Technical Note

Nanoscopic Distal Biceps Repair With Cortical Button and Interference Screw

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Abstract: Distal biceps pathology can be addressed using different techniques, each with its advantages and disadvantages. The current trend is to move toward minimally invasive procedures based on feasibility and known clinical benefits. Endoscopy for distal biceps pathology is a safe procedure. Through the NanoScope, this procedure is even more effective and safer.

Distal biceps tendon (DBT) ruptures are uncommon, occurring at a rate of 2.5 per 100,000 patient-years, and can result in a significant loss of functional supination and flexion strength and a decrease in the resistance to fatigue.[1] They predominantly affect the dominant extremities of middle-aged, active men who engage in weight-lifting activities.[2] These injuries usually occur when the biceps undergo strong eccentric contraction.[3,4]

Substantial debate continues regarding surgical indications, single-incision versus double-incision techniques, and fixation options.[1] It is widely accepted that surgery leads to optimal recovery in patients with complete tears.[4,5] Without operative repair, a significant decrease in endurance and supination (40%) and flexion (30%) strength can be expected.[3]

Surgical repair is performed using either a 1-incision or 2-incision approach. Multiple fixation methods have been developed, including bone tunnels, suture anchors, intraosseous screws, and suspensory cortical buttons.[2,3,6] Biomechanical evidence showed a significantly stronger initial fixation strength of the cortical button and the cortical button/interference screw construct than the suture anchor and interference screw alone.[4] The overall complication rate reported in open techniques is 25% with a major complication rate of 4.6%, with transient lateral antebrachial cutaneous nerve neuropraxia or radial sensory nerve paresthesia as the most common complications.[7]

Endoscopic techniques help diagnose the extent of partial tears. Inspection of the distal insertion of the short head can disturb the tendon. Biceps endoscopy has been proposed to overcome this disadvantage, with similar results compared with the standard open incision in terms of complications.[8,9]

Nanoscopic techniques recently have emerged in orthopaedics to limit the size of surgical incisions and reduce the risks associated with surgical procedures. Their use has recently been reported in the anterior labral repair of the shoulder, proximal biceps tenotomy, distal clavicle resection, medial meniscus repair, and anterior and posterior cruciate ligament reconstruction, among others.[10-14] All aim to minimize risks around exposure, visualization, and local tissue disruption.

We present a nanoscopic technique to assist in the repair of total acute rupture of the distal biceps muscle. We believe this will help achieve better visualization and protection of at-risk neurovascular structures and minimize associated complications (Table 1).

Surgical Technique (With Video Illustration)

This procedure (Video 1) was performed in patients with complete avulsion of the DBT, clinical diagnostic

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Table 1. Pearls and Pitfalls of Nanoscopic Distal Biceps Avulsion Repair

Pearls	Pitfalls
Identify the biceps tendon stump, subcutaneous, proximally, and ulnar. Use the dry nanoscope view.	Avoid releasing, or holding the lacertus fibrosus
After loading the biceps sutures in the BicepsButton, pass again one strand thought the biceps 15 mm proximally.	Avoid capturing or pressing other structures during the search for the tendon stump, and injury to the radial or brachial vein.
Drill the bicortical 3.2 tunnel and 8-mm monocortical with direct nanoscopic view from the radial aspect.	Avoid the passage of the FiberLoop between both fascicle of the biceps tendon, to prevent slippage of the suture configuration
Perform a subtle elbow flexion (20°) to insert the tendon easier into the bone tunnel	Avoid drilling too eccentrically, due to a high risk of cortical fracture
Using the screwdriver, move the tendon to an ulnar position and then place the PEEK screw in the radial aspect of the bone tunnel	Avoid drilling too perpendicular to the radius, due to the risk of damaging the PIN in the posterior cortex (hypersupine and tilts ulnar 30°, to avoid this)

PIN, posterior interosseous nerve.

evaluation, and imaging (magnetic resonance imaging or ultrasonography) with an evolution time of less than 21 days. Patients with partial or chronic complete tears with a time of injury greater than 21 days were excluded.

Position and Setup

Patients are placed in the supine position (Fig 1), with the arm out on the lateral hand table. We use a disposable sterile ischemia system (HemaClear, OHK Medical Devices, Inc., Grandville, MI). All patients receive general anesthesia and local infiltration after the procedure with 10 mL of bupivacaine, 0.25%. A soft compressive bandage with Coban (3M, St. Paul, MN) is used from the tips of the fingers to 4 cm distal to the approach to avoid secondary edema.

Fig 1. Position and surgical setup. The patient is in the supine position, with the arm positioned lateral on the hand table. Fluoroscopy and NanoScope monitors are placed on the opposite side.

Anterior Approach (1-cm Endoscopic Portal)

Under fluoroscopic assistance, the bicipital tuberosity of the radius is identified, and a skin mark is drawn to guide a 1-cm-long longitudinal incision (Fig 2 A-C). We identify the lateral antebrachial cutaneous nerve using 2 Langenbeck-type retractors and dissection scissors (Fig 2D). We then perform a proximal subcutaneous dissection toward the elbow to create a cavity.

Identification and Preparation of the Biceps Tendon

Under dry vision with the NanoScope (Arthrex, Naples, FL), we identify the retracted stump of the bicep tendon, which is often in situ because of the lacertus fibrosus; with an Allis clamp, we exteriorize it through the 1-cm portal (Fig 3A).

We mobilize it and resect part of the synovial sheath and the distal 5 mm of the tendon (the tendinosis area). A Krackow stitch is performed with FiberLoop (Arthrex), starting 4 cm from the end of the tendon and extending distally while alternately passing the suture between the 2 parts of the distal bicep tendon (short and long heads) to prevent suture slippage (Fig 3 B-C). Once the tubulization of the tendon is achieved, we alternately pass both strands of suture on the Biceps-Button (Arthrex) to achieve a sliding effect with tension (Fig 3D). To finish the preparation, with an eyed needle, we pass one of the suture strands through the biceps tendon 15 mm from the distal end, which facilitates the subsequent locking and knotting of the system.

Needle Endoscopy and Preparation of the Biceps Tuberosity

Through our 1-cm portal, as in the endoscopic technique previously described by Bain et al.[15], with blunt dissection, we identify the radius, place a Langenbeck retractor over the proximal radius on the lateral aspect, and a Homann retractor through the medial part of the

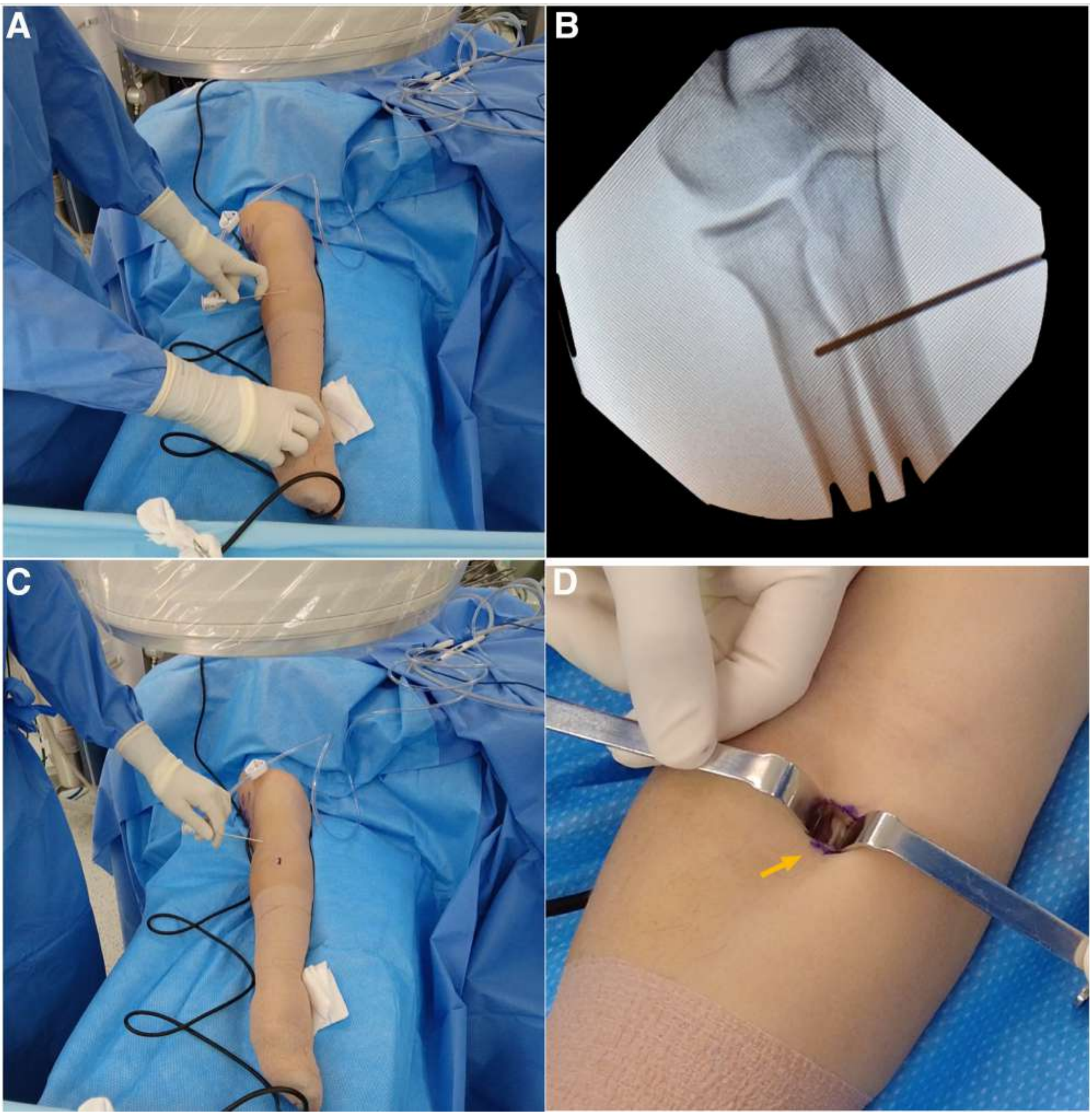

Fig 2. Anterior approach (1-cm endoscopic portal). The patient is in the supine position with the arm positioned lateral on the hand table. A, Define the position of bicipital tuberosity of the radius under fluoroscopy. B, Fluoroscopy image; trocar is over the objective. C, Mark on the skin the 1-cm anterior approach. D, Identify and protect the lateral antebrachial cutaneous nerve (yellow arrow).

radius to protect nerve and vascular structures during the procedure. We enter with the NanoScope connected to the Synergy pressure pump (Arthrex) with 100% flow and 40 mm Hg pressure. To fully observe the tendinous stump and footprint area, it is necessary to hypersupinate the forearm (Fig 4A).

Once the footprint is identified, we debride it with a shaver, place our guide needle (AK 1.1 mm), and confirm it using intraoperative fluoroscopy. Next, we place our 3.2-mm bicortical guide pin aiming to achieve at least a 30° ulnar angle (Fig 4B). A key aspect of this step is to maintain hypersupination to avoid injuring the posterior interosseous nerve as it passes through the second cortex. We then perform a monocortical tunnel with an 8-mm cannulated drill. We review our tunnel (Fig 4 C-D) and remove all of the bone debris, which is

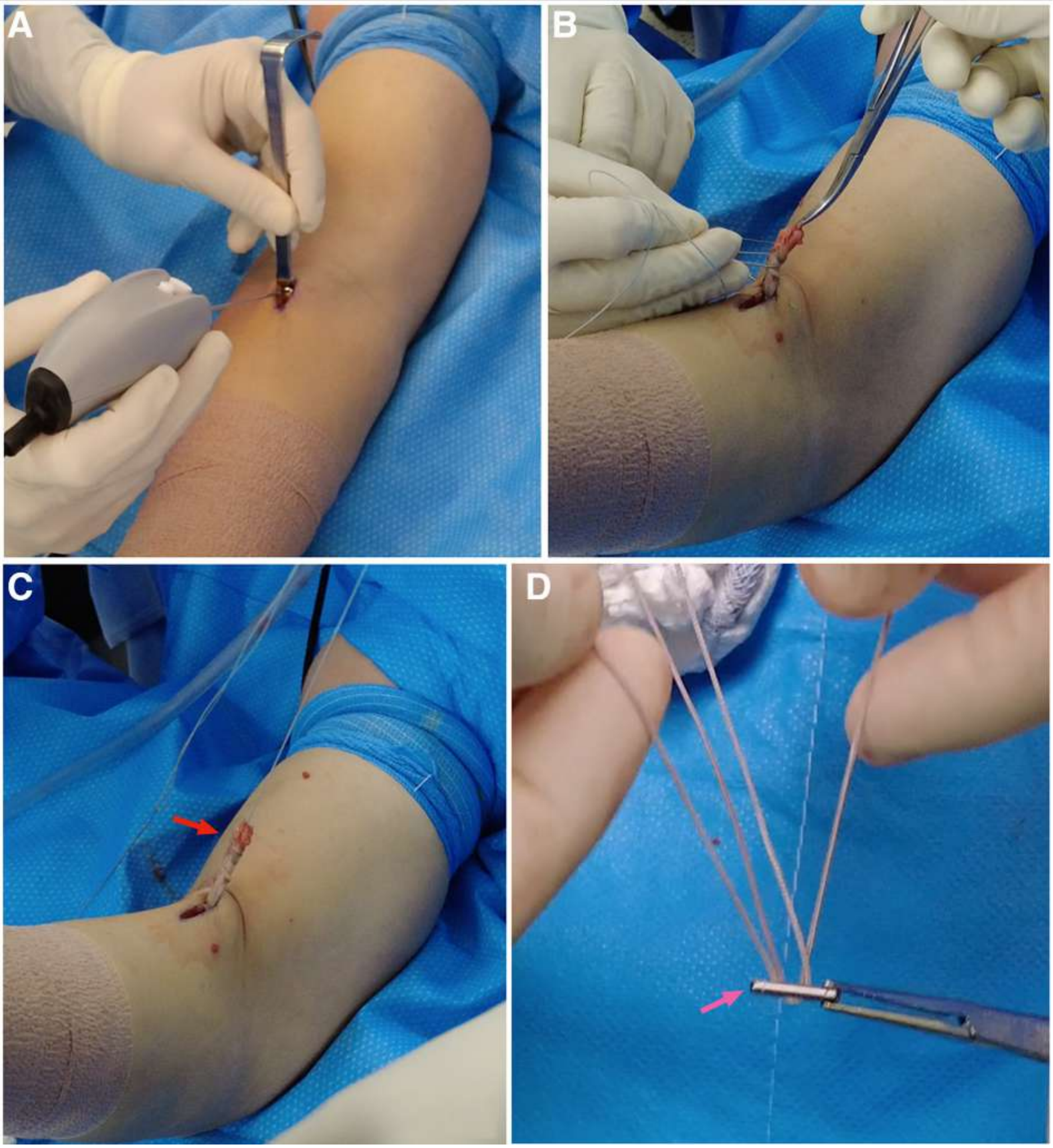

Fig 3. Identification and preparation of the biceps tendon. The patient is in the supine position with the arm positioned lateral on the hand table. (The top of the image is proximal and the right side is lateral.) (A) Dry subcutaneous nanoscopy to identify the stump of the biceps tendon. (B) Tubulization of the tendon with FiberLoop. (C) Mobilization of the distal biceps tendon (red arrow) to obtain good release. (D) Both strands of suture are passed on the BicepsButton (pink arrow) to obtain a tension—slide effect.

essential for reducing the risk of heterotopic ossification.

Tendon Reattachment and Fixation

With a direct vision of the tunnel, we insert the BicepsButton through the same anterior portal of the button inserter through both cortices to release and flip it (Fig 5A). Once this is confirmed, we advance our tendon by pulling our suture strands alternately. Sometimes, it is necessary to perform a subtle elbow flexion of 15 to 20° to achieve at least 15 mm of intra-osseous tendon (Fig 5B). We tie and block our system with a Revo knot using the strand that was previously passed through the tendon as a post suture. Finally, we

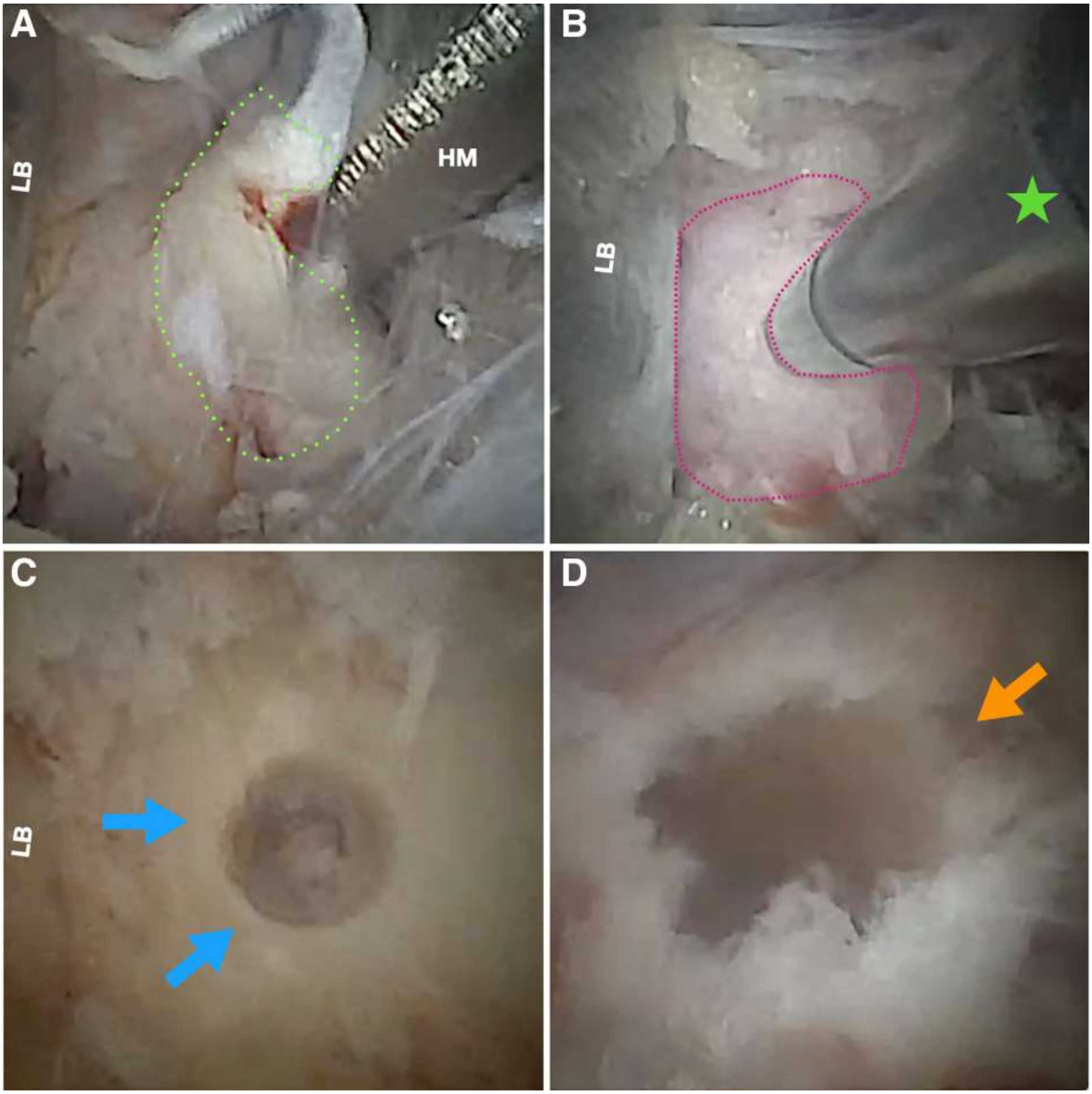

Fig 4. Needle endoscopy and preparation of the biceps tuberosity. Nanoscopic view (the top is proximal, inferior is distal, left is medial, and right is lateral) (A) Identify the remnant of the biceps tendon in the footprint (dotted green line); (B) Define the footprint area (pink area) and pass the 3.2 bicortical guide (green star). (C) Final view inside of bone tunnel, small drill hole (blue arrows) is in the middle of the 8-mm monocortical tunnel. (D) Final view of the superficial part of the bone tunnel of 8-mm weight (orange arrow). (HM, medial Homann retractor; LB, lateral Langenbeck retractor.)

place the 7 × 10-mm PEEK (polyether ether ketone) interference screw in the radial aspect of our tunnel to ulnarize the biceps tendon insertion (Fig 5 C-D).

Rehabilitation

We use a simple intermittent sling for the first 2 weeks and start self-assisted exercises of active flexion—extension and prono-supination to tolerance from day 1, avoiding passive pronation. We start rehabilitation assisted by a physiotherapist in the second week. Stretching exercises are reserved until week 6 and strengthening exercises around the third month. Patients usually return to normal daily activities, including sports, by the fourth month. We use heterotopic calcification prophylaxis to all patients for 21 days (celecoxib 200 mg once daily).

Discussion

When surgical management is preferred, different approaches to DBT pathology can be used. Traditional

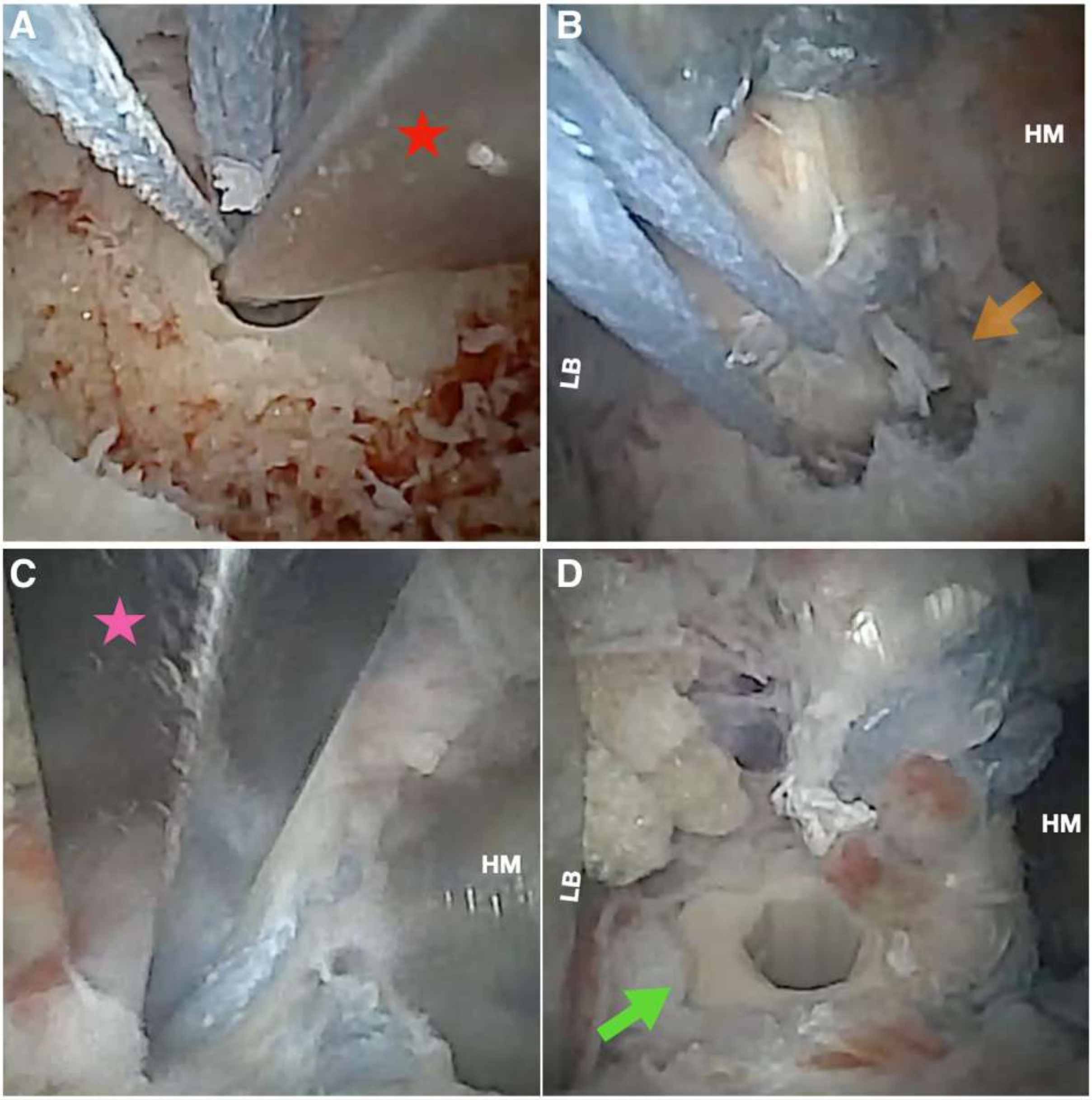

Fig 5. Tendon reattachment and fixation. Nanoscopic view (the top is proximal, bottom is distal, left is medial, and right is lateral). (A) Insertion of the BicepsButton in the deep cortical area with the specific button inserter (red star). (B) Biceps tendon reinsertion with almost 15 mm of the tendon intraosseous (orange arrow); one strand is outside the tendon and the second strand is inside the tendon for block the system with Revo knot. (C) Ulnarization of the tendon with a screwdriver post (pink star), to obtain a better anatomical position. (D) Final view of the reinsertion with the tendon in the ulnar part of the footprint and the PEEK interference screw in the radial position (green arrow). (HM, medial Homann retractor; LB, lateral Langenbeck retractor.)

surgical techniques, each with their advantages and disadvantages, are well known.[1-5]

To minimize surgical complications, orthopaedics and other fields of medicine have developed minimally invasive procedures. Arthroscopic, endoscopic, and, recently, nanoscopic procedures have emerged in this context.[10-14,16,17]

In DBT pathology, as described by Eames and Bain[15] in their endoscopic technique, a clear view of the tendons is provided and, as reported by Bhatia[18] in his cadaveric endoscopic anatomy description study of distal biceps, consistent anatomic landmarks are useful and safe to perform endoscopic DBT procedures. Caekebeke et al.[8] reported on the safety of this procedure. They found no differences in the proximity of neurovascular structures to the drill holes when comparing the traditional open technique with the endoscopic one.

Table 2. Advantages and Disadvantages of Nanoscopic Distal Biceps Avulsion Repair

Advantages	Disadvantages
Minimally invasive technique assisted by needle endoscopy	Associated cost
Less dissection, less swelling and pain.	Technically demanding, advanced arthroscopic skills
One anterior portal technique with retractors, less risk of vascular or nerve lesion	Less vision of surrounding structures in relation to the search for tendon stump in initial dry nanoscopy.
Use any system or device for distal biceps fixation	In initial cases, longer surgical time
Magnification view of biceps tendon footprint	

In summary, endoscopy is a useful and minimally invasive diagnostic and treatment approach for DBT pathology. Different procedures can be safely performed for partial or complete DBT tears. We believe that by using an even smaller scope and retractors for assistance, we can perform an even-safer procedure with this technique, allowing us to reach the footprint optimally without increasing the risk of neurovascular injury (Table 2).

There are a lack of large-scale clinical studies reinforcing what has already been demonstrated in cadaveric studies. We believe that these will be necessary to validate this procedure fully.

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