Technical Note

Rotator Cuff Repair With a Sutureless PEEK Implant

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Abstract: Rotator cuff tears are one of the most common tendon injuries. Despite advancements in rotator cuff repair techniques, outcomes remain variable. We describe repair of small rotator cuff tears with a sutureless PEEK (polyether ether ketone) implant, which eliminates the need for suture management, avoids knot tying, provides multiple fixation points, and distributes compression over a broad surface area that may enhance blood flow and healing.

Rotator cuff tears (RCTs) are the most common tendon injury in the United States, with approximately 30% of people older than 60 years having a tear.[1] Less than 5% of those with a tear will undergo surgery, with a projected annual repair rate of 331 per 100,000 people in 2022.[2,3] Current gold-standard treatment for RCTs is a transosseous equivalent double-row suture repair.[4] Failure of these anchors typically occurs at the suture-tendon interface,[5] and complications include knot impingement, suture-tendon cut-through, and anchor pullout.[4,6] Suture anchors can be challenging due to the complexity of suture management required to compress the rotator cuff against the humerus appropriately.[7,8]

In this article, we describe a technique for rotator cuff repair (RCR) using a sutureless PEEK (polyether ether ketone) implant (Sinefix; Inovedis) indicated for repair of small RCTs. The implant consists of a base plate marked with pins that capture the rotator cuff tendon and lateral tab that 2 barbed anchors fixate. This implant removes the complexity of suture management and knot tying from RCR.

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Surgical Technique

The patient is placed in the beach-chair or lateral decubitus position based on surgeon preference. The cadaver shoulder in this technique is positioned in lateral decubitus (Video 1). The skin is marked for RCR, and posterior and lateral portals are created. The implant requires an impact angle of 45° to 90° with a more perpendicular angle being favored. If this impact angle cannot be attained from the lateral portal, an additional portal can be created more superiorly. The subacromial bursa is cleared off the RCT with a shaver. The RCT is then identified to ensure it is consistent with a small tear, and the bony footprint on the greater tuberosity is debrided with a shaver to create a bleeding bed for optimal bone-tendon healing (Fig 1).

The implant comprises the medial and lateral anchor with the base plate and attached lateral tab. The base plate is 10 mm in diameter and 0.7 mm proud. The 11 base plate teeth are each 0.61 mm thick and 2.46 mm long. Required instrumentation includes a stop clip, a 12-mm trocar, a trocar tip, a medial anchor push rod, a medial anchor release tube, a repusher, a base plate inserter, a lateral anchor release tube, and a lateral anchor push rod (Fig 2).

The trocar is introduced into the joint through the lateral portal, and the trocar tip is removed. A medial anchor inserter is then created by placing the medial anchor push rod into the medial anchor release tube. The medial anchor is then placed onto the inserter. Care should be taken to ensure that the anchor is fully pushed against the anchor push rod. The anchor inserter is then passed through the base plate inserter, leaving enough room for the stop clip to be attached. The inserter and base plate inserter should be aligned using their respective guidelines found on the proximal

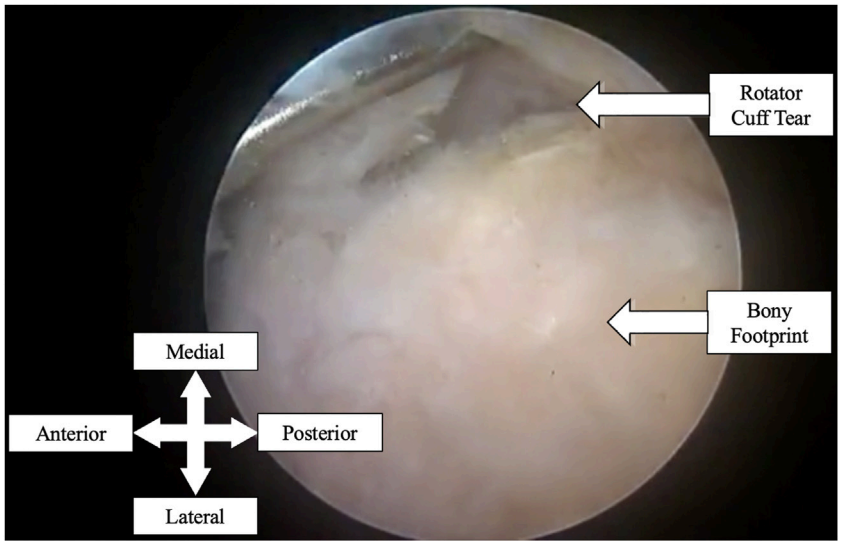

Fig 1. The rotator cuff tear is identified, and a bony footprint is created with a shaver.

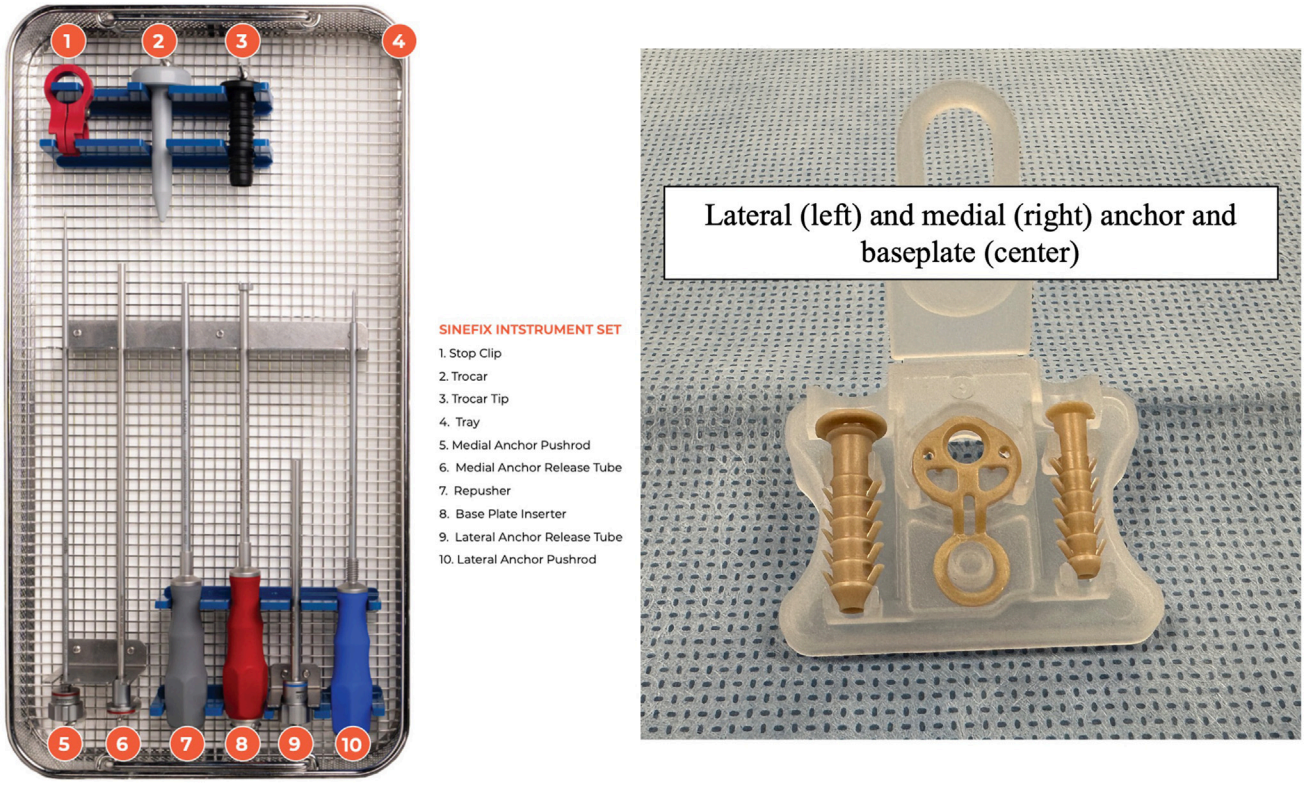

Fig 2. The PEEK (polyether ether ketone) sutureless implant (right) includes the medial and lateral anchor and the 10-mm diameter base plate and attached lateral tab. Required instrumentation (left) includes a stop clip, a 12-mm trocar, a trocar tip, a medial anchor push rod, a medial anchor release tube, a repusher, a base plate inserter, a lateral anchor release tube, and a lateral anchor push rod.

end of the inserter. The stop clip is then pushed onto the medial anchor inserter between the push rod and release tube. The base plate is then attached to the base plate inserter, ensuring that the notch on the inserter and the tab on the base plate are aligned (Fig 3).

The medial anchor with the attached base plate is introduced on the inserter into the joint through the 12-mm trocar. The rotator cuff is pierced with the inserter and mobilized over the prepared bony footprint. The implant should be oriented such that all teeth

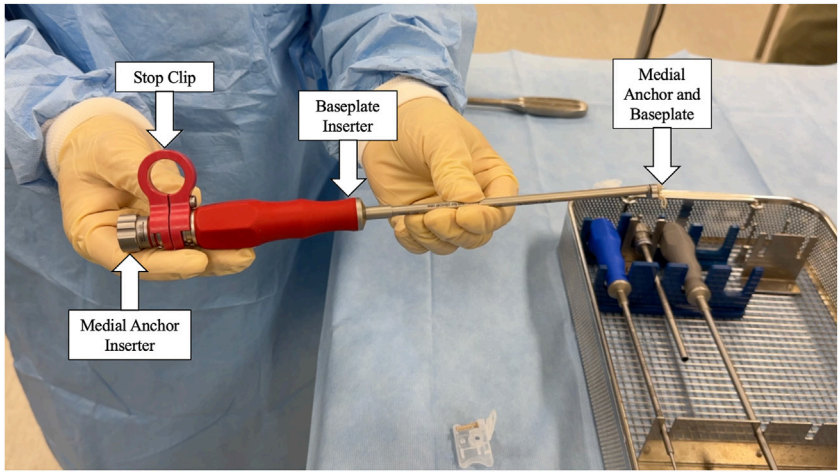

Fig 3. The medial anchor inserter, comprising the push rod and release tube, with the placed medial anchor, is inserted into the base plate inserter. The stop clip is then attached between the push rod and release tube. The base plate is then placed onto the base plate inserter.

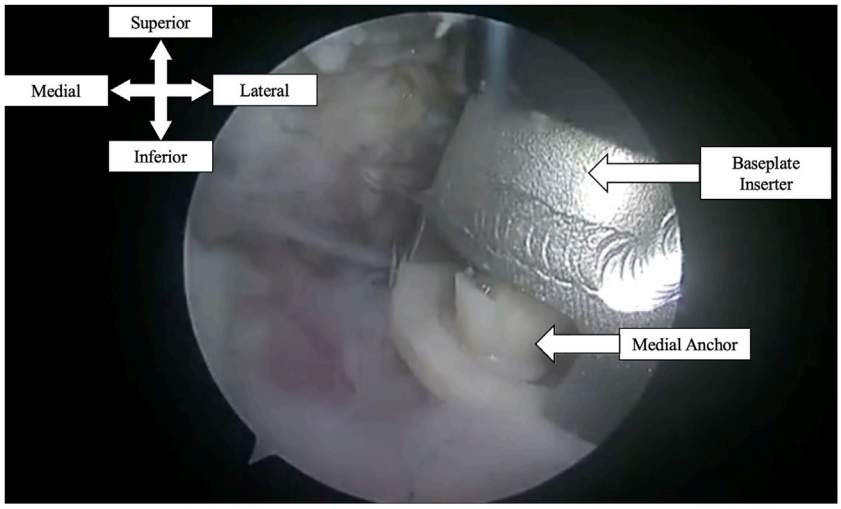

Fig 4. The medial anchor and base plate are implanted through the rotator cuff into the humeral head by malleting the medial anchor inserter at the bony footprint. Before malleting, the stop clip is removed. The surgeon should continue malleting until the push rod is seated against the release tube.

of the base plate are engaged with the rotator cuff. The lateral anchor base plate tab should be positioned just lateral to the bony footprint. After the rotator cuff is mobilized over the bony footprint, remove the stop clip from the medial anchor inserter and drive the medial anchor into the bone by malleting the inserter with light strokes (Fig 4). Continue malleting until the medial anchor push rod is seated against the medial anchor release tube. The medial anchor can be malleted with an impact angle of 45° to 90°. A perpendicular impact angle is optimal. If this impact angle cannot be achieved, mobilization of the rotator cuff and malleting of the medial anchor can be completed via a more superiorly placed portal. The base plate inserter and medial anchor inserter are removed, and the repusher is inserted into the joint. The tip of the distal end of the repusher is placed in the central canal of the medial anchor (Fig 5). The repusher should be lightly malleted until the medial anchor is seated against the base plate so that the base plate's pins have fully captured the tendon. Care should be taken to ensure that the pins do not penetrate the bone and that the base plate does not overcompress the tendon to allow adequate circulation.

The lateral anchor inserter is assembled by placing the lateral anchor push rod into the lateral anchor release tube (Fig 6). The lateral anchor is attached to the lateral inserter, ensuring the anchor is fully pushed onto the push rod and introduced into the joint via the lateral portal (Fig 7). The anchor tip is placed within the lateral tab of the implant and malleted down perpendicular to the bone (Fig 8). Instruments are removed from the joint, portals are closed in standard fashion, and the patient is placed in a sling.

Rehabilitation

The postoperative protocol for RCR with a sutureless PEEK implant focuses on gradually restoring range of motion, initially placing the operative limb in a sling for

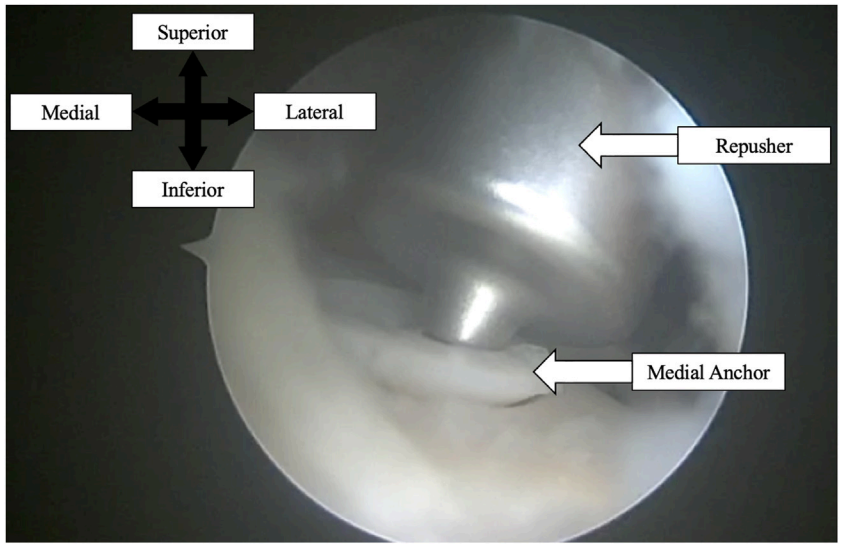

Fig 5. The tip of the repusher is inserted into the central canal of the medial anchor to appropriately seat the base plate such that it does not push into the rotator cuff.

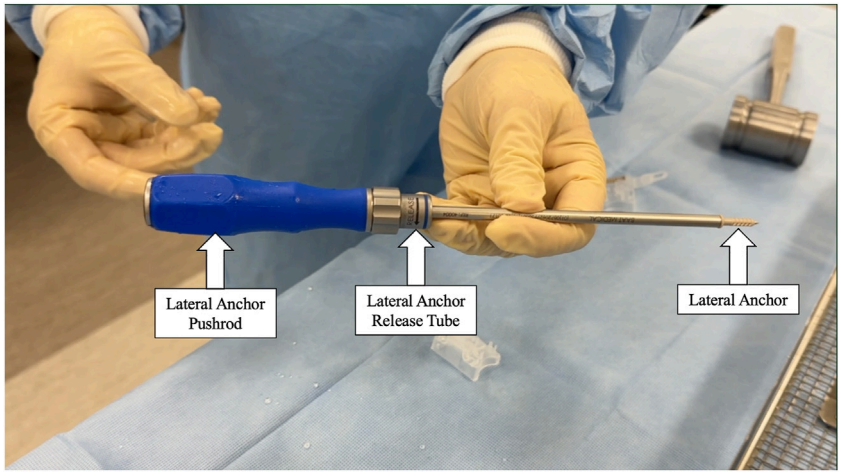

Fig 6. The lateral anchor inserter is assembled by placing the lateral anchor push rod into the lateral anchor release tube. The lateral anchor is then placed into the lateral anchor inserter.

approximately 4 to 6 weeks and progressing to full range of motion over the subsequent 6 weeks. Rehabilitation progresses from basic upper extremity exercises and stretching in the early weeks to resistance exercises of the shoulder initiated around 12 to 16 weeks.

Discussion

The proposed technique aims to simplify RCR for small tears by removing the management of sutures during the procedure. This technique reduces the steps required to compress the rotator cuff against the bony footprint. Arthroscopic knot tying for suture anchors can be time-consuming, regardless of the surgeon's skill level.[9,10] Removing suture management required in single- and double-row repairs could decrease rotator cuff operative time, which improves pain at rest and strength testing at 6 months postoperatively.[11] Decreasing operative time has also shown to prevent decreases in the Constant score, a measure of shoulder function, and external rotation at 1 year postoperatively.[12,13] There may also be decreased soft tissue manipulation that causes inflammation, resulting in reduced postoperative edema.[14]

Sufficient blood flow through the repaired rotator cuff is necessary for healing at the tendon-bone junction.[15-18] The design of the implant aims to expand the axial compressive force on the fixated RCT to increase blood flow near the tear. Double- and single-row repair relies on compression from overlying sutures on the rotator cuff that increasingly compromises blood flow as greater tension is placed on the rotator cuff.[19,20] The design of the circular base plate, with a diameter of 10 mm, spreads the compressive fixation forces over a larger surface than sutures. This may

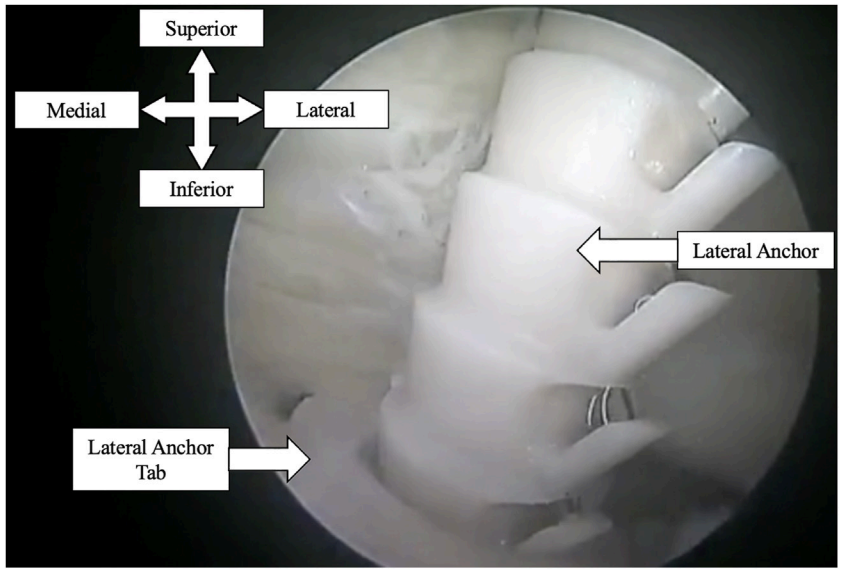

Fig 7. The lateral anchor inserter with the placed lateral anchor is implanted through the rotator cuff by malleting through the lateral tab of the base plate.

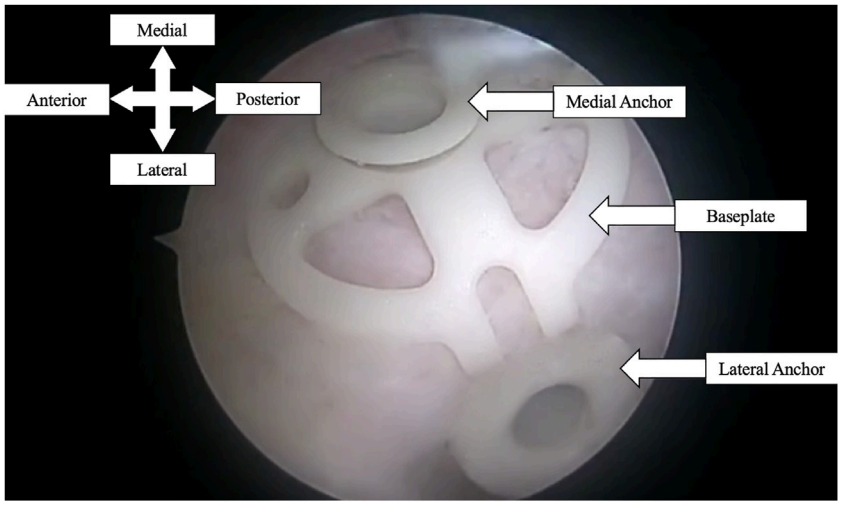

Fig 8. The medial anchor is seated against the base plate in the right shoulder.

allow for increased blood flow to the tear end and possible improved healing at the tendon-bone junction.

Suture-tendon cut-through, one of the most common reasons for RCR failure, results from the mediolateral tension forces of the rotator cuff and sutures.[21-23] As more sutures pass through the rotator cuff, less pressure is applied as each suture adds a fixation point.[24,25] This reduces the load the soft tissue needs to resist to prevent cut-through. Two fixation points are generally created for double-row repair of small RCRs. Comparatively, the implant provides 12 fixation points from its 11 teeth and medial anchor, potentially decreasing tendon cut-through.

This technique, however, is not without disadvantages. If an appropriate impact angle cannot be attained for base plate insertion, additional portals may need to be created. Also, the implant, if not appropriately seated, may cause friction and impingement in the subacromial space. Tables 1 and 2, respectively, summarize this technique's advantages and disadvantages, as well as pearls and pitfalls. In conclusion, we present a technique utilizing a sutureless PEEK implant for small RCTs.

Table 1. Advantages/Disadvantages

Advantages	Disadvantages
Potentially increased blood flow to rotator cuff tendon	Only viable for small tears
Decreased cost	Larger portal needed for sutureless PEEK implant
Foregoes suture management	Potential for shoulder impingement
Decreased operative time	Lack of long-term, clinical outcomes

PEEK, polyether ether ketone.

Table 2. Pearls and Pitfalls of Sinefix

Pearls	Pitfalls
Ensure the medial anchor can be malleted into the humeral head with an impact angle of 45° to 90°.	Over-malleting the medial anchor overcompresses the rotator cuff, decreasing blood flow.
Before malleting the medial anchor, ensure the base plate is fully positioned over the rotator cuff to provide appropriate coverage.	Use on larger rotator cuff tears may not allow for adequate compression.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: E.W.B. is a board member of EBSCO and is a consultant or advisor for Link Orthopaedics Pty Ltd and Orthopaedic Design NA. A.J.C. is a board member of the American Orthopaedic Society for Sports Medicine and is a consultant or advisor for Arthrex. A.M.M. is a board member of *Arthroscopy*; is a consultant or advisor for Arthrex, CONMED Linvatec, Fidia Pharma USA, and Miach Orthopaedics; and has equity or stocks with Reparel. All other authors (C.A.R., D.D., H.V.B., M.L.H., T.B.E.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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