Subchondral insufficiency fractures of the knee (SIFK) are characterized by acute or subacute onset of severe knee pain in older persons, usually without a history of trauma. Patients often have localized tenderness over the affected condyle and worse pain with weight bearing and at night [1]. Typically, no radiographic abnormalities are observed in early-stage SIFK; however, a subchondral radiolucent lesion, subchondral collapse, and sclerotic changes may be observed as SIFK progresses. SIFK presents on MRI as a linear T1 hypointensity with surrounding bone marrow edema pattern, most commonly on the weight-bearing portion of the medial femoral condyle [2]. Although MRI is the imaging method of choice for SIFK diagnosis, MRI is seldom used in the initial evaluation of knee pain in older adults. Consequently, early-stage SIFK may be missed and treated inappropriately.

Although initially referred to as spontaneous osteonecrosis of the knee (SONK), recent studies have suggested that the subchondral fracture comes first and gives rise to small foci of bone necrosis [3,4]. A recent review article addressing the nomenclature of subchondral lesions points out that the term SONK has been used to refer to a range of findings, from early-stage SIFK to subchondral collapse [5]. The term SONK, although a misnomer, has been used in many studies referenced in the current perspective piece. Where the study authors refer to SONK, we will use the term SIFK/SONK, as to not conflate the two conditions.

SIFK is not a uniform entity, and it is typically accompanied by other intraarticular pathology. Between 50% and 100% of persons with SIFK/SONK have concomitant meniscal injuries [3], and the relationship between meniscal injuries and SIFK may be causal: disruption of the posterior root of the medial meniscus increases contact pressure between the tibia and femur, which could result in overload of the medial femoral condyle and SIFK [2]. SIFK may also be a complication of transient bone marrow edema syndrome, also referred to as transient osteoporosis, a condition seen in men aged 40–60 and pregnant women [6]. SIFK is associated with cartilage damage and development of knee osteoarthritis (OA) [7]. In fact, in one study of 40 subjects with SIFK/SONK who were free of knee OA at baseline and followed for 1–7 years, 29 (73%) eventually developed knee OA [8]. Another study of 50 subjects with SIFK found that larger lesions on MRI generally portend worse outcomes (subchondral collapse and ultimate need for joint replacement) compared to smaller lesions [9].

Because SIFK, meniscal tear, and acute exacerbation of OA present similarly in the 40+ year-old age group and have similar physical exam findings, it may be difficult to distinguish between them. It is likely that SIFK is commonly unsuspected; “it may see us more often than we see it.” Data from a trial of nonoperative treatments for knee pain sheds light on the prevalence of SIFK. Physicians enrolled into this trial patients >45 years old with knee pain and suspected meniscal tear. The physicians were comfortable managing these patients without MR imaging. MRI was obtained by the study team as part of the research protocol to confirm meniscal tear before enrollment. The prevalence of SIFK in this study was 2.94% (95% CI, 1.15%, 4.71%), suggesting that approximately 3% of individuals with symptoms typically attributed to degenerative meniscal tear may actually have unsuspected SIFK [10]. As we shall discuss below, treatments for OA and suspected meniscal tear (such as exercise in full-weight bearing) may be contraindicated in SIFK, underscoring the importance of making the correct diagnosis.

2. Treatment of SIFK

Because SIFK is relatively rare and often unrecognized, there have been few trials investigating treatment strategies, and no standardized treatment guidelines have been established. While clinicians typically prescribe non- or partial weight bearing to promote fracture healing, we are aware of no trials or consensus documents that specifically address weight bearing status for patients with SIFK. Cases series suggest that patients managed nonoperatively for SIFK/SONK are typically treated with restricted weight-bearing for 4–8 weeks, with gradual resumption of weight-bearing activities as the pain subsides [11]. For example, in one
of 40 patients with early-stage SIFK/SONK treated with touchdown weight bearing for approximately 6 weeks, 39 experienced substantial improvement in pain and functional outcomes and 1 underwent arthroscopic partial meniscectomy followed by chondroplasty during the follow-up period (mean 6 years, range 6 months–13 years) [12]. At the medical center where this study was conducted, MRI was readily available and the mean time between symptom onset and first MRI was 2.2 months. However, in another study of 223 patients with SIFK and a mean follow-up time of 4.4 years, the rate of conversion to surgical treatment was 34% [13]. This may suggest that early diagnosis is important for nonoperative treatment to be successful. Progression to surgery was more common in SIFK patients with more advanced baseline OA. Increased age, SIFK location on the medial femoral condyle or medial tibial plateau, and meniscal extrusion were also associated with a higher risk of progression to arthroplasty.

In one uncontrolled study that tested a gradual return to walking while wearing a biomechanical device, 17 individuals with SIFK/SONK underwent AposTherapy, a 6-month, non-invasive, biomechanical treatment program utilizing individually calibrated biomechanical units placed on the soles of a shoe. They were instructed to gradually increase their walking time while wearing this device from 10 minutes/day to 60 minutes/day throughout the course of the intervention. Participants reported a 53% improvement in pain and a 43% improvement in function, as well as improved gait patterns [14]. While randomized trials are sorely needed for this problem, these results suggest that a program of reduced weight bearing, with gradual advancement in weight bearing as symptoms subside, may be beneficial.

Several additional strategies have been used to treat SIFK. Nonoperative options include lateral wedge insoles, NSAIDs, and other analgesics. Bisphosphonates have been prescribed in attempt to prevent early resorption of necrotic bone, thereby preventing structural failure and disease progression. Although observational and case studies have suggested beneficial effects of bisphosphonates, a double-blind, placebo-controlled trial showed that ibandronate (a bisphosphate) was not associated with a statistically significant or clinically meaningful improvement in functional status for patients with SIFK/SONK [15]. For those who progress to end-stage disease, knee arthroplasty is the treatment of choice [13]. Other surgical treatments include arthroscopic debridement, arthroscopic microfracture treatment, meniscal root repair, core decompression, and high tibial osteotomy.

3. Suggestions for future research

The inconsistency in nomenclature surrounding subchondral bone defects should be addressed. The term SONK should be discarded, and this condition should be referred to either as SIFK or subchondral collapse to appropriately reflect the disease etiology and severity.

Additional data are needed to determine whether non- or partial weight bearing are effective treatment strategies for promoting fracture healing and reducing the duration of symptoms and risk of OA progression for patients with SIFK. Continued full weight bearing following onset of SIFK could eventually result in subchondral collapse [16]. However, the potential benefits of restricted weight bearing need to be balanced against the potential drawbacks, including deconditioning and muscle atrophy, which may exacerbate OA symptoms. Although some patients who are diagnosed early have resolution of symptoms, bone edema and fracture line within a few months, other patients may remain symptomatic for over a year [12,17]. It is also important to investigate which features of the fracture or other knee pathology can be used to tailor treatment and weight-bearing recommendations. A study conducted by Sayyid et al. suggests that the majority of patients with SIFK have low-grade lesions (no osteonecrotic or cystic changes and no subchondral collapse), and these patients tended to fare well with toe-touch weight bearing restrictions [9]. This underscores the importance of identifying SIFK early.

It would be costly and inefficient to obtain an MRI on all patients with knee pain in order to identify those with SIFK. The 3% prevalence of undiagnosed SIFK among adults with knee pain and suspected meniscal tear suggests that imaging select patients at high risk of SIFK may be useful for identifying these rare cases, especially given that early recognition is important for a better outcome [10,12]. Research is needed to identify clinical, demographic, and radiographic features of patients with knee pain who are at higher risk of SIFK.

Because SIFK is uncommon, these research gaps will not be addressed quickly. In the absence of robust evidence, a consensus conference involving clinicians from relevant specialties (e.g., orthopedics, radiology, rheumatology, and physical therapy) might be useful to provide clinicians guidance on when to suspect SIFK and how to diagnose and manage it.

Author contributions

ZZ performed the literature review and drafted the manuscript; LB edited the manuscript; JNK conceptualized the project and edited the manuscript; all authors approved the final manuscript.

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