

Technical Note



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Percutaneous Retrograde Extraphyseal screw fixation for Type II and III Anterior Tibial Spine Avulsion Fractures: A Technical Note

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Abstract

Introduction: Anterior tibial spine avulsion (ATSA) fractures are uncommon intra-articular knee injuries in children. They are common in adolescents. Treatment for displaced ATSA fracture is fixation. Various methods of fixation are documented, most common being arthroscopic assisted fixation using various sutures or anchors. Antegrade screw fixation is also an accepted method of treatment but is associated with implant back out and impingement. We describe our technique of retrograde extraphyseal percutaneous fixation for type II and III ATSA fractures.

Method: Under image intensifier (IITV) guidance, fracture reduction was achieved and fixed with a specially designed, short-threaded, 4 mm cannulated screw. The screw was inserted in retrograde fashion proximal to the proximal tibial physis. The patient was immobilized in a cylinder cast and was allowed weight bearing as tolerated. Cast was removed at 6 weeks and range of movement exercises started.

Result: Our technique of percutaneous retrograde extraphyseal screw fixation for ATSA fracture is simple. The learning curve is less and can be used in selected case. In resource-limited situations where facilities for arthroscopy are not readily available, our technique can provide good results

Keywords: Anterior tibial spine avulsion, Percutaneous fixation, Retrograde, Extraphyseal

Introduction

Anterior tibial spine avulsion (ATSA) fractures are relatively rare injuries of children with an incidence of 3 fractures per 100,000 children annually. They commonly occur in the age group of 8-14 years [1]. Common mechanisms of injury are sports, motor vehicle accidents and fall from bicycle. ATSA fractures were classified by Meyer and McKeever into 3 types based on the degree of displacement [2]. Type I can be treated conservatively but higher grades require operative intervention. Although historically conservative [3] and Kirschner wires (K-wire) [4, 5] have been used, currently accepted and commonly used methods include arthroscopic fixation using suture anchors [6-8]. Arthroscopic techniques require special equipment and suture materials that add to the cost. There is a significant learning curve for the technique and facilities may not be available at many centers in developing countries. Type II and III fractures typically have a large fragment of bone that is amenable for screw fixation. Antegrade screw fixation method places the implant intra-articular that can lead to implant prominence and limitation of extension [9, 10]. These implant related issues may necessitate revision surgery.

In our technique we place the screw in retrograde direction above the tibial physis. This technique has not been previously described. Retrograde screw fixation has

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been described for intercondylar eminence fractures in adults [11].

The rationale for the proposed technique is based on the following facts:

- 1) Type II and III fractures have a large fragment of bone. The subchondral bone in the fragment is substantial enough for good purchase.
- 2) The direction of the retrograde extraphyseal screw is against the direction of pull of ACL providing better hold compared to an antegrade screw (Figure 1).
- 3) The direction of compression by the screw reduces the fragment accurately in the crater (Figure 2).
- 4) An extra-articular, extra-physeal screw is minimally invasive without risk of intra articular impingement.

Implant design

Specially designed cannulated cancellous screw of 4 millimeter diameter and having 12 millimeter thread length were used. Different lengths of screws are available in the set (Figure 3).

Surgical Technique

The procedure was performed under appropriate anaesthesia. The knee is aspirated, if an associated tense hemarthrosis is present. Closed reduction is performed by hyper-extending the knee. If reduction is not achieved, a stab incision/mini open arthrotomy medial to the ligamentum patellae is made and the interposing inter-meniscal ligament/soft tissue is removed. The fragment is brought into position and held in place by a probe (Figure 4). A stab incision is made on the medial aspect of the ligamentum patellae above the physis. Tissue is separated, a drill sleeve inserted and 1 millimetre of the 'K' wire is drilled aiming for the centre of fragment on orthogonal views. We have found that the subchondral bone is strong enough to drill which ensures a good hold of the screw. Pressure with a suitable joystick/probe is applied to the top through a medial incision (if not made previously). Drilling is done with a 3.5-millimetre cannulated drill bit. The specially designed screw as mentioned earlier, of accurate length is used taking care that the fragment is perfectly sitting in the base. Care is taken that screw threads are not prominent in the joint. The wound is closed and a well-fitting cylinder cast is applied in extension for 6 weeks. The patient is allowed to weight bear as tolerated soon after surgery.

Active physiotherapy is started after removal of cast until full range of movement is restored. The implant was removed typically after a year or earlier if any symptoms arose.

Case example

A 13-year-old girl presented with knee swelling after fall from a bicycle. The radiograph revealed a Type II Meyer and McKeever ATSA. Percutaneous extraphyseal retrograde

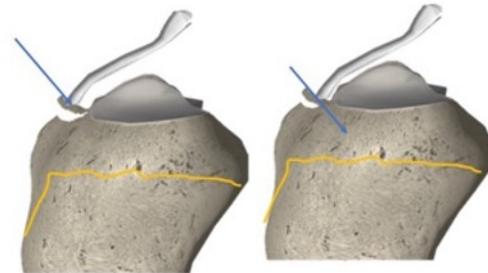


Figure 1: Classic antegrade trajectory

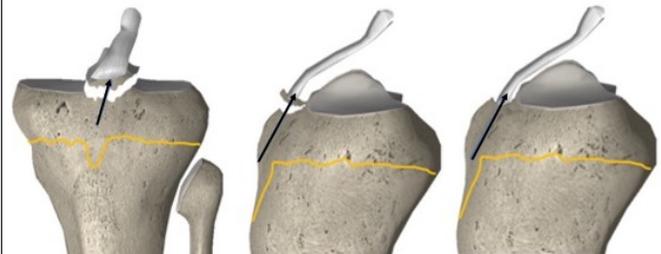


Figure 2: Retrograde screw (our technique)



Figure 3: Specially designed 4 mm CC screw with 12 mm thread length



Figure 4: Intra operative images



Figure 5: Case example: A) Pre op B) Post-operative image in cast C) Final follow up at union



Figure 6: A: Scar B) Full range of flexion

fixation was performed with satisfactory reduction (Figure 5). At 5-year follow up, there was no clinical instability and an excellent functional result (Figure 6).

Discussion

ATSA are uncommon injuries. Arthroscopic-assisted reduction and various fixation techniques are the most accepted treatment methods [12, 13]. Open reduction and fixation is an alternative [14]. The limitations of arthroscopic assisted procedure include learning curve, cost of equipment and availability of trained professional, especially in developing countries. Antegrade screw fixation is associated with intra-articular implant prominence which can cause limitation of extension, cartilage injury and retrieval of implant requires a revisit to the operating room [9, 15].

In our technique, the screw is inserted in retrograde fashion, sparing the physis and taking care not to penetrate the joint. If the need arises, a mini arthrotomy can be used instead of arthroscopy to remove inter-menisal ligament entrapment. The screw being subcutaneous can cause prominence but it can be easily removed as an out-patient procedure under local anaesthesia.

Advantages of this technique are:

- 1) Extra-physeal screw placement, reduced risk of growth disturbance.
- 2) Implant removal can be performed under local anaesthesia.
- 3) Early weight bearing in cast promotes maintenance of

reduction and induces early healing.

- 4) Arthroscopy skill is not a must, as mini-open arthrotomy can be used when needed.

Limitations of our technique

- 1) Limited role in type II and III fractures only.
- 2) Some cases may require mini open arthrotomy/arthroscopic assisted inter-menisal ligament interposition if satisfactory reduction is not achieved.
- 3) Relatively longer period of immobilization.
- 4) In some instances, screw prominence inside the joint can occur, but implant removal can be performed as an out-patient procedure.
- 5) Loss of fixation can occur if the fragment is too small. This can be taken care by pre-operative assessment of fracture fragments by magnetic resonance imaging or computerized tomography scan.
- 6) Associated intra-articular injuries cannot be directly evaluated.

Conclusion

Our technique of percutaneous extraphyseal retrograde screw fixation for ATSA is a simple and reproducible technique with a short learning curve. Further biomechanical studies are warranted to compare our technique versus arthroscopic assisted antegrade fixation.

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Declaration of patient consent : The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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