



Tripod Technique to Augment Transosseous Equivalent Rotator Cuff Repair

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Abstract: The transosseous-equivalent Speedbridge™ technique is commonly used during rotator cuff repair; however, the soft bone of the lateral humerus may result in toggling of the lateral row anchors with subsequent de-tensioning of the repair. The technique presented here uses an additional third-row anchor, in a tripod fashion, that reduces the forces on the lateral humerus anchors and protects the repair.

Arthroscopic transosseous double-row techniques are a preferred method for rotator cuff repair because they enable a large contact area and downward pressure on the rotator cuff, which improves fixation.^{1,2}

Retear rates can be high, and the causes are multifactorial.³⁻⁵ The transosseous-equivalent technique has an inherent weakness in that the construct is linked, and therefore failure in one component de-tensions the whole construct.

The lateral row of anchors is the most biomechanically vulnerable.^{2,6} The lateral row anchors can toggle in the relatively soft bone of the lateral humerus, with the cortical end of the screw tilting proximally under the load of the FiberTape suture (Fig 1). This often happens in patients who are elderly or have reduced bone mineral density in the greater tuberosity.⁷

We describe fixation of the rotator cuff using the Arthrex Speedbridge™ technique with the addition of a

third-row “tripod anchor,” using a guy wire principle, to support the lateral anchors. The guy wire principle is often used in construction to add stability to a structure and resist a predictable load. This principle is simply demonstrated when constructing a tent: the individual pole at one end of the tent is supported by 2 guy ropes, which provide opposing forces and add stability to the construct (Fig 2).

Technique

Patient Positioning

A transosseous-equivalent rotator cuff repair is performed in the conventional manner with the patient set up in the lateral decubitus position with 10 lbs of skin traction. This is down to surgeon preference, but the lateral decubitus position helps to reduce intraoperative brain hypoperfusion and allows distraction of the glenohumeral joint for better articular visualization.

Sterile Preparation

The patient is prepped by removing body hair over the area with clippers in the anesthetic room. Once the patient is anesthetized, the whole arm from axilla to fingertip is prepped with Chloraprep (2% chlorhexidine gluconate/70% isopropyl alcohol), and the hand and forearm are wrapped in stockinette and sterile drape. The shoulder is draped according to protocol, allowing visualization of the shoulder itself. The shoulder is prepped again with Chloraprep, and the surgical team change outer gloves. At this point, the important anatomic landmarks can be marked in patient-friendly permanent marker.

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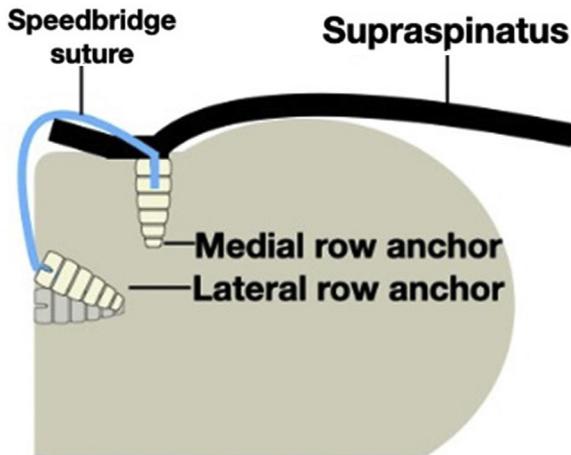


Fig 1. Coronal illustration, with the patient in the lateral decubitus position, showing the right proximal humerus and supraspinatus tendon, demonstrating the transosseous-equivalent suture bridge repair. It demonstrates the detensioning of the rotator cuff repair if the lateral row anchor toggles in the soft bone of the greater tuberosity, weakening the whole repair construct.

Portal Placement

The operative arm is abducted to 30°, and a standard posterior portal is placed, along with a lateral working portal through which the procedure is carried out. A 30° scope is inserted, and the tear pattern and mobility of the tendon are checked.

Medial Row Placement

This technique is initially performed similarly to the Speedbridge. The anteromedial anchor is inserted first, just behind the biceps. Lateral traction is applied, and an

elevator is used to lift the supraspinatus and show the footprint on the humerus. The punch is inserted to prepare the bone, and the SwiveLock™ device is preloaded with the white and blue FiberTape suture. At this stage, if the bone is felt to be soft, the tripod technique should be considered (Table 1). The anchor must be inserted perpendicular to the bone and the thumb pad held steady; the driver handle should be rotated in a clockwise direction until the anchor body is flush with the bone. The FasPass Scorpion™ is used to pass the tail of the FiberLink™ suture through the rotator cuff and then move the tail to the anterior portal. Both ends of the FiberTape must be retrieved one at a time from the medial row anchor, through the anterior portal, using the FiberTape Retriever™. These steps are repeated for the posteromedial anchor, making sure to use a black and white FiberTape to help suture recognition when performing the lateral row.

Lateral Row Placement

Ensure the arm is abducted at this point to give good access for the lateral row. Load 1 suture limb from the anteromedial row anchor and 1 limb from the posteromedial row anchor into the SwiveLock device via the posterior portal. Prepare the posterolateral bone socket with a punch, normally in the greater tuberosity and 1 to 2 cm inferior to the medial row. Use the SwiveLock loaded with the suture limbs from the medial row to tension both suture limbs, which will reduce the supraspinatus over the footprint and compress it down onto the bone. Advance the driver into the bone until the second laser line and the anchor meets the bone. Ensure that the tension on the construct is correct at this point, then rotate the SwiveLock driver clockwise

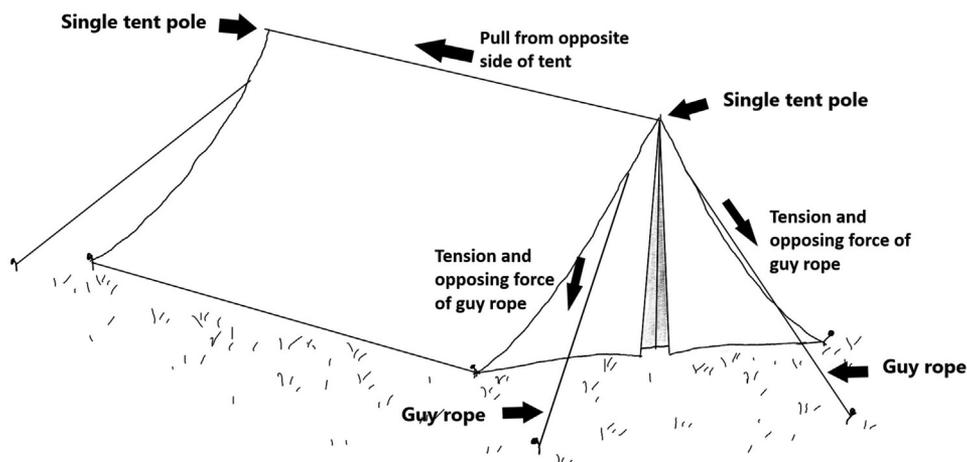


Fig 2. Illustration of a tent, demonstrating the guy rope principle. A central pole is held securely in place by 2 guy ropes that oppose the pull of the opposite side of the tent and make a stable and strong construct.

Table 1. Pearls of Wisdom for Performing this Technique

- The decision to use this technique can be made relatively early in the procedure if the bone is felt to be soft.
- If the FiberTape suture cuts through the lateral humeral cortex, consideration should be given to the procedure.
- Do not remove the eyelet sutures from the lateral row anchors until the final decision has been made.

until the anchor is flush with the bone. Repeat these steps to insert the anterolateral anchor using the anterior portal. This will produce a construct as illustrated in Fig 3, A and B. The only differences from the standard technique at this stage are that the eyelet retention sutures in the lateral row anchors are left in situ, and the working sutures are cut flush as demonstrated in the Video 1.

Tripod Anchor Insertion

If the bone is felt to be soft, then the 4 limbs of the eyelet sutures (FiberWire®; Arthrex, Naples, FL) are taken and passed through the working portal and loaded into the SwiveLock. The tripod anchor socket is prepared with a punch, placed 1 to 2 cm below and at the midpoint between the 2 previously placed lateral row anchors, illustrated in Fig 4, A and B. At this point, if the humeral bone is soft, no mallet is required, and the 4 eyelet suture limbs are tensioned against the lateral row anchors. The SwiveLock is rotated clockwise, and the anchor is inserted perpendicular to the bone until flush with the cortex. All 4 suture limbs can now be cut using the FiberTape cutter, and the portals are removed with wounds closed as the surgeon prefers. The final construct can be viewed through the lateral working portal (Fig 5).

The procedure is quick and simple to perform and requires the use of only 1 additional anchor.

Discussion

The primary goals for rotator cuff repair are to achieve secure fixation with maximal strength and increased contact pressure with the anatomic footprint site. This is proven with the evolution of single-row to double-row and suture bridge repair techniques.⁸

Repair of a rotator cuff into poor-quality bone is likely to lead to failure and high re-tear rates. The lateral row of anchors is known to be the most biomechanically vulnerable,^{2,6} and this is often due to failure of the anchors in the bone. The lateral row anchors can toggle in the relatively soft bone of the lateral humerus,⁷ with the cortical end of the screw tilting proximally under the load of the FiberTape suture (Fig 3). This will detension the suture construct, and the supraspinatus

tendon often lifts away from the greater tuberosity of the humerus as the shoulder moves and the anchor toggles. The reduced contact area between the tendon and bone, in the “healing zone,” is likely to result in a poorly healed tendon with a much reduced fixation strength.

The technique described here uses an anchor at a 90° angle relative to the bone in all 3 rows of the repair, and the eyelet of the anchor is buried. The angle of the force

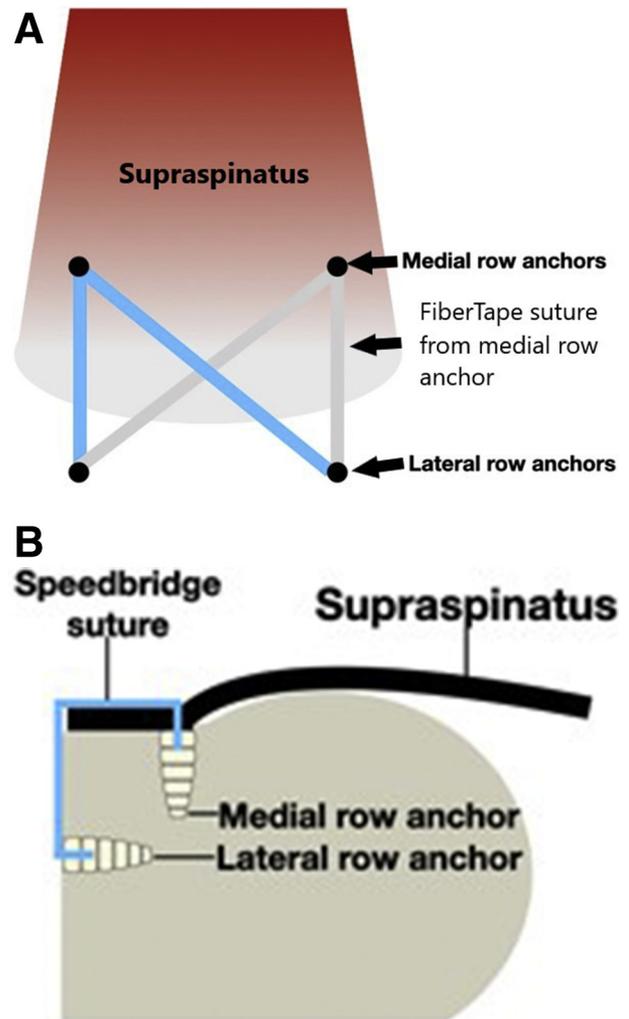


Fig. 3. (A) Illustration, with the patient in the lateral decubitus position, of the lateral view of the conventional transosseous equivalent rotator cuff repair, demonstrating the 2 FiberTape sutures, which come from each medial row anchor and are secured into the bone of the greater tuberosity via the lateral row anchors. This secures the supraspinatus tendon down over its anatomic footprint. (B) Coronal illustration of the right shoulder showing the proximal humerus and supraspinatus tendon and demonstrating the transosseous-equivalent suture bridge repair with medial and lateral row anchors correctly tensioned and inserted perpendicular to the bone, creating a strong construct.

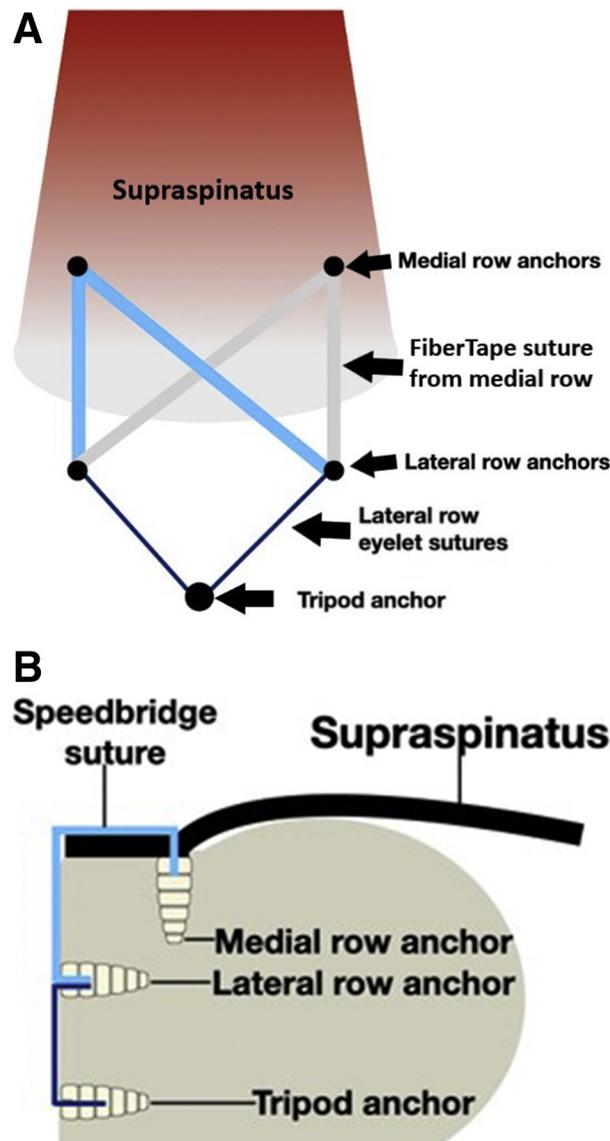


Fig 4. (A) Illustration, with the patient in the lateral decubitus position, of the lateral view of the tripod technique. It shows the well-established Speedbridge technique of medial and lateral row anchors pressing the supraspinatus tendon down onto its anatomic footprint on the greater tuberosity of the humerus. The retention of 2 eyelet sutures from the lateral row anchors is used to create the tripod anchor, which is in between and inferior to the lateral row. (B) Coronal illustration, with the patient in the lateral decubitus position, of the right shoulder, showing the tripod technique. It shows the well-established Speedbridge technique of medial and lateral row anchors pressing the supraspinatus tendon down onto its anatomic footprint on the greater tuberosity of the humerus. The retention of 2 eyelet sutures from the lateral row anchors is used to create the tripod anchor, which is in between and inferior to the lateral row. It demonstrates the correct insertion of the anchors perpendicular to the bone.

vector (pull of the rotator cuff) will be around 90° in the lateral row and around 90° in the third row, we propose.

The force vector of the supraspinatus tendon will vary in the medial row of anchors (purple arrows), depending on the motion of the shoulder (Fig 6). The medial row of anchors will pull superiorly away from the lateral row anchors (green arrow), around the greater tuberosity of the humerus. Securing the extra anchor in the bone inferior to the lateral row will

provide a counterforce, parallel to the humeral shaft, that will pull the lateral anchor row inferiorly with the added downward force from gravity (red arrow). The rotator cuff vector is likely to vary in both magnitude and direction owing to the different movements of the shoulder; however, the extra anchor will provide countertraction on the lateral row, resulting in a biomechanically strong construct and demonstrating the guy wire principle. Deadman's angle,⁹ first described by Burkhart, dictated that the anchor should

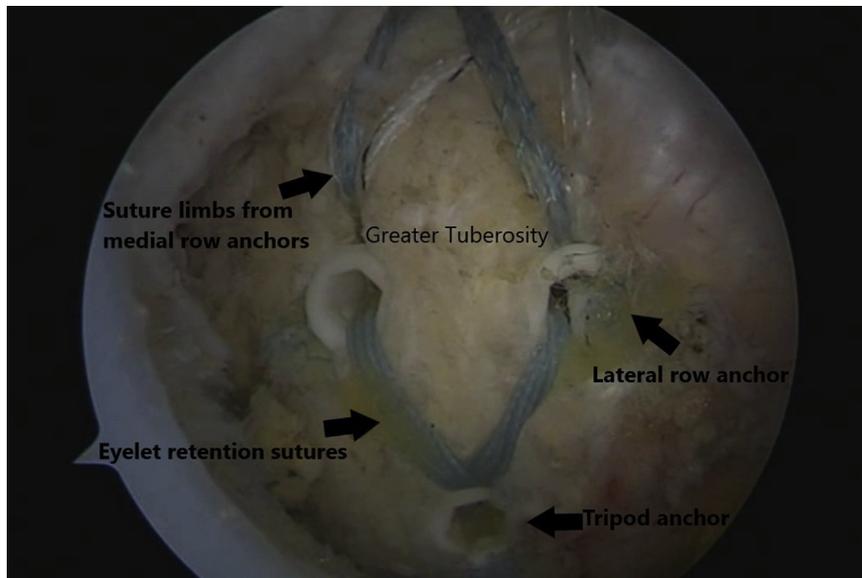


Fig 5. Intraoperative video still of an arthroscopic repair of a left rotator cuff with the patient in the lateral decubitus position, viewed from the lateral working portal. It demonstrates the final repair construct of a medial and lateral row of anchors secured further by the tripod anchor discussed in this Technical Note.

be inserted at 45° to the surface of the humerus to increase pullout strength.⁸ However, in poor-quality bone, an anchor inserted at 45° to the bone is likely to cause toggling, and the suture will pull through the bone as forces increase. Thus the tripod anchor in our technique is inserted at 90° to the bone, which gives a vector opposing the pull of the tendon and a stronger fixation in poor-quality bone. An overall stronger construct is likely to increase the contact area

and time between the supraspinatus tendon and the bone, which will encourage healing.

This approach should be used by an experienced surgeon who recognizes the poor-quality bone early intraoperatively or before the procedure (Table 1). It requires only 1 additional step to the Speedbridge technique and 1 additional anchor; therefore, it is quick to perform and has a small supplemental cost. The risks of the procedure will be like those of any arthroscopic rotator cuff repair, and patients are unlikely to experience any additional problems secondary to the added anchor. Limitations of this technique include punching another hole in already poor-quality bone and the risk that the repair will fail.

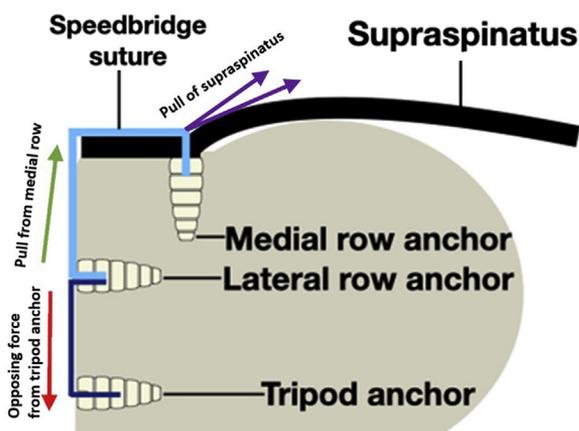


Fig 6. Coronal illustration, with the patient in the lateral decubitus position, of the right shoulder, demonstrating the final image of the tripod technique. The image shows the forces that are pulling on the construct during movement of the shoulder. The red arrow represents the opposing pull of the tripod anchor against the lateral row. The green arrow represents the pull of the medial row of anchors on the lateral row, and the purple arrow shows the pull of supraspinatus muscle.

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