

Technical Note

Modified Arthroscopic Suture Fixation of Displaced Tibial Eminence Fractures Using a Suture Loop Transporter

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Abstract: Current arthroscopic suture fixation techniques of tibial eminence fractures are time consuming and the number of anchor sutures that can be placed is limited by the cumbersome and repetitive numerous needle threading steps. This occurs at 2 stages: first, when placing anchoring sutures through the avulsed anterior cruciate ligament stump with a suture punch, and second, when there is a need to traverse the tibial bone canal with the suture ends. We describe a modification that reduces the reliance on conventional rigid instruments and instead uses a loop transporter made from readily available suture material. The suture loop transporter being malleable reduces the necessary width of the tibial bone canal to be made and has a further advantage of minimizing the bone loss during the reaming of the bone tunnel. The subsequent potential for a stress fracture at these tunnel sites is also substantially reduced. Our technique is more user friendly, more accurate, and quicker to perform. **Key Words:** Arthroscopic—Suture fixation—Fracture—Tibial eminence.

Fracture of the intercondylar eminence of the tibia is well known. It was classified first by Meyers and McKeever.¹ Zariczyj² later added a further group to this classification. Although uncommon, a sufficient number of cases have led to the development of open and arthroscopic surgical treatment techniques.³ Early ideas revolved around conventional open fracture fixation techniques using conventional metal hardware to hold the reduction. Later, the arthroscope enabled even better visualization when performed as a closed procedure. Because this is an intra-articular fracture, there is an increasing tendency away from the use of metal hardware, which often requires a second procedure for removal. The many advantages of using sutures instead have already been described in the liter-

ature⁴⁻⁷ and are of particular value in children.^{8,9} The common limiting factor with suture techniques is the difficulty of passing sutures through the tibial bone canal. Not only is it narrow, but it also usually lies at an obtuse angle to the plane of the working instruments. Although technically possible, it is always this part of the procedure that is the most time consuming. It often prohibits the surgeon from placing more sutures, which is more mechanically sound and which does directly influence later rehabilitation.

We have some experience with the techniques described by Kogan et al.⁷ and Perrez-Carro.¹⁰ Our criticisms of this technique are that it has a major repetitive step that is very tedious. This is the need to thread a large suture punch through a small Hewson-type suture passer intra-articularly and then to subsequently maneuver the suture punch while inside the Hewson suture passer loop and eventually then to bite the avulsed anterior cruciate ligament (ACL) stump. This entails quite a lot of fumbling and can make the placement, especially of the second suture using the suture punch, very difficult. Each and every subsequent suture placement cycle is faced with the same level of difficulty. It prolongs the procedure unneces-

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0749-8063/01/1701-2344\$35.00/0
doi:10.1053/jars.2001.7805

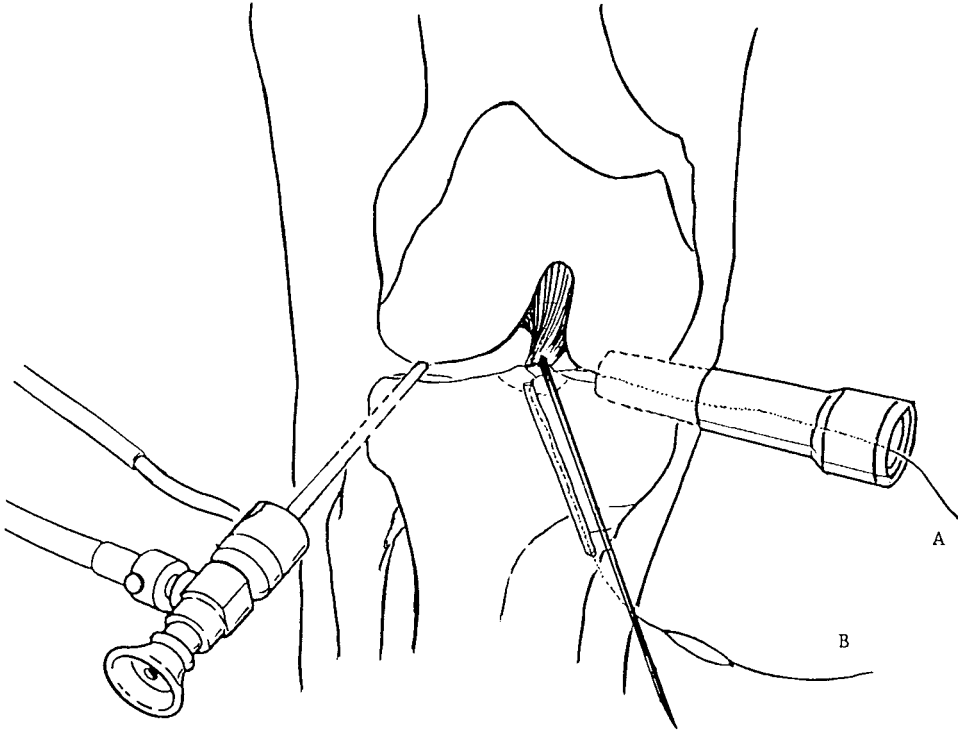


FIGURE 1. Loop transporter made from 2 strands of suture material connected by a loop. A and B represent opposite ends of the loop transporter. The ACL stump reduction is held with a K-wire.

sarily. We describe a technique we have used that is similar at the beginning, but the use of a new suture loop transporter significantly expedites subsequent suture placement cycles and the transport of the sutures

through the tibial bone canal because our suture loop transporter is flexible. A smaller diameter tibial tunnel (2 mm) will suffice. Because this occupies a smaller area, further tibial tunnels can still be placed accu-

FIGURE 2. The loop transporter is carried from portal B through to portal A. A suture punch is about to be threaded through the loop and then into the cannula portal.

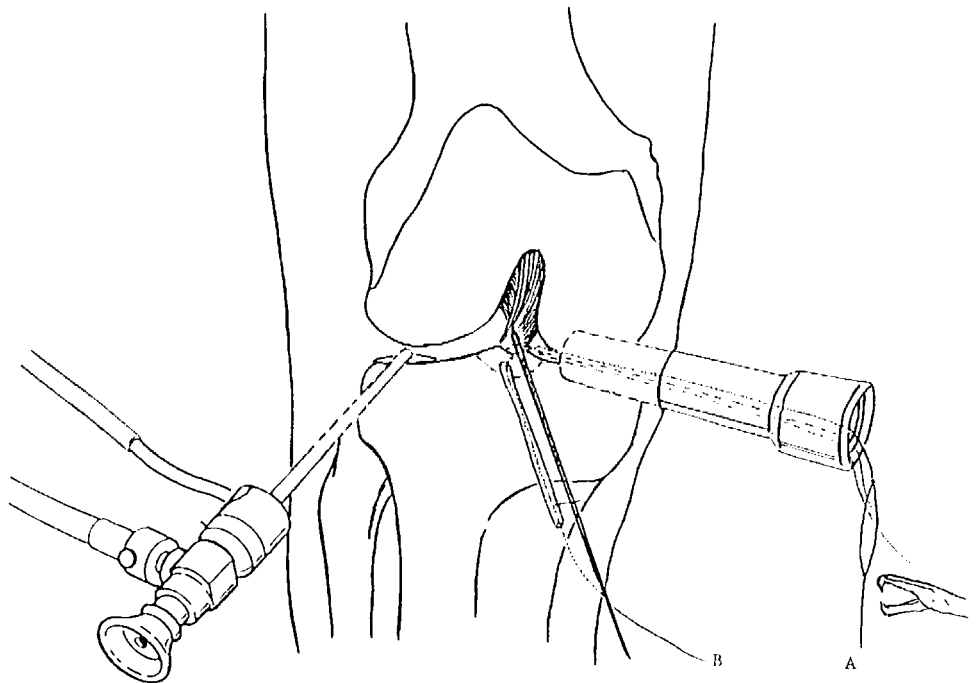


FIGURE 3. The suture punch is being manipulated inside the knee joint while the loop transporter conveniently resides outside the cannula. The 2 ends A and B are allowed to hang freely at this stage.

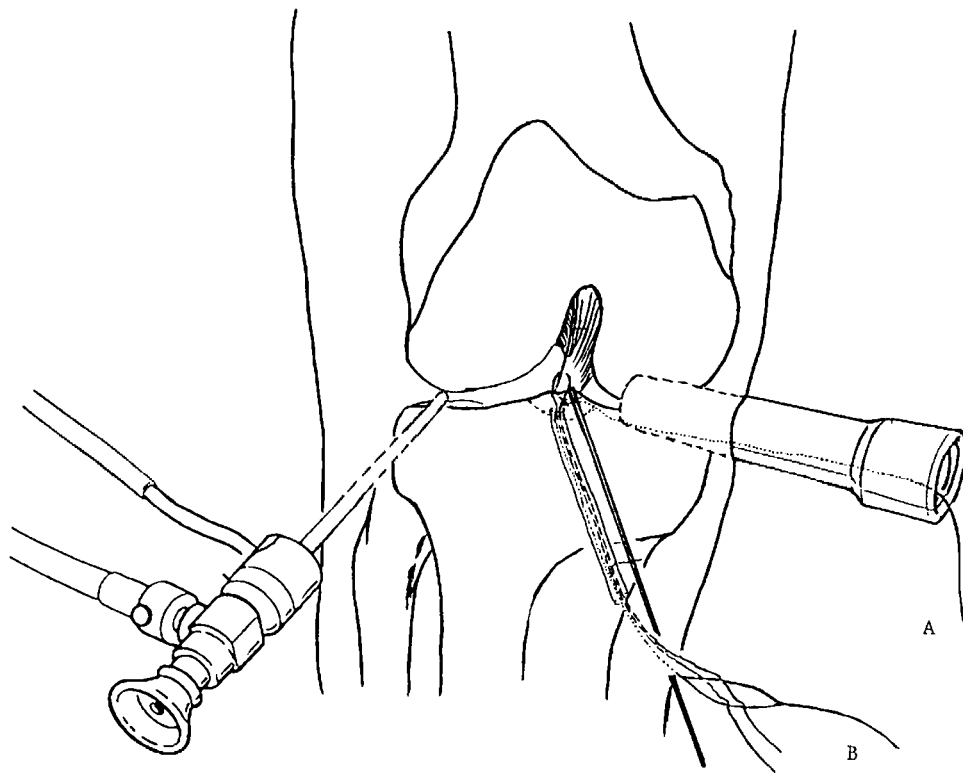
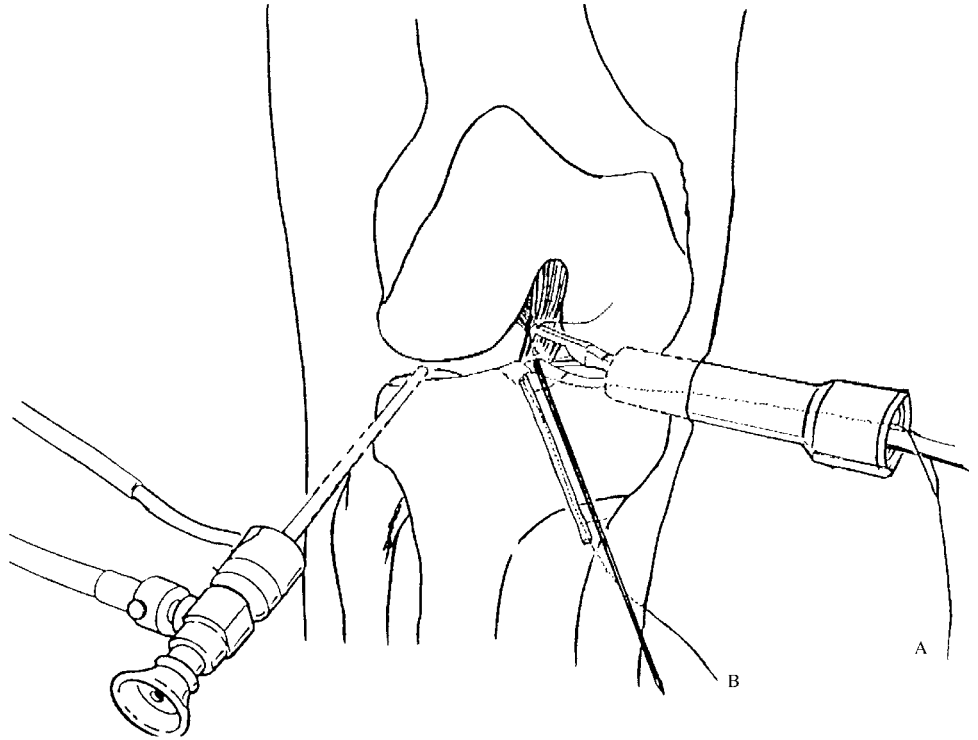


FIGURE 4. The ACL anchor sutures placed by the suture punch are retrieved initially through the cannula and loop transporter. Pulling on the B end of the loop transporter carries the anchor through the knee joint and tibial bone canal to the B portal. A is the loose end at this stage.

rately within the footprint origin of the ACL. It also has the advantage that a smaller core of bone is taken out of the bone. This minimizes the potential effect of a stress riser.

SURGICAL TECHNIQUE

1. The standard anterolateral and anteromedial portals are used. The process of assessing, debriding, and reducing the displaced ACL avulsion fragment is similar to that already described in the literature. A commercial ACL tibial drill guide is used temporarily only to maintain reduction. An optional K-wire can be used to hold the reduction in place. Our technique uniquely requires a tibial drill diameter of only 2 mm. This provides a working tibial bone tunnel.
2. A Hewson suture passer or similar device is passed into the knee cavity via the tibial bone canal.
3. The next step is to place a strong monofilament nonabsorbable suture through the knee from 1 portal, through the tibial bone canal, and out. This is achieved with a suture grasper guiding the monofilament through the Hewson suture passer. Then a small loop approximately 3 cm in diameter is created at 1 end of this monofilament, which is outside the knee, by double looping itself.
4. A second similar suture (preferably of a different color for ease of identification) is tied at the opposite equator of the loop (Fig 1). These 2 sutures with a central connecting loop comprise the new suture loop transporter, which will be used to move the anchoring sutures of the ACL through the knee. It works by applying tension to both ends, which then grips any suture material placed within the loop during the gliding process in and out of the joint (the "suture relay" principle). By its very nature, this device is very flexible and can easily negotiate the abrupt turn when entering the tibial bone canal from within the knee joint. The ends of the loop must be of sufficient length so that when the loop transporter is being loaded outside the knee with suture material the other end does not disappear into the knee. The essence of our modified technique is that a loop can then be pulled from 1 skin portal through the knee and out via another skin portal carrying any suture material with it. Furthermore, it does not restrain the suture punch while it is being maneuvered inside the knee, because the loop itself resides outside the

knee during this stage (Fig 2). This technique involves the Hewson suture passer only once at the beginning and is thus a significant time saver.

5. A suture punch is maneuvered into place—the first reduction-maintaining suture in the avulsed ACL stump. The suture punch is brought out of the knee (cannula portal) along with the 2 end strands, which will automatically be threaded through the loop transporter (Fig 3).
6. As the other end (marked "B" in diagrams) is pulled, the transporting loops close. The anchor suture is gripped and carried through the tibial canal (Fig 4).
7. The anchoring suture is removed from the loop transporter at the other portal and held with artery hemostats. The transport loop is pulled back through the knee back to its original starting position by pulling at the end marked "A."
8. A second anchoring suture is placed with the suture punch and the steps are repeated.



FIGURE 5. Lateral radiograph.

9. The second tibial canal is drilled and the process is repeated with 2 further anchors. We believe a total of 4 suture anchors is sufficient. They are then tied to each other over a bone bridge.

Example Case 1

A 38-year-old active woman had a fall while cycling and sustained a left knee injury. She presented with acute knee swelling and was unable to walk. Physical examination showed acute left knee hemarthrosis and her Lachman test was positive. Plain film radiographs revealed a Meyers and McKeever type III tibial eminence fracture (Figs 5 and 6). She underwent arthroscopic-assisted reduction and suture fixation of the fracture using the method described (Fig 7). She was allowed non-weight-bearing exercise the next day with an ACL-deficient knee brace (Donjoy, Smith & Nephew, Germantown, WI) and elbow crutches. The importance of achieving full extension was emphasized in the early postoperative days, and full flexion was achieved in the following weeks. She was



FIGURE 6. Anteroposterior radiograph.



FIGURE 7. After reduction and suture fixation.

allowed full weight bearing 6 weeks after the operation. Follow-up at 7 months showed an absence of instability symptoms, a complete full range of motion, and negative Lachman and pivot shift signs.

Example Case 2

A 23-year-old active woman tripped and fell while playing basketball. She presented with acute right knee hemarthrosis. On examination, her Lachman test was positive and plain film radiographs showed a type III tibial eminence fracture. Magnetic resonance imaging confirmed the diagnosis and excluded other associated meniscal injury (Fig 8). She underwent arthroscopic-assisted reduction and suture fixation of the fracture using the method described. Postoperative rehabilitation was the same as in case 1. Follow-up at 6 months showed an absence of instability symptoms, a complete range of motion, and negative Lachman and pivot shift signs.



FIGURE 8. Magnetic resonance imaging scan.

DISCUSSION

The essential advantage of our technique compared with that described by Kogan et al.⁷ is that a suture loop transporter is much easier to use than a rigid device like the Hewson suture passer. Because our loop transporter resides outside the knee, most of the needle threading work can also be done outside the knee, which is technically much simpler. This simplifies the actual suture placement into the avulsed ACL stump with a suture punch. The suture is placed more accurately and more quickly without hindrance from a constraining Hewson suture wire loop. As the width of

the bone canal is minimal, more sutures if necessary can be used near to one another while still remaining within the tibial origin of the ACL. In practice, we have only needed to use 4 sutures cross-tied over a bone bridge between the 2 canals. The minimal loss of net bone stock minimizes the potential of a stress fracture near these hollow bone canals. The indications for using this technique are the same as with other suture techniques for type II, III, and IV comminuted avulsion.

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