Fixation of Traumatic Chondral-Only Fragments of the Knee in Pediatric and Adolescent Athletes

Peter D. Fabricant, MD, MPH; Yi-Meng Yen, MD, PhD; Dennis E. Kramer, MD; Mininder S. Kocher, MD, MPH; Lyle J. Micheli, MD; Benton E. Heyworth, MD
Investigation Performed in the Division of Sports Medicine, Department of Orthopaedics, Boston Children’s Hospital, Boston, Massachusetts, USA

OBJECTIVES

While bone-to-bone healing may occur even in the intraarticular setting, traditional biological principles suggest that fragments consisting of cartilage alone cannot achieve successfully reconnected to bone, due to poor healing potential. Despite this, a thorough case report and a few follow-up MRIs have demonstrated successful fixation of a chondral-only fragment, and some controversy remains. This concept has been incompletely explored. There is currently a paucity of data to guide the orthopaedic surgeon who faces the scenario of an intraarticular cartilage-only fragment in the setting of acute knee injury.

The purpose of the current study was to evaluate the presenting features, techniques, healing rates, clinical course, and radiological results in a cohort of youth athletes who underwent fixation of chondral-only fragments. The study hypothesis was that this retrospective investigation would demonstrate relative safety and feasibility of chondral-only fragment fixation, such that prospective assessment of the long-term implications on preservation of function and joint health should be pursued on a larger scale.

METHODS

An IRB-approved tertiary care children’s hospital registry was reviewed to identify patients ≤18 years old who underwent fixation of a ‘chondral-only’ fragment in the knee, defined as the inability to visualize the fragment on injury radiographs or discern bone on the fragment intraoperatively. Mechanisms of injury, fragment features, fixation technique, and post-operative clinical course, including timing of sports clearance, healing on postoperative magnetic resonance imaging (MRI), and any complications or re-operations, were assessed.

RESULTS

Ten patients with median age at the time of surgery 12.5 years old (IQR:11.7-13.3), and median follow-up was 12 months (IQR:6-22 months) were included. All patients sustained an acute knee injury prior to surgery, including patellofemoral instability events (N=6), fall onto flexed knee (N=2), and hyperextension (N=2). Injury sites were trochlea (N=4), patella (N=3), and lateral femoral condyle (N=3). Median fragment size was 484mm^2 (IQR:400-600mm^2). Arthroscopy, with or without preceding arthroscopy, was performed in all cases, which were performed at a median of 1.3 weeks (IQR:1.0-2.0 weeks) post-injury. Fixation implants included bioabsorbable tacks alone (N=7), bioabsorbable screw and suture (N=1), bioabsorbable screw and tacks (N=1), absorbable suture alone (N=1). One patient (10%) sustained a reinjury 8 weeks postoperatively, requiring secondary surgery for fragment excision, and one (10%) underwent patellar stabilization surgery 3.4 years post-operatively, at which time the fragment was found to be stable. Postoperative MRI to assess the fragment was performed in 6/10 subjects at a median of 1.0 years postoperatively, with 3(50%) showing restoration of cartilage contour and subchondral edema resolution. 1/6 showed thinning of cartilage with an intact, healed interface between the fragment and donor site. 2/6 showed thickening, and 1/6 had subchondral edema, fissuring, and cystic changes. Median time to return to sports was 25.9 weeks (IQR:24.1-24.8 weeks).

DISCUSSION

Nakamura et al. presented a case report of successful healing of a chondral fragment to bone in an 11 year old. Histology at the time of index surgery revealed viable chondrocytes and the absence of bone in the fragment which was fixed to the trochlea using four bioabsorbable pins. Second look arthroscopy and biopsy at the center of the lesion 6 months later revealed normal deep and superficial cartilage zone microarchitecture with restoration of the osteochondral junction. MRI 33 months after fragment fixation showed complete lesion healing, and the patient demonstrated full range of motion, no swelling, and full symptom-free activity.

In adults, the tidemark represents a well-defined cartilage-bone junction which may serve as a weak point, resulting in more chondral-only injuries after a shearing mechanism in adults. Conversely, in the growing skeleton, a secondary physis deep to the tidemark surrounds the secondary ossification centers in the knee. Because physical tissue represents a known weak point in the growing knee, a ‘chondral-only’ shear injury of the knee in a skeletally immature patient may be more likely to contain some osseous tissue, which may partially explain the high clinical healing rates noted in this study.

Our results are comparable to a recent multicenter cohort study that investigated the fixation of osteochondral fragments of the patella and lateral condyle/trochlear region in pediatric and adolescent patients. Fourteen patients of mean age 12.9 years were studied who underwent fixation of osteochondral fragments an average of 5.2 days after injury using a variety of absorbable and metal implants. No patient was revised for fixation failure, and 3 patients (21%) underwent secondary surgery for patellar stabilization at a mean follow-up of 30 months. The clinical outcomes of the current study are similar despite the lack of macroscopic amounts of bone on all fracture fragments.

REFERENCES
