

Hybrid Treatment of Osteochondral Fracture of the Patella With Particulated Juvenile Cartilage and Fragment Fixation



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Abstract: Acute patellar dislocation can result in osteochondral fracture of the patella, resulting in multiple osteochondral fragments, with only one fragment able to be fixated into the defect effectively. In these cases, we propose a hybrid procedure to repair the defect using the fixation of one of the osteochondral fragments and particulated juvenile articular cartilage to fill the remaining defect in the patella. This technique maximizes the amount of native articular surface that we can preserve on the patella. The use of fragment fixation in combination with particulated juvenile articular cartilage will help prevent further articular damage to the patella and reduce the risk of developing osteoarthritis in patients suffering from an osteochondral fracture as a result of acute patellar dislocation.

Patellar dislocation is a common injury in the pediatric and young adult patient population and may be associated with osteochondral and ligament injuries. Patellar dislocations and chronic instability can lead to acute injuries such as osteochondral fractures of the patella and femoral condyle and cartilage-only injuries.^{1,2} Adolescents are at the greatest risk for osteochondral fracture because the articular cartilage is incompletely formed.³ The osteochondral fracture can be successfully treated by fixating the fragment back to the donor site if it is large enough or treating the defect with other cartilage restoration procedures.⁴ Cartilage restoration has been extensively described with procedures such as microfracture, autologous chondrocyte implantation, matrix-induced autologous chondrocyte

implantation, particulate cartilage grafts, and osteochondral grafts.⁵ Selection of the appropriate cartilage-restoration procedure is dependent on the patient's age, the severity of the chondral defect, osteochondral lesion size, history of previous failed surgical interventions, and available implants or allograft tissue.⁶⁻⁸

A patient who sustains an acute dislocation may have an osteochondral fracture amenable to fixation of the fragment, which may not completely restore the entire articular cartilage surface. Inadequate articular surface repair may result from only partial repair either due to fragmentation of the loose body or from the degradation of the fragment over time.⁹ Despite this, partial repair can allow the defect to go from uncontained to contained and leave a smaller residual defect.¹⁰

To prevent further dislocations and additional osteochondral fractures, the patient's patella instability needs to be addressed during cartilage repair. Patients who undergo combined tibial tubercle osteotomy and medial patellofemoral ligament (MPFL) or isolated MPFL reconstruction show reduced frequency of patellar instability.¹¹

We suggest that some patients who sustain an acute patellar dislocation and an osteochondral fracture may benefit from a hybrid procedure involving fragment fixation and concomitant particulated juvenile articular cartilage (PJAC) reconstruction to treat the remaining articular defect. After the osteochondral fragment is fixated to the defect, the juvenile cartilage allograft fills the residual articular defect. Upon successfully repairing the articular defect, MPFL reconstruction or a combined

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tibial tubercle osteotomy with MPFL reconstruction will be performed to treat the patient's chronic patellar instability.

Surgical Technique (With Video Illustration)

The patient is placed in the supine position, the knee in full extension, and with a tourniquet applied throughout the procedure. An inferolateral arthroscopic portal is made, followed by an inferomedial instrument portal under direct visualization. Diagnostic arthroscopy is performed to identify and excise the loose bodies as well as to visualize and measure the chondral defect on the patella and or the lateral femoral condyle (Figs 1 and 2).

Attention is then turned to the arthrotomy. The limb is exsanguinated with an elastic Esmarch. A lateral parapatellar approach is used to identify the soft-tissue interval between the capsule, the retinaculum, and the iliotibial band fascia. The arthrotomy is then completed far laterally for later repair or lateral lengthening. On the medial side of the patella, through the same incision, the layer is found between capsule and retinaculum to tunnel the MPFL; electrocautery is used to remove the soft tissue from the superior 50% of the patella (Video 1). Two Q-FIX anchors (Smith & Nephew, Andover, MA) are inserted 6 to 8 mm apart just proximal to the midpoint of the patella, and then the hamstring allograft is sutured down to the suture anchors (Fig 3).

The base of the chondral defect of the patellar is sharply debrided with both a scalpel and curette. The loose body's bony surface is also sharply debrided and sculpted to fit into the inferior aspect of the patellar defect (Video 1). The osteochondral fragment is reduced and stably fixed with 2 SmartNails (ConMed, Largo, FL) (Figs 4 and 5). One packet of DeNovo PJAC (Zimmer Biomet, Warsaw, IN) is prepared using a foil mold of the defect and then glued into the proximal defect with fibrin glue (Fig 6).



Fig 1. This is an arthroscopic image viewed through an inferolateral portal of a right knee in full extension. The image shows an osteochondral defect located on the medial patellar facet.

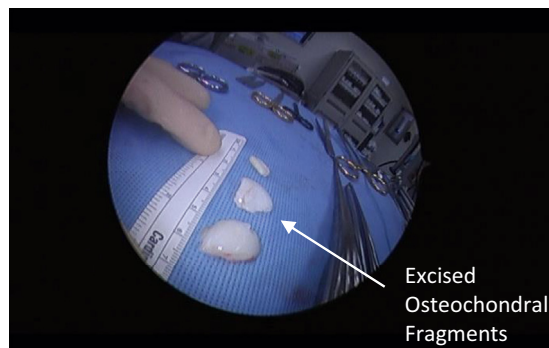


Fig 2. Three excised loose bodies are shown on the sterile table of the operating room. These osteochondral fragments were a result of osteochondral fracture due to acute patellar dislocation. The fragments are shown next to a ruler for scaling purposes.

The MPFL is then fixed to the femur in 30° of flexion with a PEEK (polyether ether ketone) tenodesis screw (Arthrex, Naples, FL). Upon completing the patella realignment, the patient's range of motion, extension endpoint, and articular surface reconstruction are evaluated. Before closing the arthrotomy, the arthroscope is used to confirm the graft position and stability. Wounds are closed in layers in a routine fashion.

The patient is placed in a hinged knee orthosis, locked in full extension, and taken to the recovery room. Patients are instructed to be non-weight-bearing with the brace locked in full extension while ambulating for the first 4 weeks postsurgery if an osteotomy is performed. Physical therapy, including passive and active range of motion and isometric strengthening, should begin one week after surgery. The patient should focus on regaining 0 to 90° of motion by the first 2 to 3 weeks. The patient is advised to begin

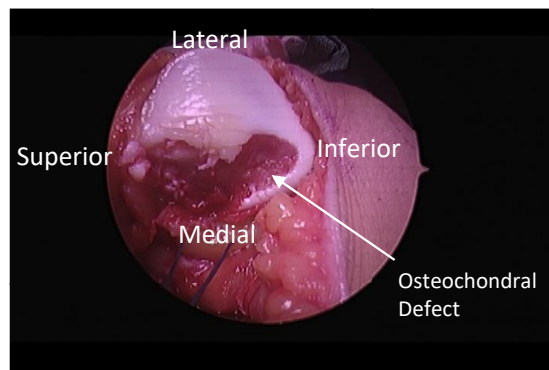


Fig 3. This image shows an everted patella through a lateral parapatellar incision of a right knee in full extension. There is a medial patellar facet osteochondral defect measuring approximately 2 cm by 1.5 cm. The Q-FIX anchors are also shown proximal to the midpoint of the patella, which are used to secure the hamstring allograft for MPFL reconstruction. (MPFL, medial patellofemoral ligament.)

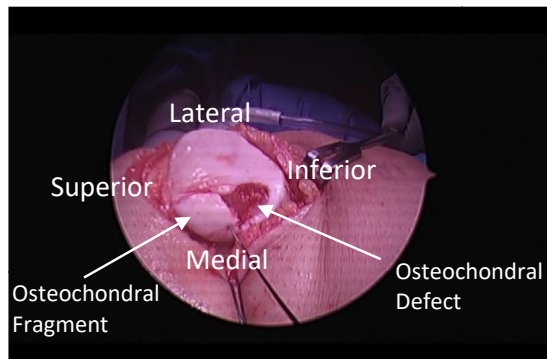


Fig 4. This image shows an everted patella through a lateral parapatellar incision of a right knee in full extension. Three osteochondral fragments were excised from this patient and only one was sufficient for fixation into the defect. This image shows fixation of the suitable osteochondral fragment in the superior aspect of the osteochondral defect in the medial patellar facet.

weight-bearing as tolerated after four weeks with their knee brace locked in full extension. After 6 weeks, the patient is full weight-bearing, only using the brace when needed.

Discussion

Osteochondral fractures of the patella secondary to acute patella dislocation should be treated surgically to address loose bodies and osteochondral defects leading to post-traumatic osteoarthritis. We outline a novel technique that repairs the osteochondral fragment to the defect and uses PJAC to reconstruct the remaining articular defects, as the fragment, in some cases, will not fill the articular gap in its entirety. Using our hybrid technique will promote the restoration of a homogenous articular cartilage surface. In contrast, isolated fixation of the available osteochondral fragment may leave a significant residual defect, and

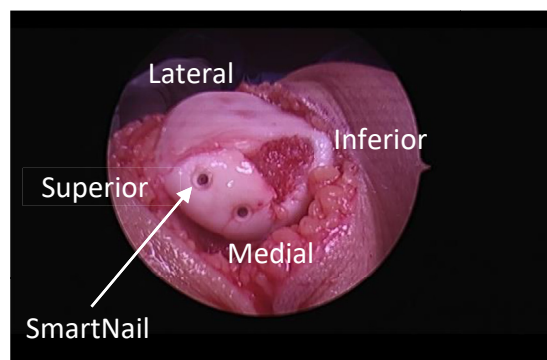


Fig 5. This image shows an everted patella through a lateral parapatellar incision of a right knee in full extension. 2 SmartNails are shown through the chondral surface of the osteochondral fragment into the superior aspect of the osteochondral defect in the medial patellar facet.

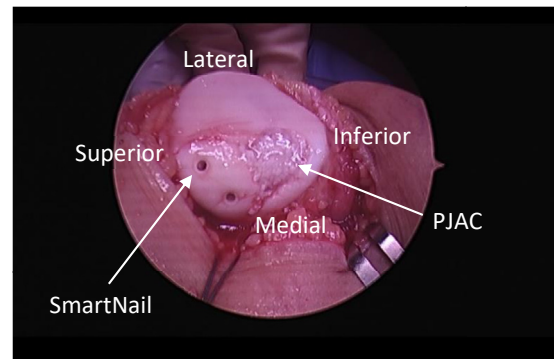


Fig 6. This image shows an everted patella through a lateral parapatellar incision of a right knee in full extension. Particulate juvenile articular cartilage (PJAC) is shown filling the remaining osteochondral defect inferior to the fixated osteochondral fragment on the medial patellar facet.

failure to fix part of the defect may leave an uncontained defect.

Alternative reduction and fixation techniques also have been described to treat osteochondral fractures effectively. Ng et al.¹² describe a crossing suture technique to stabilize the intra-articular osteochondral fragments to the patella. The reduction and fixation technique uses a suture repair performed with four drill holes placed at the defect's borders perpendicular to the anteroposterior surface of the patella. Sutures are passed through these drill holes, creating 4 suture loops, 2 diagonal to and the other 2 parallel to the osteochondral fragment. The fragment is then reduced to the patella and secured by tying the four suture loops. Nuelle et al.¹³ describe a similar method for fixation of the osteochondral fragment using bioabsorbable screws. The main difference in this technique and the technique described in this Technical Note is the addition of microfracture in the osteochondral defect. A literature search reveals a paucity of reports comparing the efficacy of biodegradable screws or tacks and the cross-suture method of osteochondral fragment repair to the patella. Studies have shown that both fixation methods are effective in restoring articular cartilage after an osteochondral fracture. Schlechter et al.¹⁴ reviewed 38 adolescent patients who underwent fixation of osteochondral lesions due to osteochondral fracture or osteochondritis dissecans. The osteochondral lesions were fixed using bioabsorbable screws. At a minimum of 2-year follow-up, the authors identified 32 patients with good functional outcomes, none requiring a revision cartilage procedure.¹⁴ Malecki et al. analyzed a group of 17 patients who suffered an osteochondral fracture of the patella following dislocation.⁴ This group was treated surgically using a transpatellar suture technique to fixate the osteochondral fragment.⁴ After clinical and magnetic resonance imaging follow-up, the patients were found to have restored patellar articular

Table 1. Pearls and Pitfalls of the Hybrid Procedure Including Fixation of an Osteochondral Fragment and Use of Particulated Juvenile Cartilage for the Treatment of Osteochondral Fracture of the Patella

Pearls	Pitfalls
<ul style="list-style-type: none"> • Use a curette to debride the base of cartilage defect and the hematoma/fibrinous tissue on the bony side of the osteochondral fragment. • Use a small k-wire to hold the fragment in place before securing the fragment with an absorbable tack. • Place the tack in the central aspect of fragment to minimize the risk of fragmentation. • Avoid debridement of adjacent fat pad in order to protect particulated cartilage graft if the lesion is uncontained. 	<ul style="list-style-type: none"> • If the fragment moves during placement of the absorbable tack, it is difficult to locate the drill hole on far cortex. • If eversion of the patella is insufficient, reduction of the fragment will be difficult. • The patient may develop arthrofibrosis, use a continuous passive motion device immediately.

Table 2. Advantages and Disadvantages of Using the Hybrid Procedure Including Fixation of the Osteochondral Fragment and Particulated Juvenile Cartilage to Treat Osteochondral Fracture of the Patella

Advantages	Disadvantages
<ul style="list-style-type: none"> • This technique can turn an uncontained defect into a contained defect • Hybrid technique requires less allograft tissue, thus is cheaper • The surgeon is prepared if loose body cannot be fixated as they have allograft tissue on hand (PJAC) 	<ul style="list-style-type: none"> • PJAC is expensive • PJAC is not available on the shelf at all hospitals and must be ordered in advance • Need to have absorbable tacks on the shelf.

PJAC, particulated juvenile articulate cartilage.

surface.⁴ Therefore, the fixation technique could potentially be at the surgeon's discretion and experience to accomplish the hybrid reconstruction. Whether a bioabsorbable screw or cross suture is used, if the fragment is not sufficient to provide complete patella osteochondral reconstruction, PJAC can fill the remaining chondral defect.

In cases similar to the one described here, alternative cartilage repair techniques should be considered when the osteochondral fragments have broken off into smaller pieces that cannot all reliably be reduced and stabilized. Using both autologous bone grafts and PJAC will allow for the restoration of quality articular cartilage of the patella. Hybrid patellar osteochondral reconstruction will theoretically prevent further chondral damage and reduce the risk of future osteoarthritis, especially in adolescents. Pearls and pitfalls as well as advantages and disadvantages are outlined in Tables 1 and 2, respectively.

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