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Arthroscopic Reduction of Tibial Spine Avulsion using Transosseous Suture Technique Using Banana Laso: Technical Note

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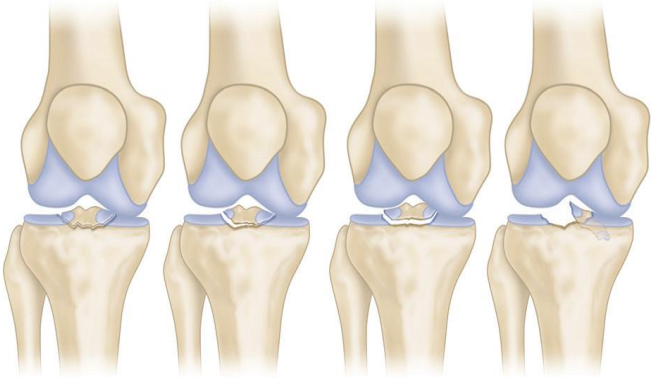
The intra-articular portion of the upper tibial surface, called tibial eminence, consists of two spines: medial and lateral. The anterior cruciate ligamentis attached to the medial spine, whereas lateral spine has no attachment to any other structure.[4] Tibial spine avulsion fractures (intercondylar eminence fractures) are most commonly faced in young patients between 8 and 14 years of age.[1,2] Though such fractures in paediatric patients are rare injuries, they account for 14% of all anterior cruciate ligament (ACL) injuries in the same age group.[3] The mechanism of injury is hyperextension of the knee with simultaneous rotation of the knee on the tibia, as may happen while falling off a bicycle, playing soccer or participating in other forceful sports related activities. Significant tension is put on the ACL, while doing hyperextension of knee.[5] As the ACL originates on the lateral femoral condyle and inserts onto the anterior tibial spine, The forceful hyperextention results in an avulsion fracture of the tibial attachment site and this also leads to weakness in the cruciate ligament. The bone fails before the ligaments as per their elastic property and, hence, these fractures are common in children than in adults. The tibial spine fractures are classified [Meyer and McKeever] into three types: type 1 fracture is undisplaced; type 2 is partially displaced or hinged; and type 3 is completely displaced or inverted and impossible to reduce because of the transverse meniscal ligament preventing seating of the fragment.[6]A type IV is also described by Zaricznyj[7], which represents rotation and comminution of the fragments.



Meyers and McKeever classification of tibial eminence fractures

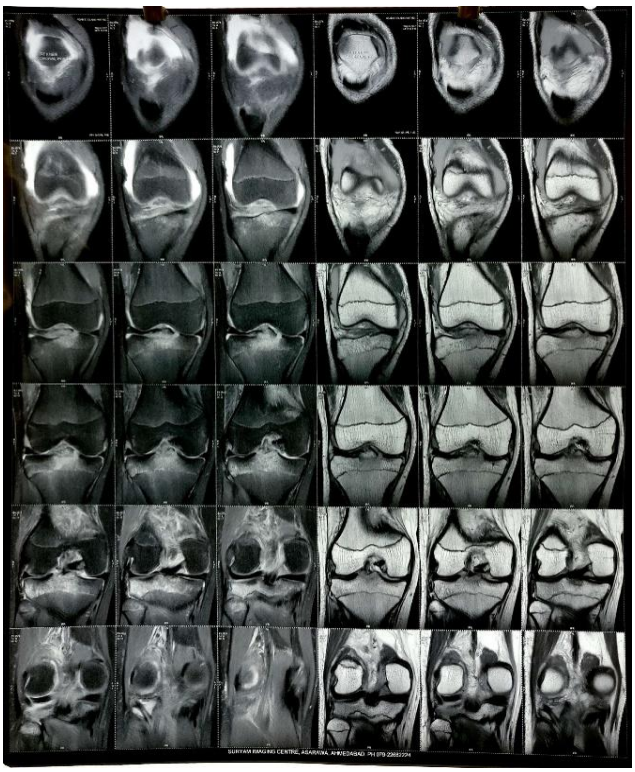
Type 1: little or no displacement;
Type 2: elevated anteriorly and proximally, with some displacement but with a cartilaginous hinge
Type 3, complete displacement (intact fragment)
Type 4: comminuted fragment

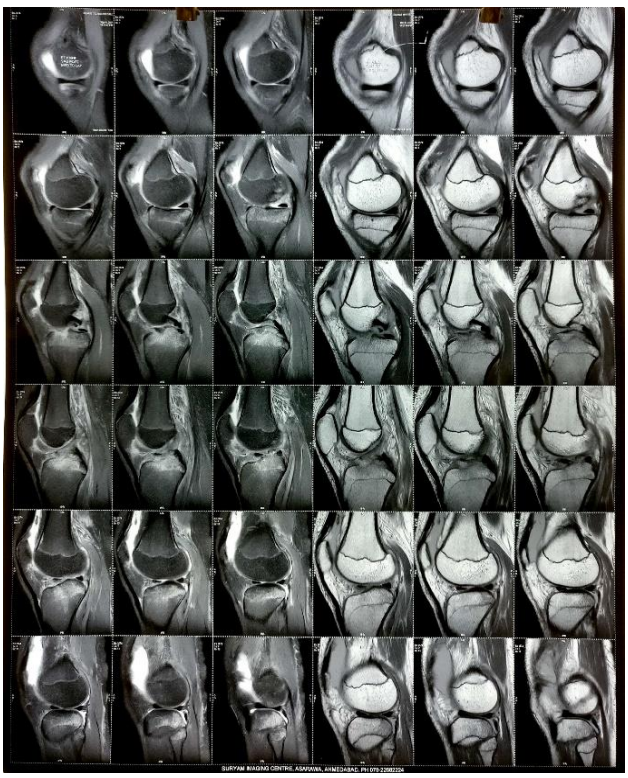
Type 1 and 2 fractures are suggested by Rockwood *et al*[8] to be managed by conservative means and operative management for type 3 fracture. To minimize of the risks of fracture nonunion, clinically evident knee laxity, and loss of range of motion, earliest operative reduction and fixation of Meyers and McKeever type II and III tibial spine fractures is important.[9] Open reduction and internal fixation approach was traditionally utilized while opting for operative management; however, with evolution of arthroscopy, both methods have shown similar results. Arthroscopically also allows evaluation of the fracture pattern and addresses concomitant intra-articular pathology. Arthroscopic-assisted reduction and fixation has become the gold standard for fixation. Nowadays, multiple techniques for arthroscopic reduction and internal fixation have been developed, but none has been gold standard. Suture and screw fixation are the most commonly described fixation techniques and both have yielded satisfactory results. To avoid a second surgery for removal of implant, most prefers avoiding use of metal hardware in this intraarticular type of fracture. The advantages of using sutures instead especially in children have been described in the literature.[10, 11.] The problem with suture techniques is the difficulty and the time consuming of passing sutures through the ACL avulsed stump and the tibial bone tunnels. In this article, a technique is described that use banana laso AR -4065B (Arthrex, Naples, FL) to pass 2 sutures, one through the ACL substance and the second over the bone fragment through the same tibial tunnels, making the procedure fast and easy.

Surgical Technique

Preoperative Evaluation

The diagnosis of a tibial spine avulsion fracture is made by the patient's history, clinical examination, and radiographic evaluation. The history entails a young patient who fall down from two wheeler before 1 month. A swollen and painful knee with an inability to bear weight on the affected extremity. Radiographs typically reveal an avulsion fragment off the tibia. Diagnosis can be made with radiographs alone, or with advanced imaging such as computed tomography and/or magnetic resonance imaging, as these are useful to describe the size of the fragment and any associated injuries.





Patient Setup

The patient is placed on a standard operative table in supine position under spinal anaesthesia with limb fixed in a thigh support, with the leg hanging free and a tourniquet is applied around the proximal thigh to minimize blood loss and maximize visualization. The operative leg is prepared proximally from the foot to the mid-thigh below the tourniquet, and is draped in a sterile fashion.

Arthroscopic Portal Placement

Standard knee arthroscopy is performed using a 30 degree4.0-mm arthroscope. To establish the anterolateral portal, a vertical incision is made using a No. 11 blade, hugging the border of the lateral patellar tendon at the level of the inferior pole of the patella. The knee is then entered with a blunt trocar and scope sheath, and these are gently guided up to the suprapatellar pouch. Complete diagnostic arthroscopy is performed, inspecting for chondral damage, loose bodies, and meniscus tears. A spinal needle is used to create the working anteromedial portal under arthroscopic visualization, and an incision is made in the same verticalfashion.

Preparation of the Tibial Spine Avulsion

To ensure that the femoral attachment of ACL being intact it is probed and the tibial spine avulsion is identified and inspected. Tibial spine fragment is probed to determine the amount of displacement, comminution, and soft tissue involvement. Often the avulsed fragment is larger than that suggested by the radiograph due to the cartilaginous component. The medial meniscus, lateral meniscus, and inter meniscal ligament are examined and probed to determine their relationship to the fracture fragments. The ACL should be looked for ecchymosis and attenuation. A 3.5-mm motorized shaver is used to debride haematoma and loose fragments from the fracture base. Sometimes the medial meniscus or inter meniscal ligament is incarcerated in the fracture and it is released with a probe.

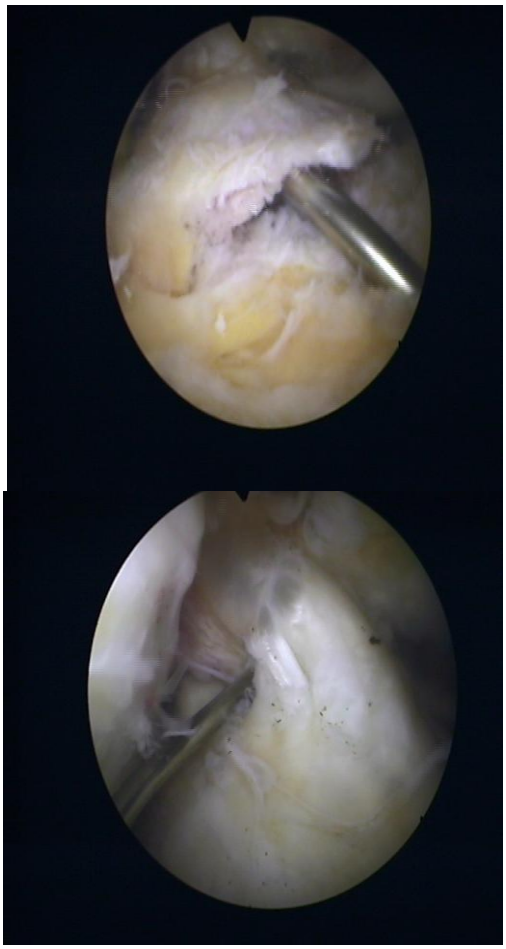


Fig 2. Intraoperative arthroscopic views of the right knee viewed from the anterolateral portal.(A) Tibial spine fragment is probed to determine the amount of displacement, comminution, and soft tissue involvement. (B) A probe is used to ensure tension in the anterior cruciate ligament (star)

Performing the Suture Lever Reduction Technique

To perform the suture lever reduction technique, a banana laso AR -4065B (Arthrex, Naples, FL) with perforating needle with nitinol wire loop (Figure:3) is used so as to pass a No. 2 ethibond suture around the ACL near the base of its insertion on the fragment. The suture is then retrieved from the anteromedial portal and tied to the ACL. A small incision is made medial and distal to the tibial tubercle and, using an ACL drill guide, a guide wire is drilled to exit the posterior half of the bony fracture bed of the tibia without drilling through the fracture fragment. The technical pearl is then to shuttle the suture anterior to the fracture fragment, and then through the

tibial tunnel. In this way, the fracture fragment is levered down inferiorly and posteriorly to an anatomic reduction. The sutures are tied tightly under head of tibial post on the antero-medial surface of the proximal tibia.

Fig 3.Banana Laso with nitinol wire

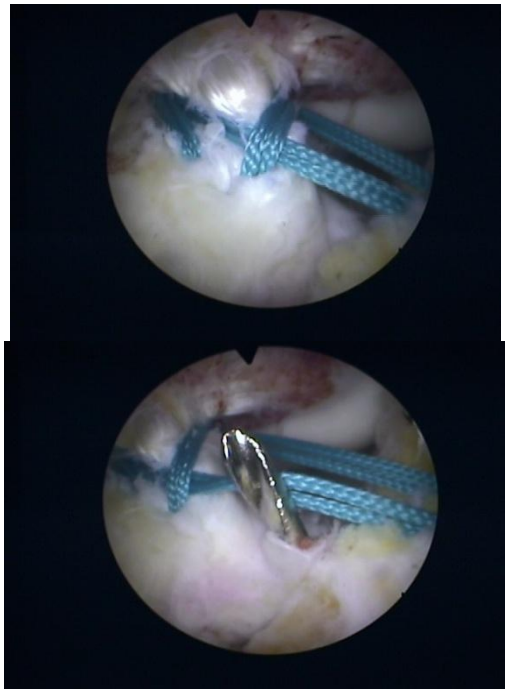


Fig 4: Intraop images showing suture reduction of tibial spine

Final Examination and Postoperative Care

Flexion and extention of the knee is done to check for stability, and re-examined under direct arthroscopy so as to confirm the joint stability. A final intraoperative radiograph of the knee is taken to ensure that the tibial spine avulsion remains anatomically reduced. The wounds are then closed in the standard fashion. The knee is placed in a functional brace locked in extension. The brace is worn for a total of 8 weeks and held in extension during the first week, with gradually increased range of motion. Non-weight-bearing is recommended for at least 5 weeks postoperatively. Intraoperative arthroscopic views of the right knee viewed.

Discussion

To restore joint congruity and cruciate integrity, displaced tibial spine fractures should be treated surgically with reduction and fixation through an arthrotomy or arthroscopic techniques.

Arthroscopy has always been considered superior as it allows for near perfect diagnosis and treatment of associated injuries, if found at all and reduction and fixation of all types of tibial spine fractures and simultaneously reduces the morbidity associated with open techniques. This repair has been previously described using open and arthroscopic approaches, with the latter having a decreased risk of soft tissue complications and postoperative pain. The arthroscopic pull-out method, among all the

available methods, is the most widely applicable technique, because it can be performed regardless of the bone fragment sizes or comminution degrees, and does not nessesitate removal of the internal fixation material. We modified the conventional pull-out method with using the device a banana laso AR -4065B (Arthrex, Naples, FL).

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