Level V Evidence

Abandoning Microfracture of the Knee: Has the Time Come?

Jack M. Bert, M.D.

Abstract: Marrow stimulation has been performed for more than 45 years beginning with the simple drilling of bony surfaces, burring or "abrading" the sclerotic lesion, and more recently using awls to penetrate eburnated bone to promote blood flow to the bony surface. Multiple authors have promoted these procedures as "helpful," but others have confirmed only short-term relief with destruction of the subchondral surface. Unfortunately, proponents do not compare their marrow stimulation results to a control group that had debridement alone. A recent study confirmed that microfracture (MF) is equivalent to debridement and does not affect the subchondral bone, which therefore does not reduce the success rates of future surgery subsequent to MF. This brief review summarizes some of the factual data showing that marrow stimulation may not offer any improvement over debridement alone and that, in fact, MF results in significant destruction to the subchondral bone.

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In the late 1970s Dr. Lanny Johnson, who I consider one of the godfathers of arthroscopy and a mentor of mine, rectended abrasion arthroplasty as the definitive treatment for osteoarthritis of the knee. Before that time, the Pridie procedure (drilling with a K-wire) was common[1] and was the treatment of choice in eastern Europe (Fig 1) for bone-on-bone lesions before surgeons had access to total knee replacement implants, which did not occur in some cases until the late 1980s. In 1982, Dr. Johnson was a guest lecturer at the annual American Academy of Orthopaedic Surgeons meeting and spoke on the use of abrasion arthroplasty (Fig 2) for the treatment of knee osteoarthritis. He presented 103 cases, and one third of his patients had second-look arthroscopies with biopsies at 2-year follow-up. He reported satisfactory results in more than two thirds of his patients. Dr. Clement Sledge stated at that meeting that "Only Dr. Johnson could get such good results." Dr. Henry Mankin later commented that this treatment could not possibly reconstitute "normal" cartilage in the human knee.

After years of performing the Pridie procedure for osteoarthritis of the knee for "moderate" osteoarthritis, I was intrigued with abrasion arthroplasty for isolated grade IV lesions and began using the procedure in the mid-1980s. Unfortunately, after performing more than 100 cases, I found that 20% of my patients actually complained of more pain after the procedure, and those who had arthroscopic debridement alone did just as well as those who had abrasion arthroplasty plus debridement. I published these results in the *Arthroscopy* journal in 1989,[2] and shortly thereafter this retrospective study was duplicated by Rand[3] in 1991 with similar results. Subsequently, abrasion arthroplasty became less popular and was eventually abandoned by most surgeons in the United States in the early 1990s.

A third marrow-stimulation procedure, microfracture (MF) was reported in 2001[4] and remains popular today (Fig 3). Based on a PearlDiver database review, approximately 78,000 cases are performed annually, second only to chondroplasty for early osteoarthritis of the knee.[5] Multiple articles have reported on the early success rates of this procedure when small grade IV lesions are encountered during routine arthroscopy of the knee, which occurs in 19% to 74% of patients.[6-9]

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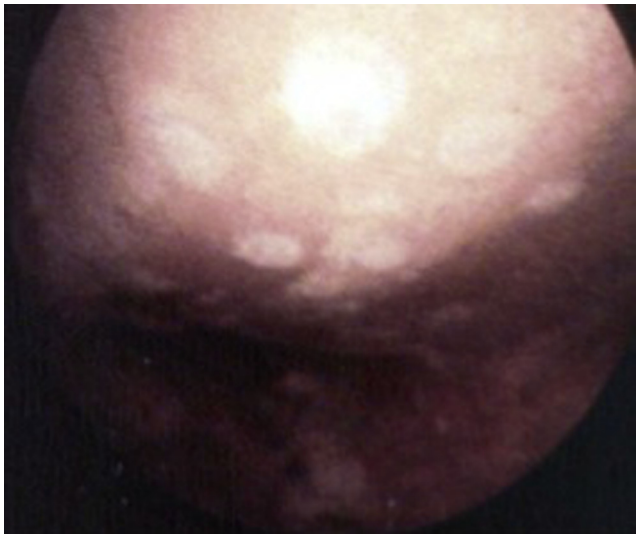

Fig 1. Arthroscopic image of a medial femoral condyle 6 months after a Pridie procedure.

Unfortunately, these studies have no control group; they report subjective results as satisfactory but show significant deterioration after 2 years.[10,11]

Subsequent to abrasion arthroplasty or marrow stimulation with use of a 4-mm pick, fibrocartilage forms on the surface that lacks proteoglycan.[2] As Chen et al.[12] and Pritzker et al.[13] noted, when the calcified cartilage layer is not broached, accessing type II collagen fibers—which accounts for 95% of the collagen content in cartilage—will not occur. This layer of calcified cartilage appears to be at least 6 mm beneath the superficial zone on the surface of articular cartilage. Thus, a routine awl will not reach the calcified cartilage layer in most knees, and it has been suggested that

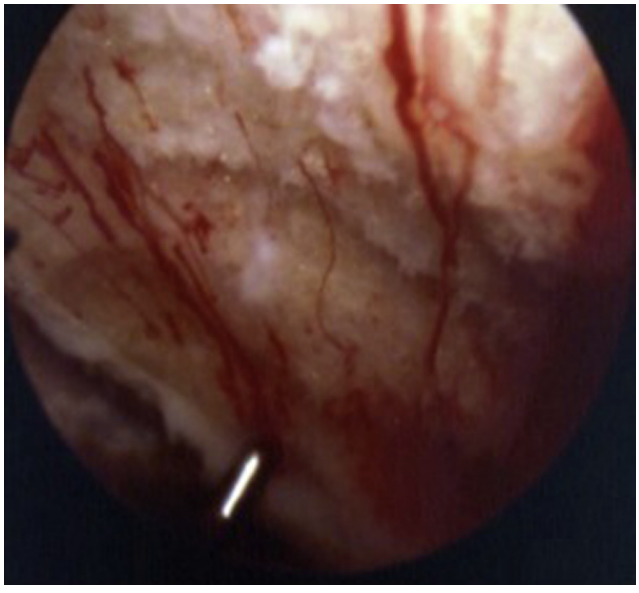

Fig 2. Intraoperative photograph of abrasion arthroplasty.

Fig 3. Intraoperative photograph at the time of microfracture.

"nanofracture" can allow for deeper drilling while avoiding calcification surrounding the drilled area by designing a pin with a flared portion just proximal to the tip of the pin.

MF has a significant effect on the micro- and macroarchitecture of subchondral bone. Multiple authors have reported subchondral cysts and intralesional osteophytes (Figs 4 and 5) in most animal and human follow-up studies from 6 months to 5 years, and they have found that these drilled sections are very fragile[14-17]

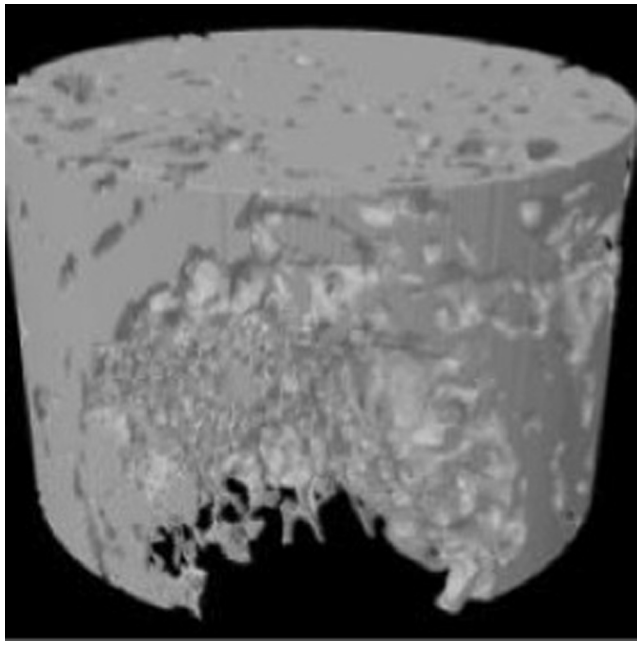

Fig 4. Core biopsy specimen after microfracture confirming subchondral bony destruction. (Courtesy of Ming-Hao Zheng, M.D., Ph.D.)

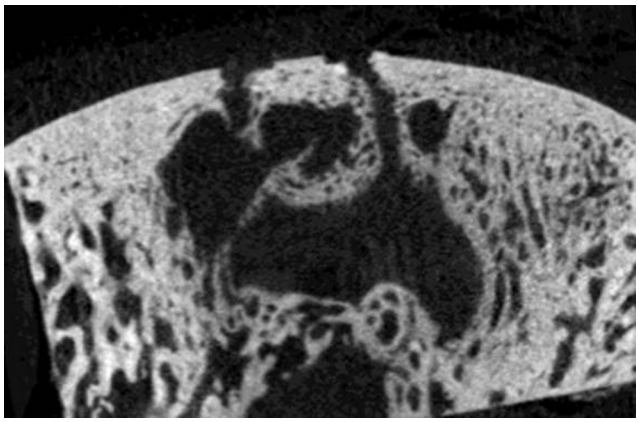

Fig 5. Cross-section biopsy specimen after microfracture confirming subchondral cyst formation. (Courtesy of Ming-Hao Zheng, M.D., Ph.D.)

(L. Fortier, personal communication, November 2014). This procedure truly does "fracture" the subchondral bone and makes the bone brittle. Recently, it was postulated that subchondral cyst formation is caused by infiltration of cytokines and metalloproteinases into the subchondral bone subsequent to MF and may certainly explain the cause of subchondral bone destruction subsequent to MF (M-H. Zheng, personal communication, October 2014). In addition, subchondral lucency has been noted on magnetic resonance imaging subsequent to MF (Fig 6), which would indeed represent this bony destruction as a result of MF (C.S. Winalski, personal communication, October 2014). Clinically, one of the side effects of subchondral drilling is that it causes worse results subsequent to future cartilage formation surgery than if the MF had not been done.[18] Furthermore, MF deteriorates over time. Several meta-analyses confirm that results dramatically decrease after 2 years, and a recent review of Level I and Level II studies found that at 5 years, failure could be expected regardless of lesion size.[9-11]

Gudas et al.[19,20] concluded, in the only Level I study comparing MF with debridement to debridement alone, that there was no difference between MF with debridement and debridement alone in a group of young athletes at a minimum 10-year follow-up. Ironically, "what goes around comes around," because this was the same conclusion that both Rand[3] in 1991 and my study in 1989[2] reached when we compared abrasion arthroplasty with debridement to debridement alone.

There is no comparative control group in any of the articles reporting satisfactory results subsequent to marrow stimulation. The only prospective study that compares marrow stimulation (i.e., MF) to debridement alone for osteoarthritis of the knee is the 2013 Gudas et al. study.[20] In this month's issue of *Arthroscopy*, Sansone et al.[21] review 75 patients with long-term follow-up who had abrasion arthroplasty for focal femoral condylar lesions; 29% were lost to follow-up and 68% of the remainder reported positive results. Without a control group to compare the patients who underwent abrasion arthroplasty to those who received simple arthroscopic debridement alone in a normally aligned knee, it is my opinion that these results should not imply that abrasion arthroplasty should be performed in patients with focal grade IV lesions of the femoral condyle.

Furthermore, it should be recognized that recent evidence substantiates the conclusions of older literature dating back to 1976[22] that if the patient has malalignment, proximal tibial osteotomy should be performed, which will result in fibrocartilage formation (Fig 7) on 93% of femoral condylar surface grade IV lesions when unloaded without the need for any marrow stimulation of the affected osteoarthritic surface.[23,24] These studies confirm that fibrocartilage forms over grade IV eburnated bone when the bony surface is simply unloaded.

In summary, it is my strong opinion that there is no indication to perform MF or abrasion arthroplasty for isolated articular cartilage lesions. Debridement yields the same results as MF or abrasion arthroplasty. Furthermore, chondroplasty will not worsen the microarchitecture of the underlying bone for inevitable

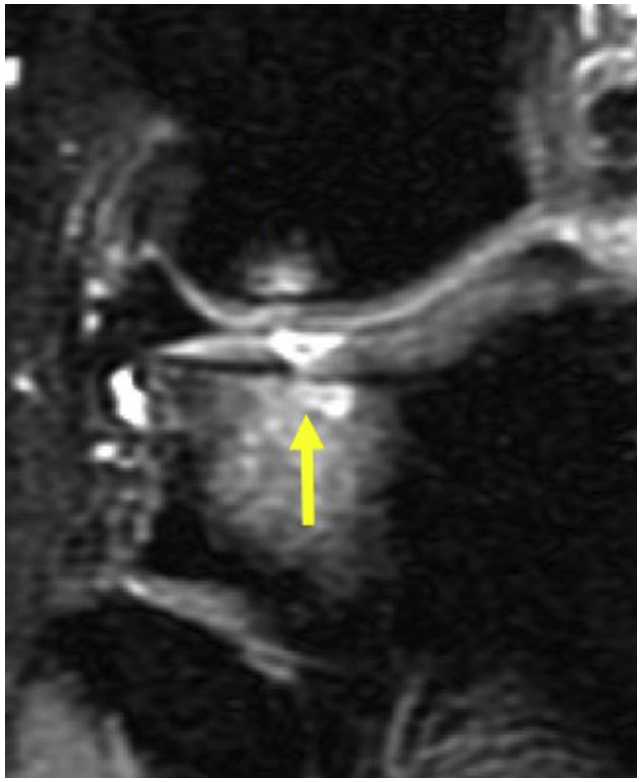

Fig 6. Magnetic resonance image of tibial plateau 11 months after microfracture confirms subchondral lucency (arrow) caused by subchondral cyst formation. (Courtesy of Carl S. Winalski, M.D.)

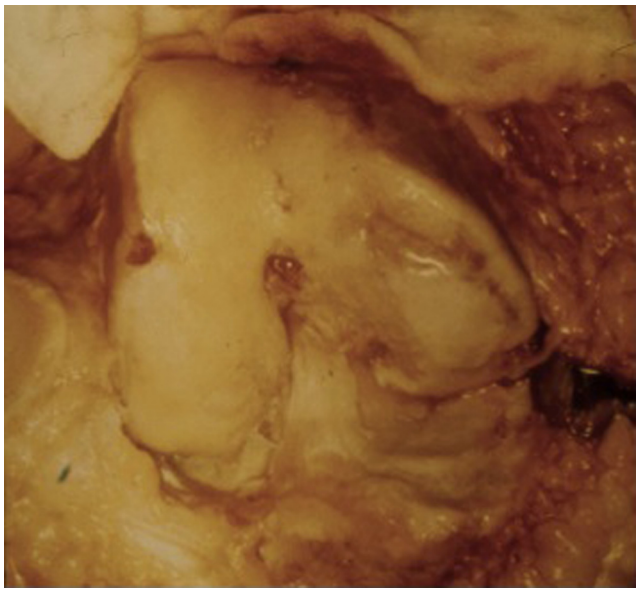

Fig 7. Arthrotomy of right knee at time of total knee arthroplasty 10 years after proximal tibial osteotomy, with fibrocartilage formation on 90% of medial femoral condyle. (Courtesy of Mark B. Coventry, M.D.)

future surgical intervention. Prospective comparative trials must be performed before marrow stimulation should be considered the "procedure of choice" for focal lesions of the femoral condyle or tibial plateau. There is simply no justification in the literature to support the use of marrow stimulation procedures, especially MF, at this time.

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