Technical Note

Endoscopic Application of a Collagen Scaffold for Treatment of Achilles Tendinopathy

Samuel Ka-Kin Ling, M.B.Ch.B., Ch.M., F.H.K.A.M., and Patrick Shu-Hang Yung, M.B.Ch.B., F.H.K.A.M.

Abstract: This technical note explores Achilles tendinopathy treatment, focusing on the endoscopic application of a bioinductive collagen scaffold, a different approach to this prevalent condition. Indications include symptoms of midportion Achilles tendinopathy that have not responded to nonsurgical treatment. A co-axial 2-portal Achilles tendoscopy using a 30° 4-mm arthroscope is performed with the patient in a prone position. The procedure involves standard Achilles tendoscopic debridement and adhesiolysis, followed by the scaffold's introduction through the proximal portal in a rolled-up state; this bioinductive collagen scaffold is then unfolded arthroscopically and on-laid over the tendinopathy site under tendoscopic visualization. The bioinductive scaffold is then anchored with soft-tissue anchors, after which the portal incision can be closed and the patient rehabilitated according to standard protocol. This technique is notable, as it negated the need for an open incision and instead uses endoscopy for the application of this collagen scaffold which can be a stand-alone treatment option for Achilles tendinopathy; or used in conjunction with other minimally invasive Achilles tendon treatment procedures such as an endoscopic flexor hallucis longus transfer.

Achilles tendinopathy, a prevalent condition lacking a definitive cure,[1,2] has prompted the exploration of various surgical techniques.[3-5] These techniques encompass tendon transfers,[6] microtenotomy, and debridement.[7] Among these options, endoscopic debridement[8] stands out because of its ability to mitigate the complications associated with open surgery, such as wound problems necessitating flap surgery.[9] In addition, novel treatments have emerged, ranging from noninvasive interventions like pulsed electromagnetic field therapy[10,11] to biologics. One such innovative treatment involves the use of a bovine type 1 collagen scaffold (REGENETEN, Smith & Nephew).[12,13] Although previous reports have detailed its application through open surgery, this technical note aims to present a simpler and more effective approach by employing endoscopic techniques for the application of this collagen scaffold.

From the Department of Orthopaedics and Traumatology, Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong SAR (S.K-K.L., P.S-H.Y.); and Orthopaedic Learning Centre, The Chinese University of Hong Kong, Hong Kong SAR (S.K-K.L., P.S-H.Y.).

Received January 30, 2024; accepted April 15, 2024.

Address correspondence to Samuel Ka-Kin Ling, M.B.Ch.B., Ch.M., F.H.K.A.M., Dept. of Orthopaedics and Traumatology, 5/F LCW Clinical Sciences Building, Prince of Wales Hospital, HKSAR. E-mail: samuel.ling@link.cuhk.edu.hk

2212-6287/24162
https://doi.org/10.1016/j.eats.2024.103071

Indications for Surgery

Patients with symptoms of midportion Achilles tendinopathy characterized by localized pain 2 to 6 cm proximal to the Achilles insertion can be eligible. Patients should undergo a course of conservative management including physiotherapy, pulsed electromagnetic field therapy, orthotics, to name a few, before considering surgical intervention; those who have suboptimal improvement from conservative treatment are indicated for surgery. Contraindications to endoscopic application of the collagen scaffold include documented allergies to bovine material and an active infection over the surgical site.

Surgical Technique

In this article, videos and photographs were taken from a cadaveric specimen. The surgical procedure is typically conducted with the patient under general or spinal anesthesia, although local nerve blocks can also be considered. The patient is positioned in a prone position with a thigh tourniquet applied.

As described in previous studies, Achilles tendoscopy is performed using the co-axial technique. It can either be a distal medial portal with a proximal lateral portal

or a distal lateral portal with a proximal medial portal. The proximal and distal portals can be used interchangeably as viewing and working portals, ensuring flexibility in the procedure. A 5-mm skin incision is created just medial (or lateral) to the Achilles tendon near its insertion into the calcaneum. A nip-and-spread technique is used until the Achilles tendon can be identified. Because of the limited anatomic space in the Achilles tendoscopy, the plane is initially created using a blunt instrument such as a hemostat from the distal portal. A 4-mm arthroscope (30° field of view, working length 160 mm; Smith & Nephew) is introduced from the distal viewing portal (Fig 1). The scope is then advanced proximally, past the region of tendinopathy, and crossing to the lateral aspect of the Achilles tendon (or the medial aspect if the initial distal portal was a lateral one).

The proximal portal is then created with the endoscopic light source, helping identify underlying neurovascular structures. The skin incision should be just lateral to the Achilles tendon and located ~6 to 7 cm from the Achilles insertion. When creating a proximal lateral portal, special care should be taken to avoid the sural nerve. A nip-and-spread technique should be employed for portal creation (Fig 1). Debridement and adhesiolysis (Fig 2) are performed using a 3.5-mm shaver (DYONICS; Smith & Nephew); ensure that an adequately healthy proximal Achilles tendon is visualized as the extent of debridement needed (Fig 3).

The collagen scaffold is introduced through the handle from the proximal portal (Fig 4) and deployed as an on-lay on the diseased tendon; the patch is initially curled, and an additional distal portal may be required to help unravel the collagen patch (Fig 5). Unfolding of the collagen patch is performed by firing the button on the handle; the patch will then be unraveled by the built-in metal prongs. Tendoscopic visualization is used to ensure the patch is placed at the region of tendinopathy.

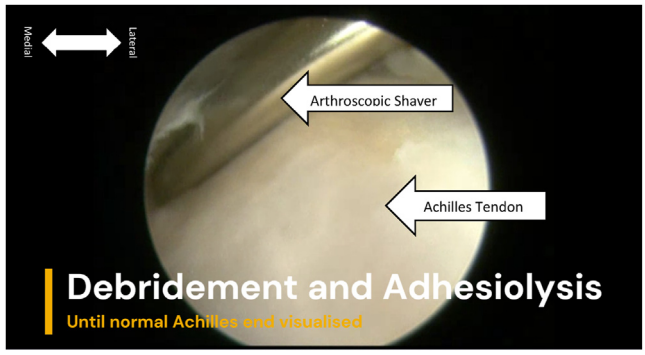

Fig 2. Visualization of the dorsal aspect of the Right Achilles tendon. This image shows the visualization of the Achilles tendon from a distal medial viewing portal. An arthroscopic shaver is inserted from the proximal lateral working portal, which allows debridement and adhesiolysis with an arthroscopic shaver to be performed.

The collagen patch can then be secured using the soft-tissue anchors (poly-L-lactic acid; Smith & Nephew). Place 2 anchors proximally and 2 anchors distally. The anchor is introduced and fired using the arthroscopic handle provided. It is important that the anchors are placed within the blue boundary of the collagen patch, as the patch has minimal mechanical properties. If the anchors are placed too close to the edge, there is a risk of cut-through (Fig 6).

Once the 4 anchors are deployed, the handle can be safely removed; take care to visualize a good "sit" of the collagen patch onto the tendinopathy region (Fig 7). Passive mobilization of the ankle joint with tendoscopic visualization of the collagen patch is advised to confirmed a stable fixation, additional soft-tissue anchors can be deployed as required. Wounds are then closed per usual hospital protocol; the author uses a layered closure with 4-0 VICRYL and 4-0 ETHILON sutures.

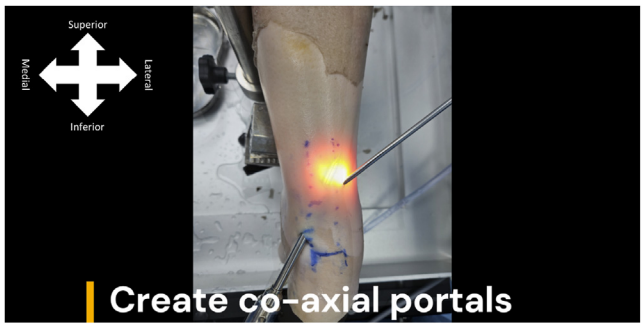

Fig 1. Right Achilles tendoscopy with coaxial portals. In this figure, we are visualizing the right hindfoot from the posterior aspect; this demo shows the use of the distal-medial and proximal-lateral co-axial portals. If the proximal-lateral portal is used, care must be taken to avoid the sural nerve; a "nip-and-spread" technique of the skin is advised.

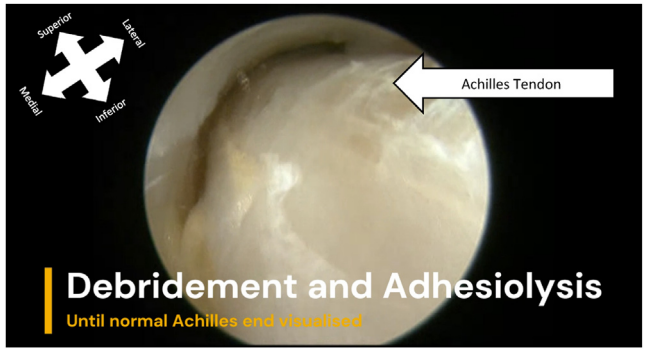

Fig 3. After adequate endoscopic debridement of the Right Achilles tendon, one should be able to visualize the underlying shiny Achilles tendon.

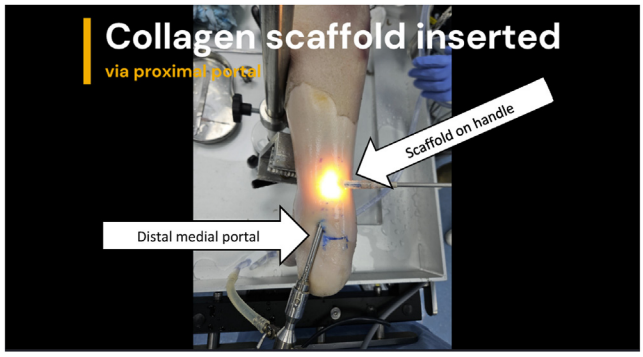

Fig 4. This illustration demonstrates how to handle the collagen scaffold by inserting it through the Right proximal-lateral portal. The process can be visualized through the distal medial portal. Note that the patch should be inserted in a curled-up position and later deployed and unraveled under tendoscopy with the help of a commercial handle.

Postoperative Rehabilitation

The stability of the fixation should be confirmed tendoscopically before closure of the wound with passive motion of the ankle joint. If performed as an isolated procedure, there is no need for additional protection and the patient is allow free mobilization and ambulation immediately after the surgery. Sutures will be removed at 2 weeks postoperatively, and the patient can undergo rehabilitation of Achilles tendinopathy by the physiotherapy department which involves loading and strengthening followed by functional training.

Discussion

Achilles tendinopathy is a common but difficult pathology to treat, with many patients not responding well to nonoperative therapy.[14] Endoscopic tendon Achilles tendon debridement and adhesiolysis have been effective in alleviating symptoms. Regenerative medicine techniques like stem cell therapy or acellular collagen scaffolds are becoming increasingly popular.

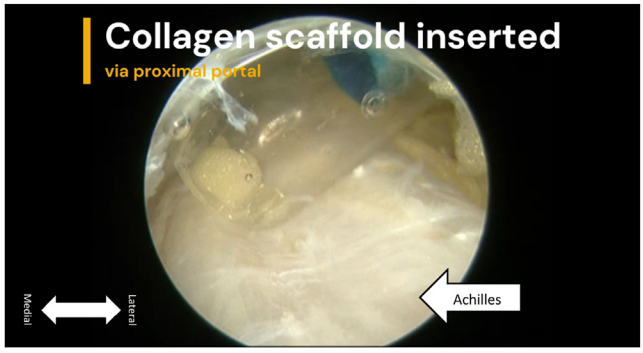

Fig 5. This is the tendoscopic view of the collagen patch inserter. It is inserted in a curled format on the superficial aspect of the Right Achilles tendon from the proximal-lateral portal; the visualization portal is from the distal-medial portal.

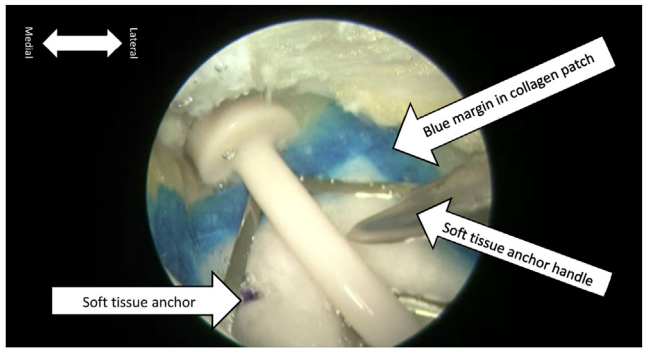

Fig 6. This is the Right Achilles endoscopic view from the distal medial portal while the patch is inserted via the proximal lateral portal. Once deployed, the metallic prongs will help unravel the collagen patch. This figure shows that one soft tissue anchor is already deployed in the proximal medial region, and the surgeon is currently inserting a soft tissue anchor in the proximal lateral region of the patch.

The bioinductive type 1 collagen patch created from Bovine Achilles tendon (REGENETEN), has shown promising results as a surgical augmentation in patients with massive rotator cuff tears[15] and in patients with degenerative Achilles tendon rupture.

Advantages of this technique are that small tendoscopy incisions decrease the chance of a wound complications, which may be devasting in the region of the Achilles tendon.[9] Although application of the scaffold can be performed as an open procedure, the bioinductive collagen implant, which measures 20 mm (width) × 26 mm (length), requires an incision of similar length. Using this described endoscopic technique, the procedure can be performed using 2 tendoscopic portals. This is especially useful in cases in which the surgeon has performed adjunct procedures

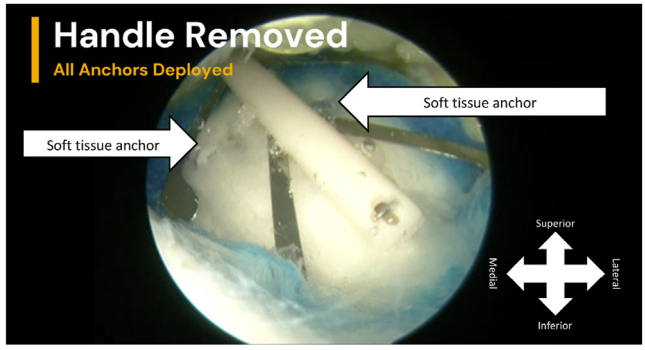

Fig 7. The collagen patch is placed beneath tendoscopic visualization via the distal medial portal during the procedure. The previously curled patch is then uncurled by triggering the handle and gently placed over the area of maximum tendinopathy. Arrows indicate the soft-tissue anchor placement. It is important to note that anchors should be secured within the boundaries and at the edge of the patch, shown in blue, to ensure proper placement.

minimally invasively, such as an endoscopic flexor hallucis longus transfer or endoscopic calcaneoplasty to maintain the benefits of a minimally invasive surgery. In addition, aside from treatment of tendinopathy; this technique can also be used in cases of Achilles tendon rupture.[16] Specifically for repairs using percutaneous or minimally invasive techniques, an endoscopic procedure would be consistent to the aim of percutaneous surgery. In conclusion, we present the technique of a simple tendoscopic assisted application of a bioinductive collagen patch for treatment of Achilles tendon disorders.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: S.K-K.L. reports consulting or advisory with Smith & Nephew. P.S-H.Y. reports consulting or advisory and lecture fees with Smith & Nephew.

References

1. Ko VM, Cao M, Qiu J, Fong IC, Fu SC, Yung PS, Ling SK. Comparative short-term effectiveness of non-surgical treatments for insertional Achilles tendinopathy: A systematic review and network meta-analysis. *BMC Musculoskelet Disord* 2023;24:102.
2. Li HY, Hua YH. Achilles tendinopathy: Current concepts about the basic science and clinical treatments. *Biomed Res Int* 2016;2016:6492597.
3. Carreira D, Ballard A. Achilles tendoscopy. *Foot Ankle Clin* 2015;20:27-40.
4. Wagner P, Wagner E, Ortiz C, Zanolli D, Keller A, Maffulli N. Achilles tendoscopy for non insertional Achilles tendinopathy. A case series study. *Foot Ankle Surg* 2020;26:421-424.
5. Lui TH. Endoscopic calcaneoplasty and Achilles tendoscopy with the patient in supine position. *Arthrosc Tech* 2016;5:e1475-e1479.
6. Batista JP, Del Vecchio JJ, van Dijk N, Pereira H. Endoscopic FHL transfer to augment Achilles disorders. *J ISAKOS* 2020;5:109-114.
7. Thermann H, Fischer R, Gougoulias N, Cipollaro L, Maffulli N. Endoscopic debridement for non-insertional Achilles tendinopathy with and without platelet-rich plasma. *J Sport Health Sci* 2023;12:275-280.
8. Steenstra F, van Dijk CN. Achilles tendoscopy. *Foot Ankle Clin* 2006;11:429-438, viii.
9. Ling SK-K, Mak MC-K, Lui TH. Considerations when performing soft tissue coverage procedures during revision foot and ankle surgery. In: Zgonis T, Roukis TS, eds. *Revisional and reconstructive surgery of the foot and ankle*. Philadelphia: Lippincott Williams and Wilkins, 2022.
10. Ko VM, He X, Fu SC, Yung PS, Ling SK. Clinical effectiveness of pulsed electromagnetic field therapy as an adjunct treatment to eccentric exercise for Achilles tendinopathy: A randomised controlled trial. *Trials* 2023;24:394.
11. Lui PP. Stem cell technology for tendon regeneration: current status, challenges, and future research directions. *Stem Cells Cloning* 2015;8:163-174.
12. Ng KMK, Chow MW, Liyeung LL, Ling SKK, Yung PSH. The application of a bioinductive implant in Achilles tendon repair: A case report. *J Clin Med Surg* 2022;2:1061.
13. Valk J, Wilk MJ, Murdock K, Saad MA. Bioinductive collagen implant augmentation for myotendinous Achilles rupture in a teenage competitive gymnast: A case report. *JBJS Case Connect* 2023;13(2).
14. Siu R, Ling SK, Fung N, Pak N, Yung PS. Prognosis of elite basketball players after an Achilles tendon rupture. *Asia Pac J Sports Med Arthrosc Rehabil Technol* 2020;21:5-10.
15. Camacho-Chacon JA, Cuenca-Espierrez J, Roda-Rojo V, et al. Bioinductive collagen implants facilitate tendon regeneration in rotator cuff tears. *J Exp Orthop* 2022;9:53.
16. Ling SKK, Slocum A, Lui TH. 5-year results of the 1.5cm incision Achilles tendon repair. *Foot (Edinb)* 2017;33:35-38.