Technical Note

Anatomic Acromioclavicular Ligament Reconstruction Using Semitendinosus Autograft With Suture Augmentation: Surgical Technique

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Abstract: Acromioclavicular (AC) joint separations are common injuries and account for 3.2% of shoulder injuries. These injuries typically occur among adolescent and young adult athletes during contact sports, such as hockey, wrestling, and rugby. Low-grade AC joint separations (Rockwood grade I-II) are often successfully treated nonoperatively. High-grade AC joint separations (Rockwood grade IV-VI) have the potential to alter scapular kinematics, causing painful and restricted motion, and are often treated surgically. Over 150 surgical techniques have been described to treat AC joint separations. Techniques vary in the types of implants used (screws, pins), use of anatomic or nonanatomic reconstructions, number of drill holes used, use of arthroscopic or open procedures, use of distal clavicle resection, and types of augmentation (allografts, autografts, sutures). The procedure can be expensive, with the implants and grafts costing varied amounts and, at times, thousands of dollars. The purpose of this Technical Note is to describe an inexpensive method of open anatomic AC joint reconstruction using a single bone tunnel, suture tape, and a semitendinosus autograft.

Acromioclavicular (AC) joint separations are common injuries and account for 3.2% of shoulder injuries.[1] These injuries typically occur among adolescent and young adult athletes during contact sports, such as hockey, wrestling, and rugby.[2] Low-grade AC joint separations (Rockwood grade I-II) are often successfully treated nonoperatively.[1] High-grade AC joint separations (Rockwood grade IV-VI) have the potential to alter scapular kinematics, causing painful and restricted motion, and are often treated surgically.[1]

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Surgical Technique

Indications

The indications include AC joint separations of grade IV to VI or lower-grade separations that have failed nonoperative treatment.

Preoperative Preparation and Positioning

The patient is positioned in the beach-chair position and undergoes induction under general anesthesia with endotracheal intubation. The operative extremity is draped free, and preoperative prophylactic antibiotics are administered as is standard (Video 1).

Graft Harvest

The semitendinosus autograft is harvested from the ipsilateral leg in the standard manner. The graft is prepared, and No. 2 FiberWire (Arthrex, Naples, FL) is placed on each end of the graft for passage.

Approach

The skin incision is made using the anterior two-thirds of a standard saber-cut approach for AC joint reconstruction. The incision starts from the posterior edge of the AC joint, traversing distally to the superior edge of the coracoid (Fig 1). The deltotrapezial fascia is incised in line with the clavicle, and the lateral portion of the clavicle and the AC joint are exposed (Fig 2). A Homan retractor is placed deep to the distal clavicle, and a sagittal saw is used to remove approximately 5 mm of the distal clavicle (Fig 3). A 2-mm drill hole is then made at the anterior two-thirds—posterior one-third junction of the clavicle, in a superior-to-inferior direction, even with the medial side of the coracoid (Fig 4). The coracoid is exposed using blunt dissection, and a No. 0 Vicryl suture (Ethicon, Somerville, NJ) with the needle removed is passed inferior to the coracoid (Fig 5).

Graft Passage

A 2-mm × 54-inch Arthrex FiberTape is used and cut into 2 halves. One end of each of the 2 suture tape halves, the semitendinosus autograft, and a No. 0 Vicryl suture (with the needle removed) are secured to the passing suture and shuttled under the coracoid in a medial-to-lateral direction using a Satinsky clamp (Fig 6). The lateral limb of the most medial suture tape is passed through the previously drilled hole using a Hewson suture passer from inferior to superior and clamped to the other limb of the same suture using a hemostat (Fig 7). The lateral limb of the second suture tape is passed from the lateral side of the coracoid underneath the clavicle and clamped to its opposite end over the top of the clavicle (Fig 8). The graft is adjusted to lengthen the medial limb, which is then passed underneath the clavicle from anterior to posterior, medial to the previously passed suture tape limbs (Fig 9). The same graft limb is shuttled under the coracoid using the No. 0 Vicryl previously passed, in a lateral-to-medial direction (Fig 10).

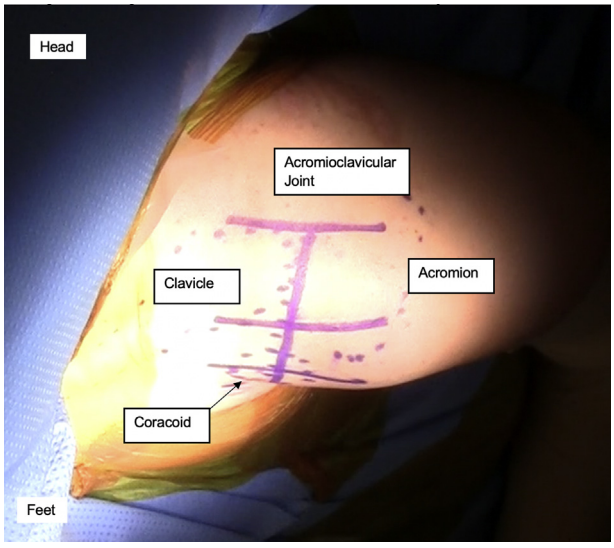

Fig 1. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The top of the image is inferior, and the bottom is superior. The solid line delineates the length of the surgical incision for the anatomic acromioclavicular joint reconstruction.

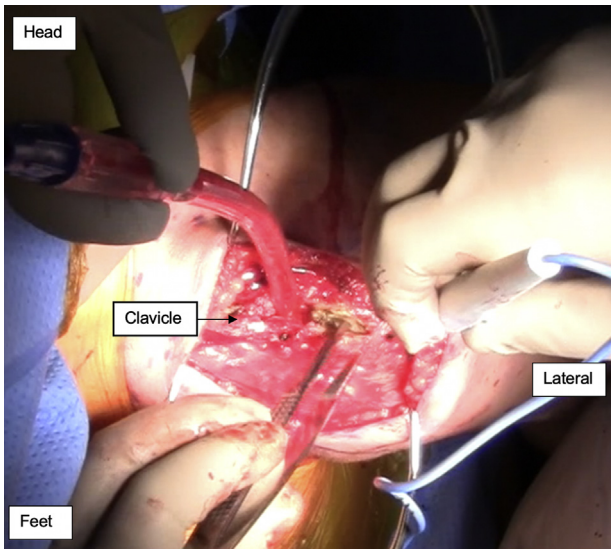

Fig 2. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. The soft tissues and periosteum around the clavicle are incised and elevated to expose the lateral clavicle and acromioclavicular joint.

Securing of Graft

The AC joint is manually reduced, and the suture tapes are both tied and cut (Fig 11). The semitendinosus graft is then secured to itself using No. 2 FiberWire

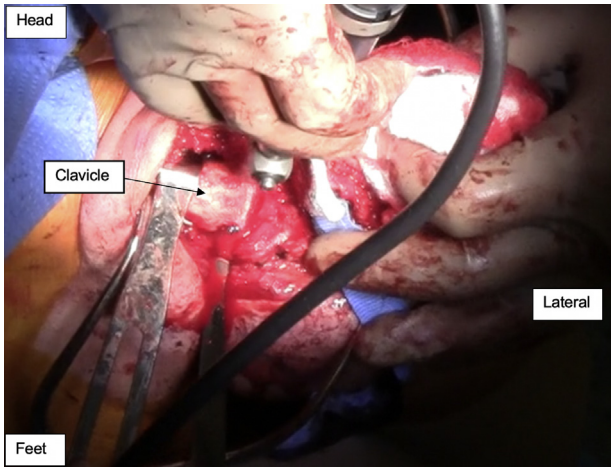

Fig 3. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. An oscillating saw is used to remove approximately 5 mm of the distal clavicle.

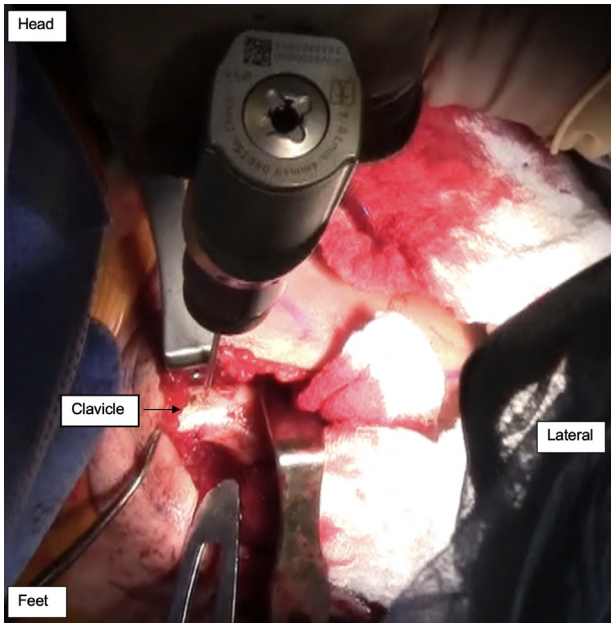

Fig 4. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. A 2.0-mm drill bit is used to place a hole in the clavicle at the level of the medial aspect of the coracoid.

where the ends meet at the clavicle (Fig 12). Knots are placed where there will be adequate soft-tissue coverage to prevent prominence.

Closure

The surgical wound is irrigated with sterile saline solution. The deltotrapezial fascia is closed using an interrupted figure-of-8 stitch and No. 0 Vicryl suture.

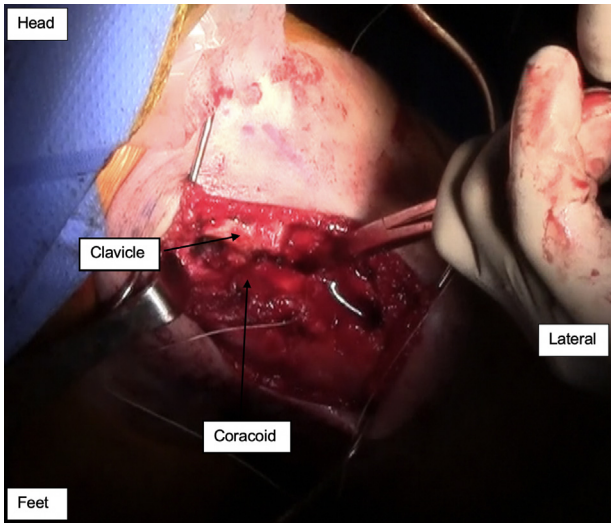

Fig 5. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. A Satinsky clamp is used to pass a suture (with no needle) underneath the coracoid. This will be used to shuttle the graft.

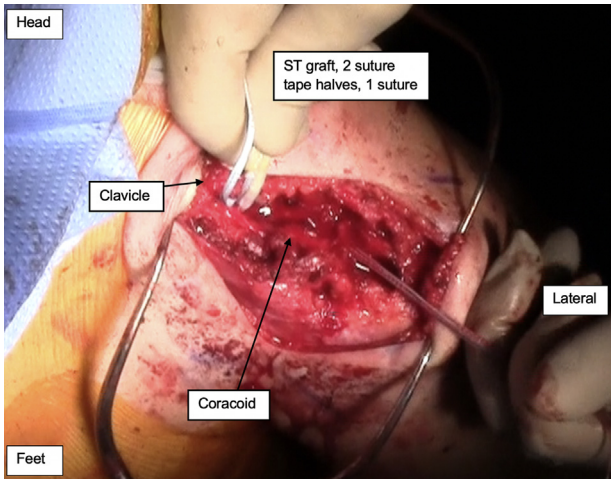

Fig 6. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. A 2-mm × 54-inch suture tape is cut in half. The 2 halves of the suture tape, the previously harvested semitendinosus (ST) autograft (or allograft), and a suture are secured to the passing suture and shuttled underneath the coracoid.

The subcutaneous layer is closed using No. 2-0 Vicryl and the skin is closed using No. 3-0 Monocryl (Ethicon) with a subcuticular stitch. Steri-Strips (3M, St Paul, MN) are applied, and a sterile dressing is placed.

Postoperative Management

The patient is placed in a shoulder sling and allowed immediate range of motion of the hand, wrist, and

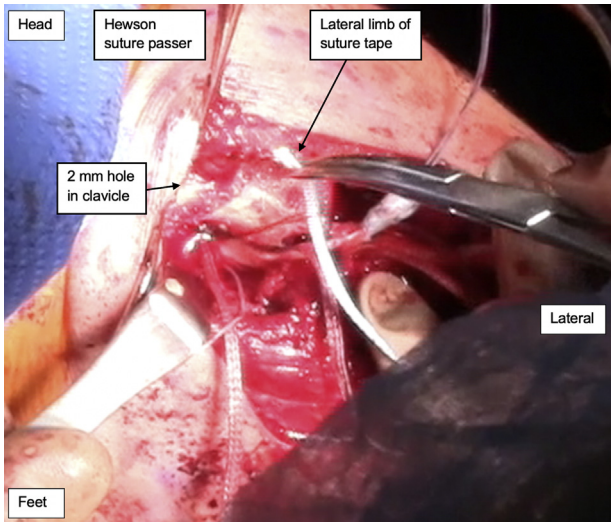

Fig 7. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. The lateral limb of the most medial suture tape is passed through the previously drilled 2.0-mm hole using a Hewson suture passer from inferior to superior, clamped to the other limb of the same suture using a hemostat, and placed to the side of the field.

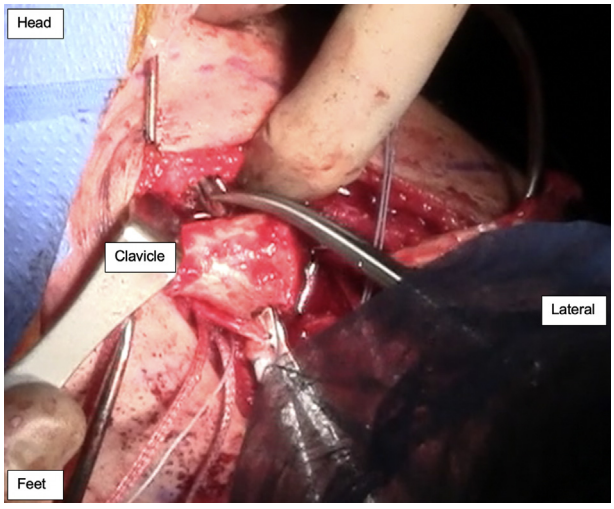

Fig 8. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. The lateral limb of the most lateral suture tape is passed from the lateral side of the coracoid underneath the clavicle (from anterior to posterior) and clamped to its opposite end over the top of the clavicle.

elbow. Shoulder motion is restricted in the immediate postoperative period, and pendulum exercises are started at 2 weeks postoperatively. At the 8-week mark, the patient is allowed active range of motion of the shoulder, with strengthening permitted at 12 weeks postoperatively. Advantages and disadvantages of the described technique are detailed in Table 1, and pearls and pitfalls are presented in Table 2.

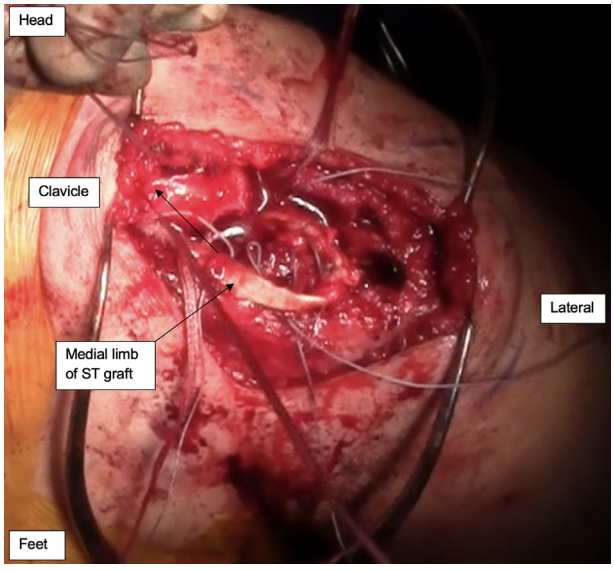

Fig 9. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. The semitendinosus (ST) graft is adjusted to lengthen the medial limb, which is then passed underneath the clavicle (anterior to posterior). This will re-create the conoid ligament.

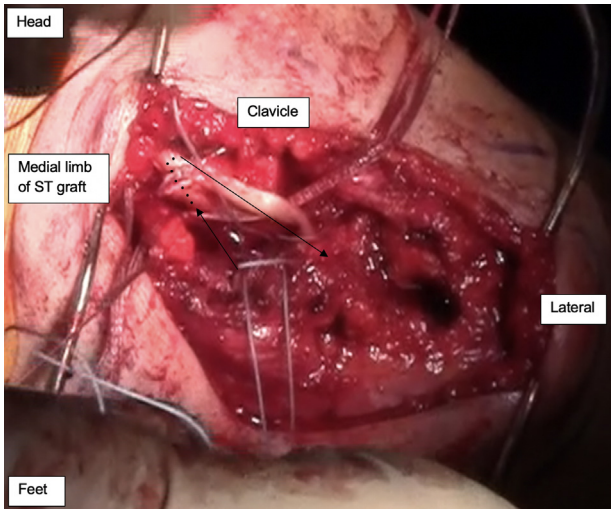

Fig 10. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. The medial graft limb that was previously passed under the clavicle is shuttled under the coracoid (from lateral to medial) using the previously passed suture. (ST, semitendinosus.)

Discussion

Traditional nonanatomic reconstruction techniques for AC joint separations have had variable success and complication rates, driving efforts toward improving outcomes and developing alternative techniques. Anatomic reconstructions have become more popular over time as clinical studies have shown improved outcomes with anatomic reconstructions over nonanatomic techniques.[3]

A major concern after anatomic AC joint reconstruction is the risk of fracture. A recent meta-analysis by Gowd et al.[4] found the pooled complication rate of

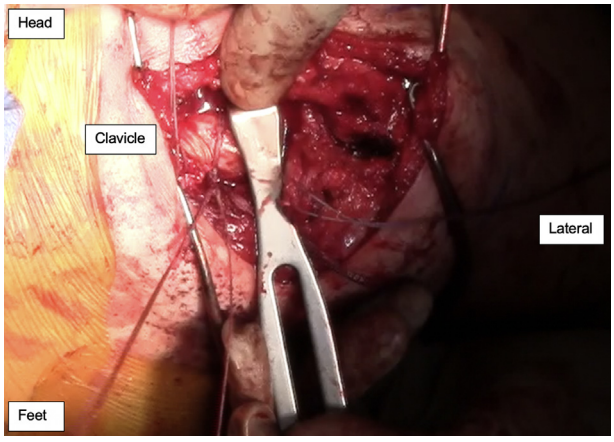

Fig 11. Intraoperative image of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. The acromioclavicular joint is manually reduced, and both suture tape ends are tied and cut.

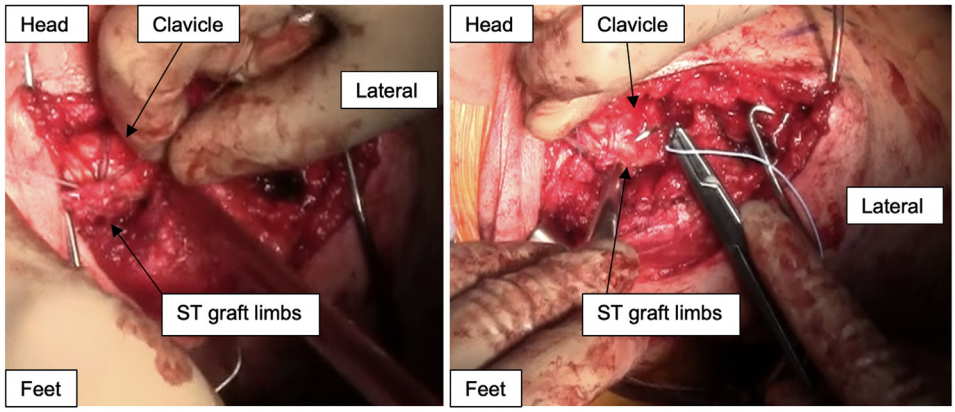

Fig 12. Intraoperative images of a left shoulder in the beach-chair position as viewed from above. The head is to the top left, and the feet are to the bottom left. The semitendinosus (ST) graft is brought to the clavicle, lateral to the other end of the graft, to re-create the trapezoid ligament and is secured to itself using No. 2 FiberWire.

1,704 patients who had undergone AC joint reconstruction to be 14.2%. The second most common complication was fracture of the clavicle or coracoid, which was present in 5.7% of patients. Similarly, a systematic review by Moatshe et al.[5] analyzed outcomes and complications of AC joint reconstruction segmented by reconstruction technique. They analyzed 165 cases (across 10 studies) using a free tendon graft and found an overall complication rate of 10.3%. The most common complication was superficial infection, followed by clavicle fracture and graft rupture. To minimize the risk of clavicle fracture, many techniques have explored using a single drill hole in the clavicle. A recent biomechanical study evaluated single-versus double-tunnel AC joint reconstruction in a cadaveric model.[6] The study concluded that the biomechanical properties were equivalent with a theoretical decrease in the rate of clavicle fracture with single-tunnel techniques. The goal when developing our described technique was to minimize the drill hole number (1) and size (2 mm) in the clavicle and eliminate holes in the coracoid to limit the risk of fracture. However, we must acknowledge that any drill hole placed in the clavicle carries with it the risk of fracture.

The use of free tendon grafts in AC joint reconstruction has become more popular over the past 15 years.[5] Biomechanical studies have examined the role of tendon grafts in reconstruction techniques. A study by Lee et al.[7] showed no significant difference in load to failure of semitendinosus graft and the native coracoclavicular ligaments. The use of semitendinosus autografts in anatomic reconstructions has also been established as having improved outcome scores compared with the modified Weaver-Dunn procedure.[8] This technique provides stable suture fixation for early maintenance of reduction, whereas a woven tendon graft reinforces the construct once matured and provides long-term maintenance of reduction.

Limitations and risks of the described technique should be considered before surgery. The use of a semitendinosus autograft requires graft harvest, which carries with it the potential for increased surgical time and associated donor-site morbidity and complications (including saphenous nerve and medial collateral ligament injury). However, it is important to note that an allograft could be substituted for the autograft if desired. Another point to discuss is whether to perform shoulder arthroscopy during the surgical procedure because

Table 1. Advantages, Disadvantages, Limitations, and Risks of Anatomic Reconstruction of Acromioclavicular Joint

Advantages	Disadvantages, Limitations, and Risks
Graft incorporation promotes long-term stability.	Autograft requires harvesting, which may increase surgical time.
Suture reinforcement allows short-term stability.	Donor-site morbidity and/or complications may occur.
The technique and implants are inexpensive.	Because the procedure is performed in an open manner, intra-articular pathology may be missed.
Use of tendon autograft eliminates the risk of disease transmission with allograft.	A small drill hole placed in the clavicle carries with it the risk of fracture.
No drill holes are made in the coracoid, eliminating the risk of coracoid fracture.	Rupture or failure of suture fixation is possible, which could cause the graft to displace or loosen.
Use of a single small drill hole in the clavicle minimizes fracture risk.	Graft rupture or failure is possible.

Table 2. Surgical Pearls and Pitfalls

Pearls	Pitfalls
The AC joint should be manually reduced before the suture tape is tied.	Knots tied superiorly on the clavicle may be prominent and symptomatic.
The suture tape should be tied after passage of the graft to allow for easier passage.	Performing a distal clavicle excision that is too large (>10 mm) may increase strain on the graft.
Use of a Satinsky clamp eases passage around the coracoid.	

AC, acromioclavicular.

glenohumeral pathology has been reported to occur concomitantly with AC joint separations in 15% to 39.3% of patients.[9,10] Arthroscopy is not required to perform this technique but could be added if needed or if preferred by the surgeon. The potential for early failure exists with this technique because the initial short-term stability is conferred primarily by suture tape fixation. Incomplete reduction before securing the suture tape or loosening or breakage of the suture could potentially lead to early graft attenuation or failure. Meticulous surgical technique is needed to ensure the success of this operation.

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