Study of arthroscopic fixation of PCL tibial avulsion fractures using tightrope like device

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Abstract

Avulsion fracture of the posterior cruciate ligament (PCL) from its tibial insertion is a rare injury in the Western world. In comparison, its incidence is much higher in countries such as India or China because of the more frequent 2-wheeler–related injuries. The treatment of such fractures is ever evolving. Surgical treatment is a must for these fractures. Open reduction and internal fixation with either k wires or cc screws is being practiced on a regular basis. The tibial attachment of the posterior cruciate ligament is located in an area which is difficult to access. Hence arthroscopic technique of fixation is gaining popularity these days. The Tight Rope device has recently gained popularity and has been well accepted for the purpose of acromio clavicular joint repair and reconstruction of the anterior cruciate ligament, achieving solid fixation with good clinical results. A total of 10 cases operated by this technique have been included in this study and graded according to Lysholm Knee Score. This study is entitled to bring about the technique, clinical efficacy and complications of this technique.

Keywords : Posterior cruciate ligament, Tibial avulsion fractures, Arthroscopic fixation, Tightrope.

Introduction : The PCL serves as a primary restraint against posterior tibial translation and adjusts rotational movement in near extension[1]. Once injured, a malfunctioning posterior cruciate ligament carries the potential for long-term sequelae, including persistent instability, decreased activity level and degenerative changes[2,3,4]. Avulsion fractures of posterior cruciate ligament (PCL) represent a specific form of PCL injuries[5]. Improper treatment of this injury results in an incompetent PCL that leads to knee instability and osteoarthritis.[6] Many operative methods of these fractures are reported. Conventional techniques using direct posterior or posteromedial approach are widely used despite the potential risk of complication, such as damage to the neurovascular structure, tearing of the gastrocnemius muscle and scarring of the wound.[7,8] Cancellous screws or cannulated screws are generally used for open reduction and internal fixation. However, screw fixation is indicated only for the large and noncomminuted fragment. Small or comminuted fragments are difficult to fix; in addition, there is a potential risk of fragmentation of the fracture fragment.[12] Due to its deep location and the complexity of the adjacent anatomy, minimally invasive and arthroscopic techniques are gaining interest.[9,10] This growing popularity has prompted a rapid increase in arthroscopic techniques, albeit a paucity of studies exists regarding their clinical outcome.[11] Arthroscopic surgery has an advantage of less soft tissue damage, however, it requires specialized equipment and experience.[12] The Tight Rope device has recently gained popularity and has been well accepted for achieving solid fixation with good clinical results. This technique provides accurate reconstruction of the anatomic footprint and rigid fixation for early rehabilitation, and it can address concomitant intra-articular lesions. It does not require an open approach or a second surgical procedure for hardware removal. In this technique, the tibial avulsion of the PCL is reduced under a direct arthroscopic view, offering the possibility to achieve re-fixation of the avulsion to the anatomic insertion site. The reduction also can be controlled with an intraoperative picture intensifier, enabling anatomic re-fixation. Even in the case of a comminuted fracture pattern, the Tight Rope device can be used because of the broad tibial insertion site of the PCL and its resulting ligamentotaxis, which helps to mold the bony fragments and facilitate reduction.[1]This study is intended to bring out various advantages and disadvantages in Study of Arthroscopic Fixation of Posterior Cruciate Ligament Tibial Avulsion Fractures using Tightrope like device, its technical difficulties and clinical outcome.

Aims and objectives

- To evaluate the functional and radiological outcomes of arthroscopic fixation of PCL avulsion fractures
- To compare the results of this study with reported studies.
- To study the advantages and disadvantages of this technique.

Materials and methods

Materials

- TV, Camera system & Light source

- Shaver System to Debride the joint
- Pneumatic Tourniquet to obtain a bloodless field
- Basic Arthroscopic Instruments
- Trocar, Cannula, Arthroscope (300), Probe, Hand Instruments
- PCL Reconstruction Instruments
- Tibial Guide, Guide Wires, Reamers, Graft Sizer, Femoral, Beeth Pin,
- Suture wheel
- Ethibond No. 5
- Might rope / Tight rope.
- Underwater cautery.
- Exchange rod
- Portal cannula

Inclusion criteria : All cases above 18 years of age having clinically instability of PCL and Xray / MRI evidence of PCL avulsion fractures are included in the study.

Exclusion criteria

- Gross Osteo-arthritis of the knee where knee bending is not possible
- Associated bleeding/ coagulation disorder
- Infected joint.
- Multiligamentous injury

Method : The patient undergoes spinal/epidural or general anaesthesia, receives perioperative antibiotics, and is placed in the supine position on the operating table. After a thorough physical examination, a tourniquet is applied to the patient's thigh, the lateral post is adjusted, and the leg is prepared and draped in a sterile fashion.

The arthroscopic portals used are as follows: anteromedial portal, anterolateral portal, and posteromedial portal. Routinely, diagnostic arthroscopy is performed to be aware of concomitant lesions. Fracture debris and blood clots are removed to create visual access to the tibial fracture site of the PCL.

The arthroscope is advanced posteriorly between the medial femoral condyle and the PCL into the popliteal recess. The posteromedial portal is created by a percutaneous guide needle, adjacent to the posteromedial femoral condyle and about 1 cm above and posterior to the joint line. Partial synovectomy and opening of the posterior capsule are performed to expose the extent of the bony avulsion. The size of the fragment is measured by use of the 5-mm tip of the probe, the fracture gap is debrided, and the avulsion fragment is reduced for testing purposes.

After completion of the initial diagnostic arthroscopy, a 1.5-cm-long incision is performed about 10 to 30 mm distal to the tibial tuberosity on the anteromedial lower leg. A tibial PCL drill guide is inserted into the joint by use of its tip to reduce the fracture under direct visualization.

The drill sleeve is then placed on the antero medial tibial cortex, just above the footprint of the pesanserinus. With the drill guide held in this position and under a clear arthroscopic view through the first posteromedial portal, a 2.4-mm guidewire is inserted, aiming for the mid part of the avulsion, to secure the reduction of the bony avulsion temporarily.

The central guidewire is over-drilled with a 4-mm cannulated drill bit. Both the guidewire placement and the drilling direction are controlled by a picture intensifier on straight anteroposterior and lateral views.

The beeth pin is passed in a transtibial manner and the loop is removed from the posteromedial portal. The Tight Rope is mounted on ethibond and the ethibond with the loop of the Tight Rope is pulled through with the beeth pin.

Once the oval button of the Tight Rope device is flipped under arthroscopic visualization, traction is applied to the pretibial sutures. The securing guidewire is removed, and the Tight Rope is tightened with the tibia drawn anteriorly until complete reduction is achieved.

The Tight Rope is then knotted securely with suture wheel anteriorly. Finally, the pretibial incision and the arthroscopic portals are closed in standard fashion.

Observation and result : The average age of the 10 patients was 31.7 years. Out of 10 patients 7 were male and 3 were female. 6 out of 10 fractures were right sided and rest 4 were left sided. Stable reduction was achieved in all the fractures pre-operatively as confirmed on c-arm. Time taken from surgery was an average of 70 minutes from incision to closure. Post-operative check x-ray was done for the evaluating the reduction inantero - posterior and lateral views and mobilization was started with support. Than patient were followed for six months and follow up x-rays were taken and patient were allowed to bare full weight with long knee brace 4 weeks after surgery. Post-operative physiotherapy consisting of knee bending, ankle pumps and static quadriceps exercises were started immediately after surgery. The Lysholm knee score was excellent in 4 cases and good in rest 6 cases.

Chart 1 - *Lysholm Questionnaire (Scale).*

Limping (5 points)
Never = 5
Mild or periodically = 3
Strong and continuous = 0

Support (5 points)
No support = 5
Walking stick or crutches = 2
Impossible = 0

Restraining (15 points)
No restraining or restraining feeling = 15
Has the feeling, but no restraining = 10
Occasional restraining = 6
Frequent = 2
Joint restrained at examination = 0

Instability (25 points)
Never miss a step = 25
Seldom, during athletic activities or other strong-effort exercises = 20
Frequently during athletic activities or other strong-effort exercises (or unable to participate) = 15
Occasionally in daily activities = 10
Frequently in daily activities = 5
At each step = 0

Pain (25 points)
No pain = 25
Intermittent or mild during strong-effort exercises = 20
Marked during strong-effort exercises = 15
Marked during or after walking more than 2 Km = 10
Marked during or after walking less than 2 Km = 5
Continuous = 0

Swelling (10 points)
No swelling = 10
Upon strong-effort exercises = 6
Upon usual exercises = 2
Continuous = 0

Climbing stairs (10 points)
No problem = 10
Slightly damaged = 6
One step at a time = 2
Impossible = 0

Squatting (5 points)
No problem = 5
Slightly damaged = 4
Not exceeding 90 degrees = 2
Impossible = 0

Total score: _____

Score table: Excellent: 95 – 100; Good: 84 – 94; Fair: 65 – 83; Poor: < 64

fig 1 : pre-operative lateral xray showing pcl avulsion fracture

fig 2 : MRI scan showing pcl avulsion fracture

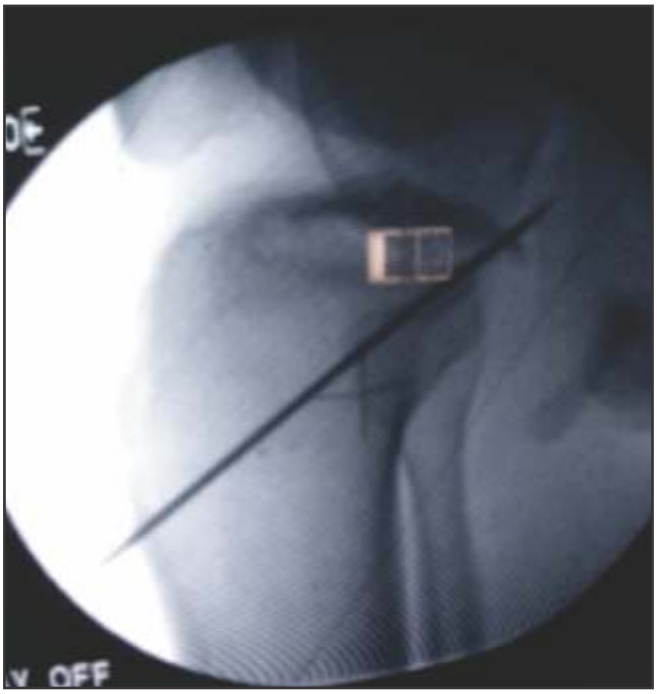

fig 3 : c-arm view of guidewire placement

fig 4 : immediate post-op ap view

fig 5 : immediate post – op lat view

fig 6 : 6 months follow up ap view

fig 7 : 6 months follow up lat view

Discussion

There are two approaches for the surgical treatment of displaced tibial avulsion fractures of the PCL an open and an arthroscopic one. Both appear to have advantages and disadvantages.

The advantages of arthroscopic fixation are as follows

(i) It obviates the need for hardware removal

(ii) Reduction can confirmed both arthroscopicaly and flouroscopically

(iii) Concomitant intra-articular lesions can tackled in the same sitting

(iv) Fracture ends can be curetted and interposed soft tissue can be curetted and shaved

(v) As it provides superior visualization of fracture fragment it provides superior anatomic reduction and union of the fracture fragments with decreased morbidity.

(vi) Minimally invasive technique

(vii) Lesser chance of damage to neurovascular structures

(viii) Smaller scar as opposed to larger scar of open method which may restrict range of motion postoperatively

(ix) Even in the case of a comminuted fracture pattern, the TightRope device can be used because of the broad tibial insertion site of the PCL and its resulting ligamentotaxis, which helps to mold the bony fragments and facilitate reduction.

The disadvantages of arthroscopic fixation are as follows[13]

(i) The procedure is challenging and demanding

(ii) Experienced surgeon is required for the procedure to reach the posterior compartment and capsule

(iii) The 4.5 mm drill hole may break the posterior avulsed fragments into smaller fragments

(iv) Technique is questionable in patients who have significant osteoporosis

Conclusion : The arthroscopic fixation of tibial PCL avulsion fractures is an acceptable and feasible alternative. The study showed good union rates, no complications with excellent functional recovery at the end of 6 months. But further clinical studies, with larger patient cohorts and a long-term follow up are needed to further confirm these preliminary results.

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