

# Preliminary Result of Percutaneous Screw Fixation for Bone Bruise of the Tibial Plateau

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**Abstract:** This study reports the preliminary results of surgical treatment of bone bruise of the tibial plateau. Twelve patients underwent percutaneous screw fixation with a mean follow-up of 15 months. The mean duration of surgery was 15 minutes. Preoperatively, 1 week postoperatively, 1 month postoperatively, 6 months postoperatively, and 12 months postoperatively, the mean visual analog scale scores were 7.3, 2.6, 1.2, 0.6, and 0.5, respectively. The mean Hospital for Special Surgery scores were 56, 78, 89, 95, and 98, respectively. In selective patients with bone bruise, the percutaneous screw fixation is feasible to resolve pain and prevent compression of the articular surface. [*Orthopedics*. 2015; 38(12):747-750.]

**B**one bruises, one of the most common reasons for pain and function loss in the knee, can be caused by different mechanisms and represent a spectrum of occult bone lesions.<sup>1,2</sup> The typical magnetic

resonance imaging findings include low signal intensity in the subchondral bone marrow on T1-weighted images and high signal intensity of these lesions on T2-weighted, proton density-weighted, fat-suppressed

fast spin echo images.<sup>3,4</sup> These lesions can be isolated, but are usually associated with other soft tissue injuries of the knee.

The conventional treatment for these bone bruises includes limited activity and symptomatic treatment. The small bone bruises caused by low-energy trauma usually regress within a short period. However, in bone bruises caused by high-energy trauma, healing may take several months, even years. These massive bone bruises involving the subchondral bone have the risk of associated osteochondral sequelae.<sup>5</sup>

To the authors' knowledge, there have been no reports about the specific surgical treatment of these bone bruises. The aim of this study was to evaluate the feasibility and results of percutaneous screw fixation in bone bruises of the tibial plateau.

## MATERIALS AND METHODS

Inclusion criteria for this study were skeletal maturity,

an acute injury, a bone marrow lesion involving more than one-third of the tibial plateau in the coronal plane on magnetic resonance imaging, and local pain exacerbated by weight-bearing standing with a visual analog scale (VAS) score of 7 or greater. Radiographically confirmed fractures, rheumatoid arthritis, severe osteoarthritis of the knee, and severe injuries of the cruciate ligament, meniscus, and collateral ligament that required surgical intervention were excluded from this study.

Between January 2011 and May 2013, twelve patients were enrolled in this study. There were 9 men and 3 women, with a mean age of 46 years (range, 38-61 years). The right knee was involved in 7 cases and the left in 5. Ten bone bruises were located at the lateral tibial plateau. Two bone bruises were located at the medial tibial plateau. According to Lynch's classification of bone bruises, type

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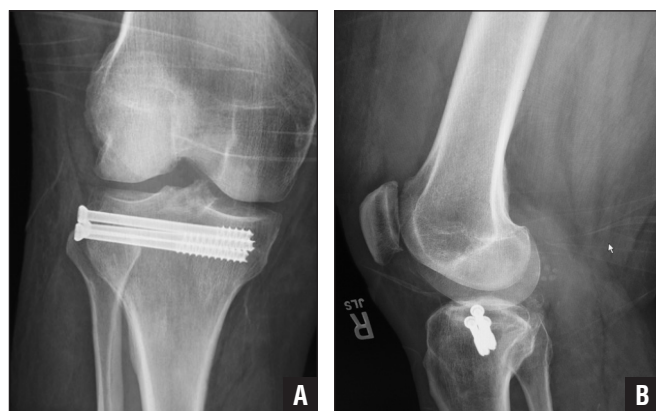
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**Figure 1:** Preoperative posteroanterior (A) and lateral (B) radiographs showing a normal knee.



**Figure 3:** Postoperative posteroanterior (A) and lateral (B) radiographs showing the screws in the tibial plateau.

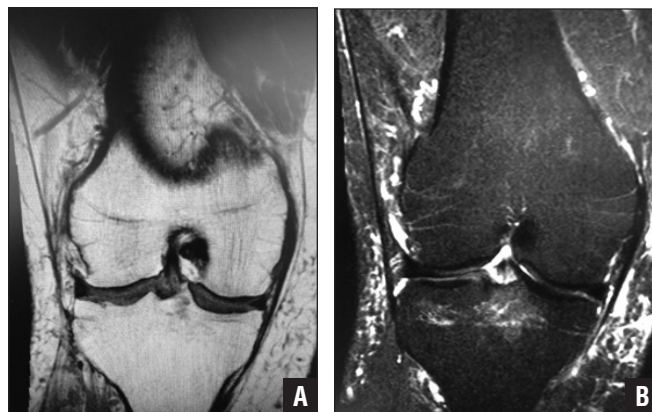
1 bone bruises do not have a cortical disruption and type 2 bone bruises have an associated cortical disruption.<sup>6</sup> All patients in this study had type 1 bone bruises. The mechanism of injury included a twisting in 8 patients and a fall from a height in 4 patients. Three patients had a stretch injury of the anterior cruciate ligament. Two patients had Grade I meniscus injuries. The mean time from injury to operation was 2 days (range, 1-4 days).

### SURGICAL TECHNIQUE

One senior orthopedic surgeon (N.A.E.) treated these

patients. The patients were placed in the supine position on a radiolucent table under general or spinal anesthesia.

The approach was dependent on the location of the bone marrow lesion. A lateral approach was used if the bone marrow lesion was located close to the lateral tibial plateau. A medial approach was used when the lesion was located close to the medial tibial plateau. Under fluoroscopy, 3 K-wires were inserted percutaneously and advanced until their tips were against the opposite bone cortex. The position and configuration of the



**Figure 2:** Preoperative coronal view showing the bone marrow lesion within the tibial plateau with decreased signal intensity on T1-weighted image (A) and with increased signal intensity on short tau inversion recovery sequence image (B).

K-wires were within 10 to 20 mm under the tibial articular surface (**Figures 1-3**). After depth gauge, the cannulated screws with appropriate length were inserted. The position and orientation of the screws were checked with fluoroscopy.

Patients were examined in the clinic every 4 weeks during the first 6 months and every 3 months thereafter. At each follow-up, the relief of pain and recovery of function were documented.

### RESULTS

The patients were followed for a mean of 15 months (range, 12-18 months). The mean duration of surgery was 15 minutes (range, 10-30 minutes). No analgesics were used in preoperative and postoperative procedures.

Before surgery, the mean VAS score was 7.3 (range, 7-10). The mean Hospital for Special Surgery score was 56 (range, 40-82).

After surgery, the patients were instructed to practice full range of motion exercises without weight bearing for

1 week. At 1 week postoperatively, the mean VAS score was 2.6 (range, 1-4). The mean Hospital for Special Surgery score was 78 (range, 66-85).

During the following 3 weeks, the patients were allowed to do the rehabilitation exercises with limited weight bearing. At 4 weeks postoperatively, the mean VAS score was 1.2 (range, 0-2). The mean Hospital for Special Surgery score was 89 (range, 80-95).

Four weeks after surgery, the patients were allowed to walk with full weight bearing. At 6 months and 12 months postoperatively, the mean VAS scores were 0.6 (range, 0-1) and 0.5 (range, 0-1), respectively. The mean Hospital for Special Surgery scores were 95 (range, 90-100) and 98 (range, 95-100), respectively. All patients were satisfied with their outcome and returned to their previous level of activity. There was no poor wound healing or infection.

### DISCUSSION

Bone bruises indicate the traumatic origin of bone

marrow lesions.<sup>1</sup> Biopsy specimens from the articular cartilage overlying the bone bruise lesions showed the death of chondrocytes, alteration of the mechanical properties of cartilage explants, and/or an increase in the thickness of subchondral bone. These data are indicative of a significant injury to normal articular cartilage homeostasis, and support the suggestion that severe bone bruise is a precursor of early degenerative changes.

The currently used treatment for these bone bruises is delaying return to full weight bearing status to prevent further collapse of subchondral bone and further aggravation of articular cartilage injury.<sup>7</sup> However, in terms of the natural history of bone bruises, it has been reported that such lesions resolve within a period ranging from 6 to 12 weeks to 12 to 14 weeks, and even to 24 months.<sup>8-10</sup> In a study to examine the effects of bone bruises by Thompson et al,<sup>11</sup> it was reported that there were partial-thickness clefts in the cartilage surface and fractures across the interface of the zone of calcified cartilage and bone at the early time intervals. At 6 months, the partial-thickness clefts progressed to full-thickness clefts, cartilage fibrillation, cloning, and loss of matrix proteoglycan staining.<sup>11</sup> Boks et al<sup>12</sup> found that the median healing time of bone bruises is 42.1 weeks. Prognosis is particularly influenced by the presence of osteoarthritis.<sup>12</sup>

According to the results found in these studies, the abnormality in the bone bruises

could exist for a long time and even become worse. The process to full recovery requires a long time. Therefore, the currently suggested delay of full weight bearing for 4 to 6 weeks may not be long enough for the full recovery of the subchondral bone. Without enough subchondral support, there is a high risk of secondary collapse of the articular surface.

In the current study, the cannulated screws were percutaneously inserted in the bone marrow lesion under the articular surface. The aim of the surgery was to support the articular surface and resolve the pain. Although the surgery was limited to bone marrow lesions involving more than one-third of the tibial plateau in the coronal plane with local pain exacerbated by weight-bearing standing with a VAS score of 7 or greater, it may still be considered aggressive for bone bruises. This is because these bone marrow lesions being benign and resolving on follow-up magnetic resonance images had been postulated.<sup>13</sup> However, according to Rosen et al,<sup>14</sup> evidence of subchondral sclerosis, cartilage thinning, cartilage loss, osteochondral defects, and cortical impaction had been observed even when the bone bruise resolved.

After the percutaneous screw fixation, all patients in the current study reported pain relief (VAS score decreased from 7.3 preoperatively to 2.6 postoperatively) within 1 week, and started to walk with full weight bearing from the fifth week postoperatively. All

patients had full recovery of function with mean Hospital for Special Surgery scores of 89 at 4 weeks postoperatively and 95 at 6 months postoperatively, without collapse of the articular surface at the final follow-up.

The clinical symptoms of bone bruises are similar to those in meniscal or other intra-articular injury. The traumatic events resulting in bone bruise and/or intra-articular injury are also similar. Therefore, it is crucial to differentiate the bone bruise from the intra-articular pathology by performing arthroscopy in patients with internal derangement of the knee.<sup>15-17</sup> In the report by Jelic and Masulovic,<sup>18</sup> bone bruise was associated with the lesion of the anterior cruciate ligament in 69% of patients. In 72% of patients, bone bruise was in combination with the lesion of menisci.<sup>18</sup> In the current study, the rate of associated anterior cruciate ligament injury was 25% (3 of 12). The rate of associated meniscal injury was 17% (2 of 12). These rates were lower than those reported in the literature. The reason could be because the patients with severe injury of the cruciate, meniscus, and collateral ligament were not included in this study.

There are some limitations of this retrospective study. A small quantity of patients were involved. In addition, the period of follow-up was not long.

## CONCLUSION

The percutaneous screw fixation, which alters the nat-

ural course of bone bruises, presented the feasibility of fast pain relief and prevention of progression to osteoarthritis. However, this surgery is still controversial. Larger randomized controlled studies are needed to confirm the definitive result of screw fixation in bone bruises.

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