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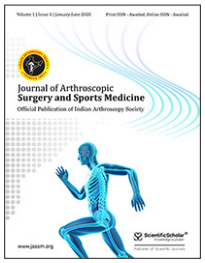
Journal of Arthroscopic Surgery and Sports Medicine



Video of Arthroscopic Surgical Procedures

Balanced, biologic, and cost-effective technique for anterior cruciate ligament tibial avulsion repair: A 15-step novel approach

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Received : 01 December 2020
Accepted : 15 January 2021
Published : 30 June 2021

DOI
10.25259/JASSM_57_2020

Video available on:
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ABSTRACT

Anterior cruciate ligament (ACL) is most common ligament injured in knee. Sometimes, these are tibial side avulsions, leading to anterior knee impingement and instability. Multiple arthroscopic techniques have been described ranging from screw, staple, and k-wire fixation. Recent past have shown emergence of various transosseous suture fixation techniques using button, disc, or bone bridge. Transosseous techniques described range from single, double, and four tunnel method using fiber wire in various configuration. Our technique highlights biologic, balanced, and knotless method of ACL tibial avulsion fixation using fiber tape and two tibial tunnels.

Keywords: Anterior cruciate ligament avulsion repair, Anterior cruciate ligament tibial avulsion fixation, Anterior cruciate ligament tibial avulsion

INTRODUCTION

Anterior cruciate injuries are common and well described in the literature. Injury types can be femoral sided avulsion, mid substance tear, or tibial sided avulsion. Tibial sided anterior cruciate ligament (ACL) avulsion was first described by Poncet in 1875.[1] Although most commonly encountered in children and adolescence, this injury has been well documented in adult population. Anterior cruciate avulsion injury happens as a result of hyperextension of knee with component of rotation as happens in contact sport and road traffic accidents. It has been shown that operative treatment provides better result and avoids complications such as non-union, symptomatic laxity, and loss of range of motion. Various surgical techniques have been described in the literature. Author presents technique of biologic, balanced, and cost-effective arthroscopic technique for ACL avulsion tibial refixation using fiber tapes no 2. This proposed technique uses fiber tape to increase contact area and avoid any knot around ACL osseoligamentous junction, thus avoiding ligament strangulation. Furthermore, the fiber tape strands can be pulled differentially, thereby ensuring balanced repair [Figure 1].

15-STEP SURGICAL TECHNIQUE

Surgery is performed under spinal anesthesia and tourniquet is used. Standard anteromedial and anterolateral portals are made for diagnostic arthroscopy. Fracture hematoma is drained

thoroughly till vision gets clear. Author recommends gravity assisted normal saline inflow method for knee inflation. STEP 1 (Assess fracture): "Fracture configuration is assessed" and classified based on Meyers and Mckeever classification. STEP 2 (Fragment clearance): Fracture fragment margin is cleared off soft-tissue attachment. This is done starting from anteromedial to anterolateral aspect using arthroscopic shaver [Figure 2]. STEP 3 (Crater clearance): Crater is cleared of soft tissue and hematoma using arthroscopic shaver. STEP 4 (Crater burring): Crater surface is made raw and smooth using arthroscopic burr [Figure 3]. STEP 5 (Fragment burring): Undersurface of fragment is made smooth using arthroscopic burr. STEP 6 (Assess reducibility): At this stage, fracture fragment reducibility is assessed using arthroscopic probe. Anterior horn of lateral meniscus may need to be pulled out of way to get fragment reduction. STEP 7 (Fragment fine tuning): Any spikes on fracture fragment obstructing reduction needs to be removed gently at this stage to get adequate fragment reduction into crater. It is important to avoid any prominence anteriorly which may cause impingement later on. STEP 8 (Preliminary fixation): Fragment is reduced with help of probe and held with a 2 mm k wire [Figure 4]. STEP 9 (Pass guide wire 1): ACL zig is used to pass 2.4 mm guide wire at the anterolateral corner of crater. STEP 10 (Pass guide wire 2): ACL zig is used to pass 2.4 mm guide wire at the anteromedial corner of crater. STEP 11 (Confirm guide wire position): Position of guide wire is reconfirmed at the stage. It is made sure that guide wires are exiting at anteromedial and anterolateral corner of crater. Any change in position of guide wire is done at this stage, if needed [Figure 5]. STEP 12 (Fiber tape around ACL stump): Fiber tape no. 2 is passed around osseoligamentous junction using suture passing device [Figure 6]. STEP 13 (Create tunnel 1): 4.5 mm drill hole is made over anterolateral guide wire. 4.5 mm drill bit is kept in place to pass nitinol wire through it and both strands of fiber tape retrieved through the drill bit using nitinol wires. STEP 14 (Create tunnel 2): Step 12 and 13 are repeated over

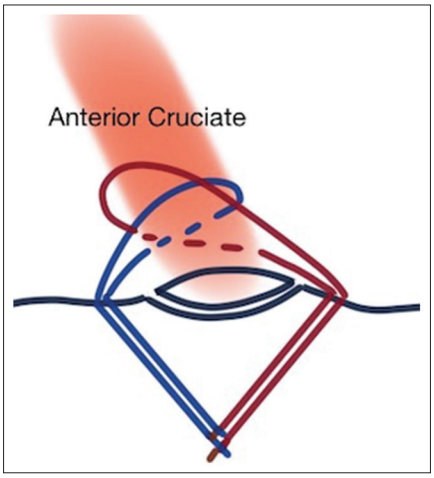

Figure 1: Balanced biologic knotless repair.

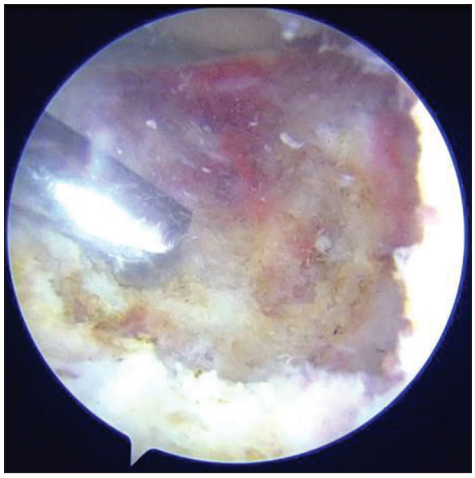

Figure 3: Step 4.

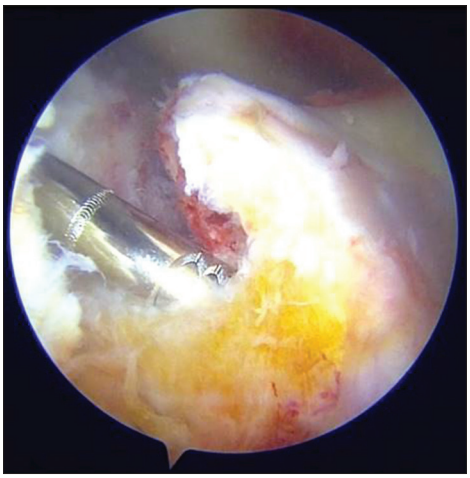

Figure 2: Step 2.

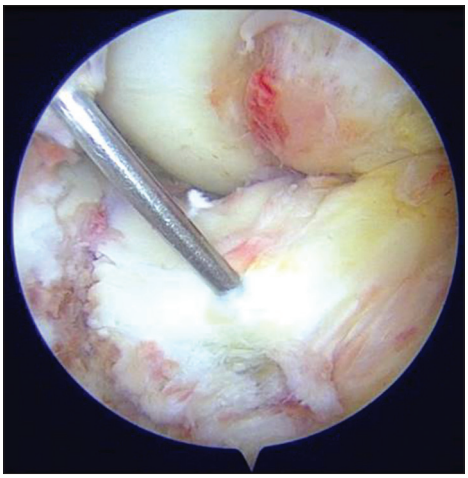

Figure 4: Step 8.

Figure 5: Step 11.

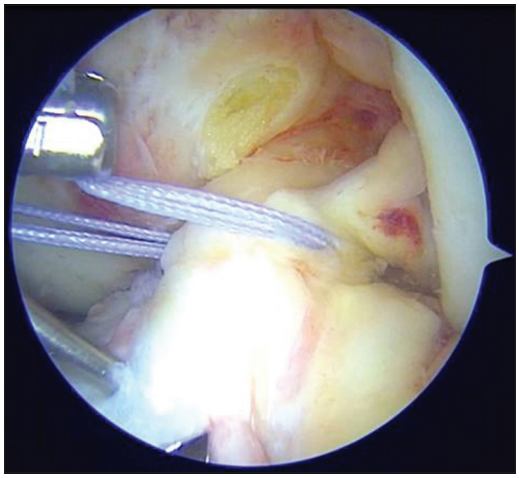

Figure 6: Step 12.

anteromedial corner of crater. STEP 15 (Final fixation): 4.5 mm drill bits are removed and all the four strands of fiber tape are pull together, maintaining equal pull on all the strands. Reduction of fragment is confirmed arthroscopically and fiber tapes are tied over suture disc [Figure 7].

POST-OPERATIVE REGIME

Knee is immobilized in long knee brace. Toe touch weight-bearing walking along with static quadriceps is started on post-operative day 1. At 2 weeks, ROM is started from 0° to 90° along partial weight-bearing walking. Full weight-bearing walking is started at 6 weeks. Jogging was allowed at 3 months. Pivot activities and return to sports are allowed only after 6 months.

DISCUSSION

Conservative management of displaced ACL tibial avulsions may need prolonged immobilization, leading to Stiffness, nonunion, and residual instability.[2] Loss of extension may result from irreducibility of fracture fragment caused by anterior horn of lateral meniscus. One of the crucial steps in managing ACL avulsions is to avoid any prominence anteriorly, leading to flexion deformity.

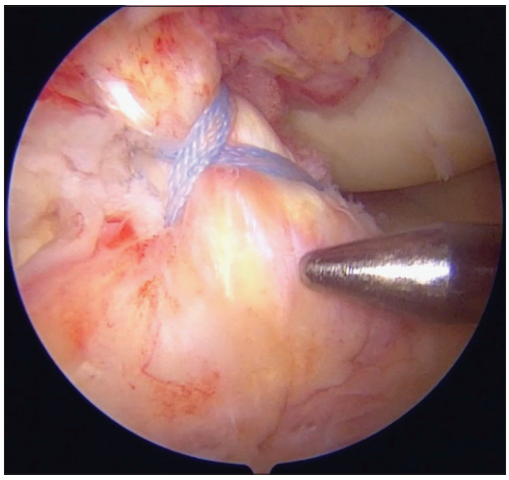

Figure 7: Step 15.

Open techniques of repair have resulted in stiffness, infection, and morbidity.[3] With advent of arthroscopy, various techniques have been described in the literature using pins, staples, fiber wire, and stainless steel wire.

Staple fixation showed comparable results to suture bridge fixation but staple back out can be a problem.[4] Moreover, potential malposition of hardware can lead to loss of extension, leading to functional limitation. Mclennan[5] popularized arthroscopy assisted treatment of ACL avulsion injuries using k wires to fix the fragment in cases where knee extension could not hold reduction. He emphasized avoiding arthrotomy to perform ACL avulsion fixation. Mclennan concluded that pin fixation is effective method of treatment but is associated with quadriceps atrophy, loss of extension, and ligamentous instability.[5]

Suture bridge technique has shown good results for fixation of ACL tibial avulsions.[6-8] Post-operative arthrofibrosis being most common complication encountered after suture bridge fixation. Delayed mobilization or mechanical impingement can lead to this complication.[9] Sliding knot using fiber wire applied through ACL stump has potential problem of damaging ACL fibers.

Author did not come across any study using two fiber tapes as primary fixation device [Table 1]. Work done by Agrawal *et al.* has used fiber tape as internal brace after primary fixation by fiber wire.[10] Strangulation technique using fiber tape has been reported for tibial spine avulsion fractures fixation.[11]

Presented technique of balanced and biological repair can help early mobilization without interfering with biology

Table 1: Various described techniques.

Technique description	Advantage	Disadvantage	Comments
Sundararajan *et al.*[4]	Reproducible, less surgical time, early mobilization	Hardware in joint, comminution of fragment, staple back-out	Malposition of hardware can potentially lead to extension block. Risk of Staple back out
McLennan[5]	Less Surgical time	Prolonged immobilization, pin removal (second procedure) at 6 weeks	No plaster cast or immobilization required in proposed technique
Chawda *et al.*[14]	Simple and reproducible. Cost effective	Screw impingement, Hardware removal, infection	Suture bridge technique avoids hardware associated complications
Jadhav and Gotecha[2]	Better biomechanics. Early mobilization	Fiber wires not holding severe communition	Fibertape with increased surface area hold communition better
Elsaid *et al.*[15]	Single tunnel technique	Fragment penetration thereby chance of fracture	Fragment handling and manipulation is minimal in proposed technique
Boutsiadis *et al.*[16]	Four tunnel technique. Superior fixation	Technically demanding	Biomechanical studies are still to prove four tunnel better than 2 tunnel technique

or stability of repair construct. By selective pulling of fiber tape strands from tibial tunnels one can balance the repair construct, thereby getting a stable repair. This technique bypasses the need for knot tying, thereby adding to biology of repair construct. Moreover, surgeons not well versed with shoulder knot typing methods can perform the technique with ease.

Better biomechanical property of suture tape as compared to fiber wire has been shown in studies.[12] Huntington *et al.* have shown better contact area and pressure with fiber tape as compared to fiber wire.[13] Author believes that improved biomechanics help in better healing of repair construct, along with early mobilization in post-operative period.

Presented technique is cost effective with use of only two no. 2 fiber tapes, thus very useful in Indian scenario [Video 1]. It is a simple, reproducible method for arthroscopic surgeons not accustomed with shoulder knot tying techniques.[14-16]

CONCLUSION

Fifteen-step biologic, balanced, and cost-effective arthroscopic technique for ACL avulsion tibial refixation using fiber tapes no. 2 is a simple reproducible technique of ACL avulsion fixation.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Pandey VK. Balanced, biologic, and cost-effective technique for anterior cruciate ligament tibial avulsion repair: A 15-step novel approach. J Arthrosc Surg Sports Med 2021;2(2):150-4.