as a concomitant procedure, can be an effective treatment for tibial plateau lesions, specifically those of the medial compartment, when varus malalignment is identified. While the patient in the current case example did not suffer from malalignment, in cases with varus malalignment, HTO should be strongly considered.

Given concerns regarding the long-term durability of microfracture – often attributed to the development of mechanically inferior fibrocartilage – new adjunct treatments have been developed with the hope of improving hyaline cartilage regeneration and improving the long-term durability of microfracture [2, 11]. In an animal model, BioCartilage (Arthrex, Naples, FL), a minced allogeneic cartilage product, combined with platelet-rich plasma, a promising biologic, has been shown to facilitate the generation of hyaline cartilage compared to microfracture alone. Similar results have also been shown with bone marrow aspirate concentrate (BMAC) [12]. Clinical outcomes remain to be determined, but the use of BioCartilage/PRP or BMAC to augment microfracture has been shown to improve hyaline cartilage regeneration in translational studies. These treatment strategies may potentially improve the long-term durability of microfracture treatment by affecting the type of cartilage fill.

Though clinical evidence for appropriate treatment of tibial plateau lesions is limited, the same principles for cartilage defect treatment apply here. As outlined above, care should be taken to utilize a technique that is logistically reasonable without adding increased risk. Therefore, treatments in this arena should focus on microfracture augmentation and cell-based treatments.

Tips and Tricks

- Avoid excessive application of BioCartilage/PRP mixture, as this can be easily dislodged by shear stresses if it stands proud over the surrounding cartilage margins.
- High tibial osteotomy should be strongly considered in cases with medial compartment involvement in the setting of varus malalignment.
- Order of operations:
  - Standard anterolateral arthroscopic approach.
  - Diagnostic arthroscopy.
  - Debridement of symptomatic articular cartilage lesions.
  - Microfracture of bare subchondral plate.
  - Evacuate saline from the knee and dry the microfracture site.
  - Prepare BioCartilage/PRP mixture.
  - Apply BioCartilage/PRP mixture and spread evenly, taking care not to exceed the height of the surrounding articular cartilage rim.
  - Apply fibrin glue to fix the BioCartilage/PRP mixture.
  - Close in standard fashion.

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