Crossing Suture Technique for the Osteochondral Fractures Repair of Patella

Wuey Min Ng, M.B.B.S., M.S.Ortho.,
Mohamed Zubair Mohamed Al-Fayyadh, M.B.Ch.B., M.S.Ortho.,
Julius Kho, M.D., F.P.O.A., Teo Seow Hui, M.B.B.S., M.R.C.S., M.S.Ortho., and
Mohamed Razif Bin Mohamed Ali, M.B.B.Ch., B.A.O., M.SportMed.&Rehab.,
F.R.C.S.(Edin.), M.Sc.(SportMed.)

Abstract: Osteochondral fracture of the patella is a common concomitant injury of the knee, especially in lateral patellar instability, and the importance of early stable fixation with minimal complication and early mobilization should be emphasized. Screws and Kirschner wires both absorbable and nonabsorbable have been the common mode of fixation of these fractures. Nevertheless, these fixation techniques require larger osteochondral fragments and are associated with cartilage abrasion, hardware prominence, synovitis, and foreign body reaction. In contrast, suture fixation can adequately stabilize smaller osteochondral fragments without comminution and prevent some of the possible complications of other techniques of fixation. We created 4 holes in a rectangular pattern on the patella oriented perpendicular to its anteroposterior surface. We used readily available, and affordable, no. 2 Ultrabraid sutures inserted into the holes and looped around the osteochondral fragment, compressing it to the patella. The technique is very simple and is relatively easy to learn. It provides secure fixation and allows early mobilization. And it spares the knee from subsequent surgical procedure for removal of metallic implants.

Patella fractures comprise around 1% of all bony injuries. More often, these fractures are either avulsion fractures or complete fractures extending to the anterior cortex of the patella.[1] Kroner first recorded the association of acute dislocation of the patella with osteochondral fractures in 1905. Although once thought to be rare in the setting of acute patellar dislocation, in 2003, Nomura et al.[2] reported that 95% of patellar dislocations occurred with cartilage injuries based on diagnostic arthroscopy. Osteochondral injury of the patella can occur both in traumatic contact and noncontact twisting injuries of the knee. Many patients are unable to recall the events.[3] These acute fractures are more often located on the inferomedial facet of the patella associated with acute lateral patella dislocation when the patella slides back tangentially over the surface of the lateral femoral condyle with the knee in a flexed position.[4] In acute patellar dislocation, the presence of osteochondral fractures is the primary indication for surgical intervention.[5] A large knee effusion usually secondary to lipo-hemarthrosis with tenderness over the medial retinaculum area is present during physical evaluation.[6] These injuries usually are evident in children and adolescents, which emphasize the importance of cartilage preservation.[7] Most fractures are small and located at the patellar attachment of the medial patellofemoral ligament (MPFL). Associated injuries include MPFL tear and bone bruises or impaction injuries to the lateral femoral condyle.[4] More often, these osteochondral fragments end up in the suprapatellar pouch or in either gutters of the knee.[6]

Standard lateral, sunrise, and merchant view and sometimes oblique radiographs are needed to visualize these fragments and fractures. Osteochondral fragments can be difficult to diagnose radiographically because they may only contain small ossified portions.[4] Matelic et al.[8] reported that 36% of children with

From the Department of Orthopaedic Surgery, Faculty of Medicine, University of Malaya (W.M.N., M.Z.M.A-F., T.S.H., M.R.B.M.A.), Kuala Lumpur, Malaysia, and Chong Hua Hospital (J.K.), Cebu City, Cebu, Philippines.

The authors report that they have no conflicts of interest in the authorship and publication of this article.

Received November 1, 2016; accepted March 14, 2017.

Address correspondence to Mohamed Zubair Mohamed Al-Fayyadh, M.B.Ch.B., M.S.Ortho., Department of Orthopaedics Surgery, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia. E-mail: m_alfaiadh@yahoo.com

2212-6287/161067/$36.00
http://dx.doi.org/10.1016/j.eats.2017.03.020

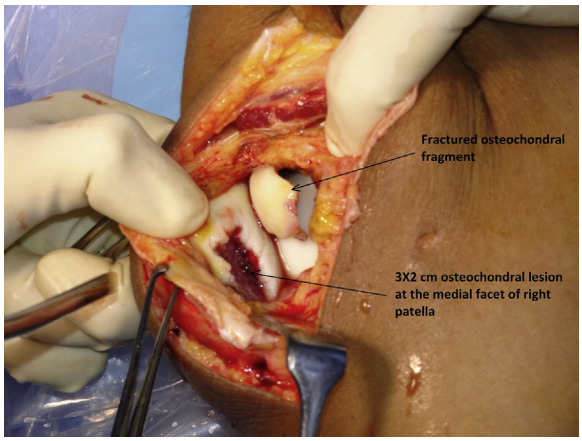

Fig 1. Using a medial arthrotomy incision for the right knee, the patella is flipped laterally. The osteochondral lesion is exposed at the inferior portion of the medial facet of the patella. The fracture's fragment can be seen coming out of the suprapatellar pouch.

osteochondral fractures have negative radiographs. Magnetic resonance imaging or a computed tomographic scan can better reveal loose bodies and better visualize the donor site and loose fragment for operative management, respectively. However, arthroscopy still remains the gold standard for accurate identification and characterization of osteochondral injuries.[6]

These injuries can lead to progressive chondral damage and early-onset arthritis. Small fragments (<5 mm) deemed unsalvageable is removed and the donor site treated with cartilage-resurfacing techniques.[6] Large osteochondral fragments, especially in weight-bearing areas from these acute fractures, should be addressed and fixed surgically.[6] Accurate internal fixation is of tantamount importance for this injury to allow early motion, which also in turn minimizes risks of arthrofibrosis.[4] Over time, these loose fragments swell and chondral degeneration and chondral surface damage occurs, thus emphasizing early surgical removal or repair to restore the anatomy and preserve the chondral surface.[6]

Arthroscopic assessment is initially done prior to appropriate exposure for rigid fixation.[6] Historically, these are fixed with headless screws or bioabsorbable pins. The choice of implant and fixation technique depends on the surgeon's preference and comfort level, including availability of the implant. Headless screws or partially threaded cannulated screws do provide compression fixation but are associated with cartilage abrasions and sometimes hardware prominence and requires later removal.[6] Bioabsorbable pin fixation, though useful for smaller lesions with scant subchondral bone, is costly and associated with implant breakage,[9] synovitis,[10] and foreign body reaction.[9] These prompted the authors to seek alternative forms of fixation. In addition, the advantage of readily available and affordable materials for fixation for such fractures was also considered.

Surgical Technique

The patient is positioned supine with a tourniquet applied. After skin preparation and draping, diagnostic arthroscopy is usually done to assess the magnitude of intra-articular damage. A midline skin incision is made from 5 cm above the superior pole of the patella extended down to the level of tibial tubercle as needed for exposure. Subcutaneous tissue is then superficially dissected to expose the vastus medialis and quadriceps tendon. Medial skin flap is then developed to expose the quadriceps tendon, medial border of the patella, and medial border of the patellar tendon. A medial parapatellar arthrotomy is then performed. The patella is flipped laterally to expose the articular surface to the front. Subsequently, osteochondral fragments are retrieved (Fig 1), blood clots debrided off, and temporarily placed on a sterile wet gauze. The fragments are inspected to assess the size and whether sufficient subchondral bone is attached to them (Fig 2). The chondral surface of the patella is then debrided to stable edges. Excessive debridement is avoided to minimize further bone loss and subsequent depression of the fragments (Table 1). Next, a 2-mm drill bit is used to make 4 holes oriented perpendicular to the anteroposterior surface of the patella in a rectangular pattern across the borders of the osteochondral fracture defect. No. 2 Ultrabraid sutures (Smith & Nephew, Memphis, TN) are passed through the holes using the meniscus MENDER II Repair System (Smith & Nephew) (Fig 3), creating 4 loops with suture ends exiting the anterior cortex of the patella (Fig 4). Two suture loops are fashioned crossing diagonal and the other 2 suture loops are fashioned crossing parallel to

Fig 2. The fractured osteochondral fragment from the medial facet of the patella is shown placed on a side table with a measurement ruler. The articular surface is facing up and the size is measured as 2.5 cm length, 2 cm width, and 1 cm thickness.

Table 1. Clinical Pearls and Pitfalls for the Suture Fixation of the Patella Osteochondral Fracture

Clinical Pearls	Clinical Pitfalls
Fixation must be done within 2 weeks of injury to prevent osteochondral fragment degeneration.	Delayed operation will result in resorption of the fractured fragments. Scaffold-based technique for chondral repair will be a good stand-by procedure.
Position the patient supine; use a rigid support lateral to the thigh and a heel support to position the knee at 90°.	The knee is flexed at 30° from the skin to deep parapatellar medial incision. Adequate exposure is necessary for secured fixation of the fragment.
Perform diagnostic arthroscopy to assess the extent of osteochondral damage and locate and retrieve loose osteochondral fragments.	Patellar instability is a common cause for osteochondral injury of the patella. It should be examined and addressed accordingly.
The fracture bed on the patella and osteochondral fragments are debrided off necrotic tissues for a proper reduction.	Overdebridement is avoided to preserve the bone attached to the fragment.
Avoid using >2-mm drill bits and drill the holes perpendicular to the patella.	The patella can be fractured if larger drill bits are used for drilling holes.
Use 4 suture loops, 2 diagonal and 2 parallel to the osteochondral fractures, to ensure secure fixation.	The fragments can be dislodged with unsecured fixation because of inadequate healing and when the patients resume knee range of movement.
Accurately reduce the osteochondral fragment to the patella.	Inappropriate reduction will result in a prominent chondral surface.
Tension the suture loops just enough to compress the fracture but not to fracture the fragment.	Once in tension, avoid sliding the sutures repeatedly over the osteochondral lesion to avoid abrading the cartilage surface.
Place the knots just on top of the periosteum of the anterior surface of the patella.	Placing the knots on the extensor retinaculum will result in inadequate tensioning of fragments at the fracture site.

each other (Fig 5). The fractured fragment edges are debrided of blood clots and necrotic tissues (Video 1). The fragment is then reduced properly to the patella and fixed with the loops compressing the fragment into the defect on the patella (Fig 5). Care is taken not to abrade the cartilage surface of the fragment by avoiding sliding of the sutures while tensioning. The sutures are then tied tightly and accordingly on the anterior surface of the patella, ensuring perfect reduction and adequate compression. The incision is closed in layers. The concomitant ligament injury such as an MPFL tear should be addressed at the same setting. Herewith, we used the soft tissue loop technique for the ligament reconstruction of the MPFL (Fig 6).[11]

Rehabilitation

After the surgery, a functional brace at 0° to 30° flexion is applied for the first 2 weeks. Partial weight-bearing ambulation assisted by 2 crutches is immediately started. Two weeks postoperatively, the skin sutures are removed. The functional knee brace is

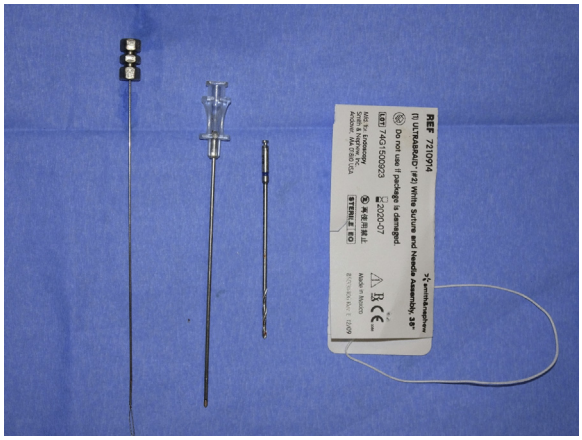

Fig 3. Instruments used for the crossing suture technique to pass the suture through the drill holes of the patella. Left to right: the MENDER II suture passer and its needle (Smith & Nephew); this is used to pass the sutures through the patellar drill holes—the needle will be inserted first through the drill hole and then the suture passer is inserted to retrieve the sutures. No. 2 drill bit, used for drilling the 4 perpendicular holes at each corner of the osteochondral lesion of the patella, and no. 2 Ultrabraid suture (Smith & Nephew), used to perform the crossing suture repair technique.

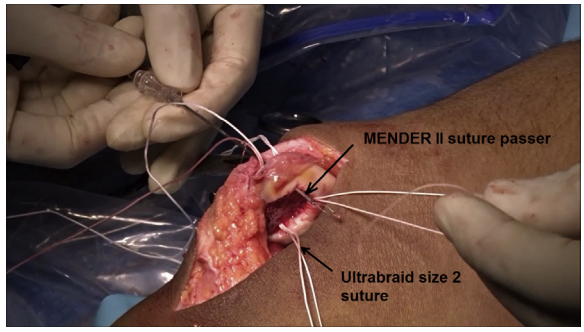

Fig 4. The MENDER II suture passer is used to pass the no. 2 Ultrabraid sutures through the 4 drill holes of the patella at each corner of the lesion. In this right patellar osteochondral defect, 2 sutures are passed through each of the 2 lateral holes, from the anterior aspect of the patella to the articular side. The MENDER II is then inserted from the anterior aspect to the intra-articular surface to retrieve the sutures. The alternate sutures from each hole are joined and passed through the other 2 medial holes from the posterior to the anterior surface of the patella.

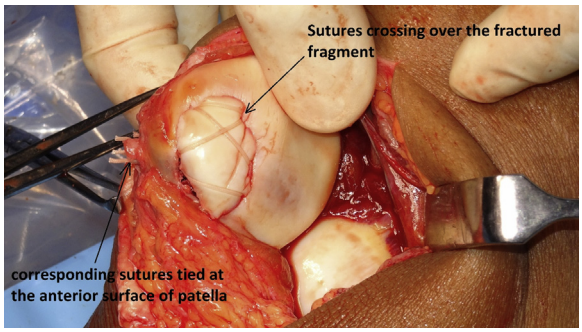

Fig 5. The crossing pattern of the sutures is shown to secure the fractured fragment in position. Two suture loops are fashioned crossing diagonal and 2 suture loops crossing parallel to each other. The sutures are tied tightly on the anterior surface of patella.

adjusted gradually to achieve 90° flexion by 6 weeks and then discontinued.

Discussion

There are several techniques to fix osteochondral fractures of the patella, and the choice of fixation is based largely on surgeon's preference. Some use screws like Acutrak headless screws (Acumed, Hillsboro, OR) designed to fix osteochondral fractures. However, they usually require larger osteochondral fragments and are removed after a few weeks postoperatively to assess healing and to avoid the consequences of fragment collapse, which can lead to prominent hardware. Bioabsorbable screws have been recommended to avoid future implant removal, but the degree of compression they provide and the fact that they remain in situ for a long time before enzymatic breakdown occurs is in question.[12] Bioabsorbable pins or wires may cause foreign body reaction, resulting in aseptic synovitis. Additionally, they provide only minimal compression across the defect junction.

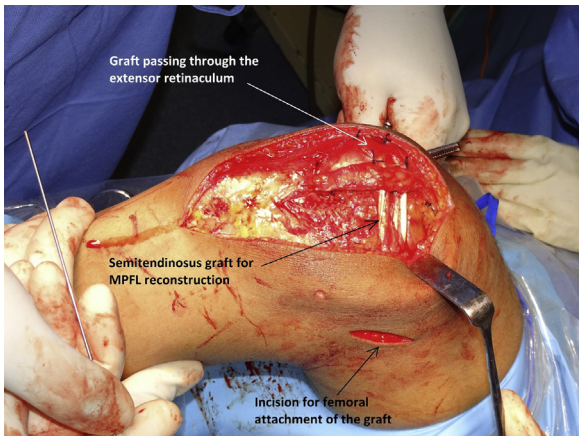

Fig 6. Reconstruction of the medial patellofemoral ligament is performed in the same setting using the ipsilateral semitendinosus graft with the soft tissue loop technique. The graft is passed through the extensor retinaculum forming a loop in the soft tissue. The free ends of the graft are passed through an anatomic isometric bony tunnel at the medial femoral condyle.

There are several advantages of this technique. It is relatively simple and easy to learn. The technique can use high-strength sutures. In this technique, we used Ultrabraid (Smith & Nephew), which is an ultrahigh-molecular-weight polyethylene polymer coated with silicone, which has a low abrasive property.[13] Screw fixation or even the bioabsorbable pin or K-wire fixation needs to have a larger osteochondral fragment with larger bone attached to it to ensure no comminution of the fragment and adequate fixation. Suture fixation does not create holes in the osteochondral fragment and does not need thick bony attachment on the fragment for adequate compression and fixation. We routinely use 4 suture loops, 2 crossing and 2 parallel, on the rectangular pattern holes to achieve a highly secure hold of the osteochondral fragment on compression fixation to the patella. This procedure can be performed simultaneously with MPFL repair or reconstruction. Because the suture material is biocompatible and nonmetallic, there is no need to remove it at a later date. Unlike the bioabsorbable screws and Kirschner wires, Ultrabraid suture is not known to cause irritation and synovitis. Suture fixation ensures adequate compression and secure fixation, allowing patients to have early postoperative range of motion exercises, preventing potential arthrofibrosis and stiffness (Table 2). However, this procedure cannot be done arthroscopically; thus, an open approach is needed.

Suture fixation of osteochondral fractures of the patella is relatively safe, simple, and easy to perform. It avoids potential complications such as chondral abrasions, synovitis, irritation, and osteochondral comminution associated with other techniques of fixation. It may be the only choice of fixation for smaller

Table 2. Advantages and Disadvantages of Crossing Suture Repair Technique for Osteochondral Fractures of the Patella

Advantages
• The technique is simple and relatively easy to learn.
• Sutures for fixation are readily available and affordable.
• Suture fixation does not create holes on the osteochondral fragment, preventing its possible comminution.
• Suture fixation can fix smaller osteochondral fragments even with minimal bone attached to it.
• The osteochondral fragment is fixed with 4 loops in a pattern ensuring secure reduction and fixation.
• The procedure can be done simultaneously with medial patellofemoral ligament reconstruction or repair.
• The technique spares the knee from using metallic implants that need to be removed several weeks postoperation and synthetic materials that can cause irritation and synovitis to the knee.
• The technique provides secure fixation, allowing early postoperative mobilization.
Disadvantages
• The procedure cannot be done arthroscopically and is limited to an open approach.

osteochondral fragments that cannot be fixed by other fixation techniques. High-strength sutures for fixation are readily available and are relatively more affordable than other fixation devices. In addition, the technique enables adequate compression and fixation, ensuring early mobilization.

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