Technical Note

Fluoroscopic and Endoscopic Calcaneal Exostosis Resection and Achilles Tendon Debridement for Insertional Achilles Tendinopathy: Surgical Techniques

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Abstract: This Technical Note describes the minimally invasive surgical techniques for insertional Achilles tendinopathy: fluoroscopic and endoscopic calcaneal exostosis resection and Achilles tendon debridement. First, two portals are placed 1 cm proximal and distal to the exostosis on the lateral heel. Next, blunt dissection around the exostosis and exostosis resection is performed under fluoroscopic guidance. The remaining space after the exostosis resection is used as the working space for endoscopy. Finally, the degenerated Achilles tendon is debrided endoscopically.

Introduction

Insertional Achilles tendinopathy is defined as posterior heel pain associated with degenerative changes of the distal Achilles tendon and exostosis to the Achilles tendon insertion.[1] Surgical treatment is considered after 3 to 6 months of proper conservative treatment without suitable results.[2-4] Surgical treatments for insertional Achilles tendinopathy includes the medial or lateral paratendinous approach, transtendinous approach, calcaneal exostosis resection, Achilles tendon debridement, resection of Haglund deformity, reattachment of the distal Achilles tendon, flexor hallucis longus tendon transfer augmentation, dorsal wedge calcaneal osteotomy, endoscopic reconstruction of the Achilles attachment, fluoroscopic and endoscopic calcaneal exostosis resection, and Achilles tendon debridement.[1,2,4-10]

A study on fluoroscopic and endoscopic calcaneal exostosis resection and Achilles tendon debridement reported good outcomes.[1] This study enrolled 44 patients (mean age: 55.7 years), reporting improved overall median visual analog scale (VAS) for pain and the Japanese Society for Surgery of the Foot (JSSF) scores, from 64.5 to 6.5 and 67.0 to 100, respectively.[1] Moreover, 100%, 93.2%, and 100% of patients achieved the minimal clinically important difference for the VAS, JSSF, and the Victorian Institute of Sport Assessment-Achilles (VISA-A) scores, respectively, and 77.3%, 86.4%, and 81.8% achieved the patient-acceptable symptom state for the VAS, JSSF, and VISA-A scores, respectively.[1] The median VISA-A scores improved from 40.5 to 95.0 points, and the median time to return to sports activities was 4.5 months. Five cases (11%) required reoperation, and two cases (4.5%) had scar sensitivities.[1]

That study did not describe the precise surgical techniques. Thus, this Technical Note describes them. This study was approved by the Institutional Review Board of Yashio Central General Hospital (approval number: YIHCE002-02).

Surgical Techniques

Preoperative Images

Preoperatively, three-dimensional computed tomography images (with video illustration) are obtained to confirm the shape of the calcaneal exostosis, and

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magnetic resonance imaging (MRI) is performed to confirm the Achilles tendon attachment to the calcaneus, intra-tendon ossifications, and degenerated Achilles tendon (Figs 1 and 2).

Patient's Position, Arrangement, and Anesthesia

The patient is placed in the prone position with the medial heel on the table (Fig 3A). Of note, patients with prone-position risk factors, such as obesity, can be positioned in the supine position; however, resecting the lateral exostosis may be challenging. An endoscopic monitor, fluoroscopic monitor, and fluoroscope are placed on the nonoperated side (Fig 3A), and the surgeon is positioned at the caudal end of the operating table. The patient receives general anesthesia. However, local anesthesia is considered for patients with a risk of complications from general anesthesia and those who opt for daytime surgery. A thigh tourniquet was not necessary.

Portals

The portals are marked 1 cm proximal and 1 cm distal to the exostosis on the lateral heel under fluoroscopic guidance using a surgical pen.[1] Notably, if the portals are too close to the exostosis, then the bur overlaps the exostosis fluoroscopically, making it difficult to resect. Marking the prominence of the exostosis also helps determine the extent to which the exostosis should be removed (Fig 3B). A fluoroscopic image of the lateral calcaneus is obtained preoperatively to confirm the exostosis resection (Fig 4A). Five-millimeter skin incisions are made at the planned portals.

Fluoroscopic Blunt Dissection Around the Calcaneal Exostosis

A raspatrium is introduced through the portals, and blunt dissection around the exostosis and intra-tendon ossifications are performed (Fig 4, B and C).[1] We use a raspatrium, a hobby tool (Art-Line, Mineshima Co., Niigata, Japan) available through internet shopping, with one straight and one curved end; this was convenient because the curved end easily dissects the opposite side of the exostosis from the portal.

Fluoroscopic Calcaneal Exostosis Resection

A 3.0-mm hooded abrasion bur (Formula, Stryker, Kalamazoo, MI) is introduced through the proximal portal, and the exostosis is resected under fluoroscopic guidance (Fig 4D).[1] Care is taken not to damage the normal insertion of the Achilles tendon while manipulating the resection and to maintain the exostosis in one mass. If the exostosis shatters into bone pieces, resection is difficult because the pieces are barely visible owing to the fluoroscope's low radiation dose. When the edge of the exostosis is difficult to resect from the portals, an additional portal is created near the edge. The surgeon checks the edge's resection by rotating the calcaneus internally and externally under fluoroscopic guidance. The volume of large intratendon ossification is decreased using a bur. Of note, complete resection should not be performed fluoroscopically because removal is easier endoscopically. The marked area of the bony prominence is palpated to confirm that the prominence is perfectly resected. The space remaining after resecting the exostosis is used as the endoscopy working space.

Endoscopic Achilles Tendon Debridement

A 2.3-mm 30° endoscope (Stryker) is introduced through the distal portal. An infusion pump (FloSteady, Stryker) is set to auto-calibration mode.[11] Washing away the debris with endoscopic water gradually makes the structures identifiable (Fig 5, A and B). Normally, the Achilles tendon attaches to the calcaneus and is white and straight. The

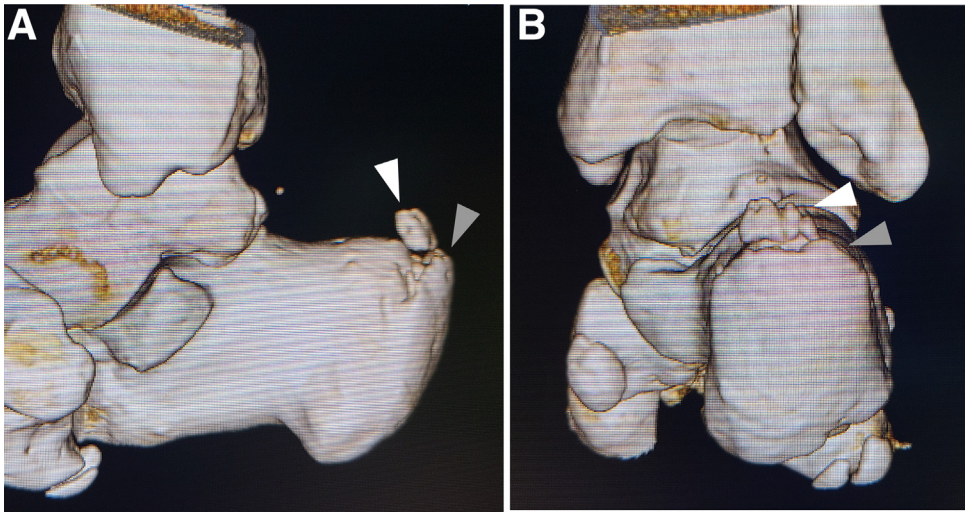

Fig 1. Preoperative three-dimensional computed tomography images of the right calcaneus of a patient with insertional Achilles tendinopathy. Before surgery, the surgeon should confirm the shape of the exostosis (gray arrowhead) and intra-tendon ossifications (white arrowhead) to achieve a perfect resection. (A) Lateral view. (B) Posterior view.

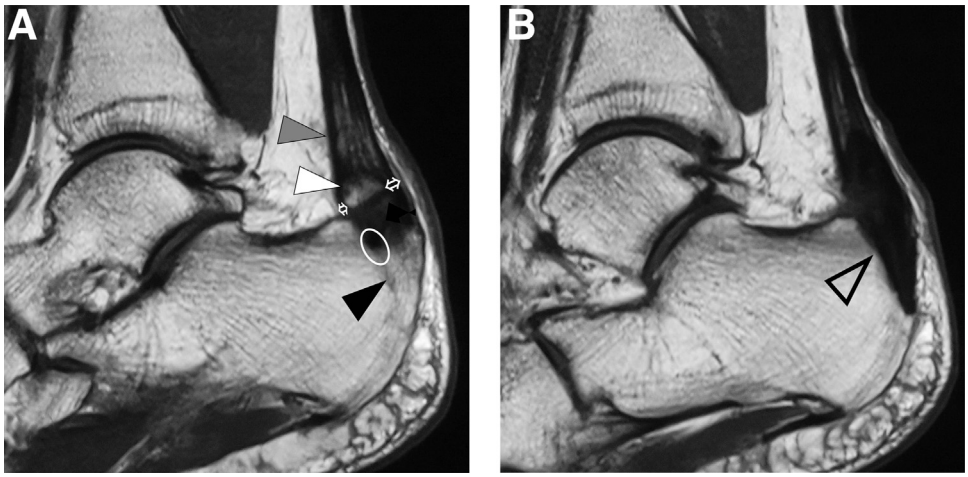

Fig 2. Preoperative and postoperative T1-weighted magnetic resonance imaging (MRI) of the lateral view of the left calcaneus of a patient with insertional Achilles tendinopathy who underwent fluoroscopic and endoscopic calcaneal exostosis resection and Achilles tendon debridement. (A) Calcaneal bone exostosis (black arrowhead), intratendon ossification (white arrowhead), and the degenerative Achilles tendon (gray arrowhead) were visible in the preoperative MRI. Before surgery, the surgeon should confirm the Achilles tendon attachment area (ellipse) and take care not to damage the portion of the attachment other than the exostosis during fluoroscopic resection of the exostosis. In addition, the surgeon should confirm the volume of the tendon at the intra-tendon ossification level (white arrows) and the degenerated Achilles tendon range (gray arrowhead) to be debrided. (B) MRI 1 year postoperatively. The calcaneal exostosis and intratendon ossification were resected, and the defect that remained after resection was filled with soft tissue, showing the same signal as the Achilles tendon (arrowhead). This figure and figure legend were published in the report by K. Nakajima entitled "Fluoroscopic and endoscopic calcaneal exostosis resection and Achilles tendon debridement for insertional Achilles tendinopathy results in good outcomes, early return to sports activities, and few wound complications." *Arthrosc Sports Med Rehabil* 2022;4:e1385-e1395; Copyright: the Arthroscopy Association of North America 2022.

degenerated portion of the Achilles tendon, originally attached to the exostosis and released by resection, is visualized as a free end with a pale-yellow appearance (Fig 5B); it is unlike a normal tendon and bone but rather a hybrid of the two tissues. This degenerated portion is resected and debrided endoscopically. The degenerated and normal Achilles tendon areas are on a continuum; thus, the boundary is unclear. Therefore, debridement is stopped when the degeneration area identified on the preoperative MRI is cleared (Figs 2A

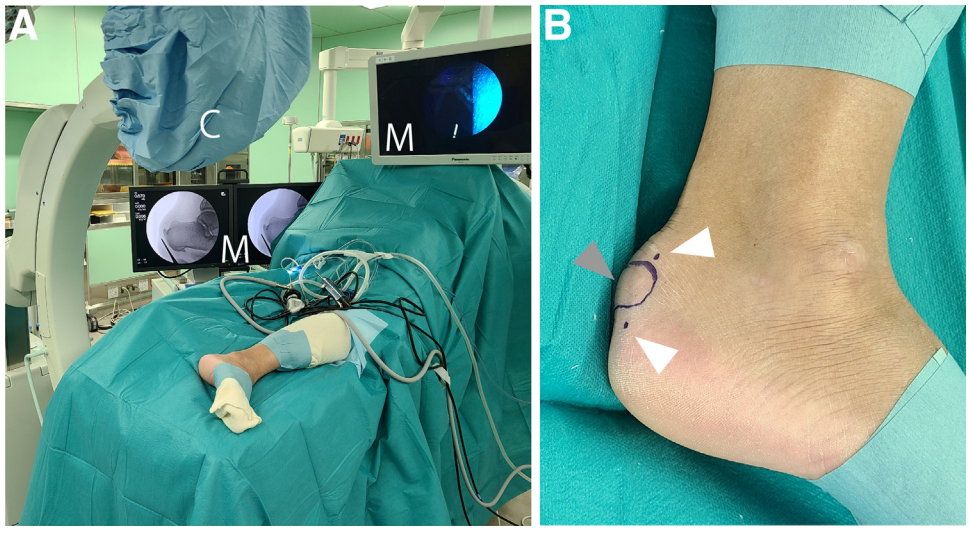

Fig 3. Operative field and preoperative markings for fluoroscopic and endoscopic calcaneal exostosis resection and Achilles tendon debridement for insertional Achilles tendinopathy. (A) The operative field. The patient is placed in a prone position with the medial heel on the table. A C-arm (C) and fluoroscopic and endoscopic monitors (M) are placed on the unoperated side. The surgeon positions himself at the caudal end of the operating table. (B) Preoperative markings. Planned portals are marked 1 cm proximal and distal to the exostosis on the lateral heel using a surgical pen under fluoroscopic guidance. The prominence of the exostosis is also marked to determine the extent of bone to be removed.

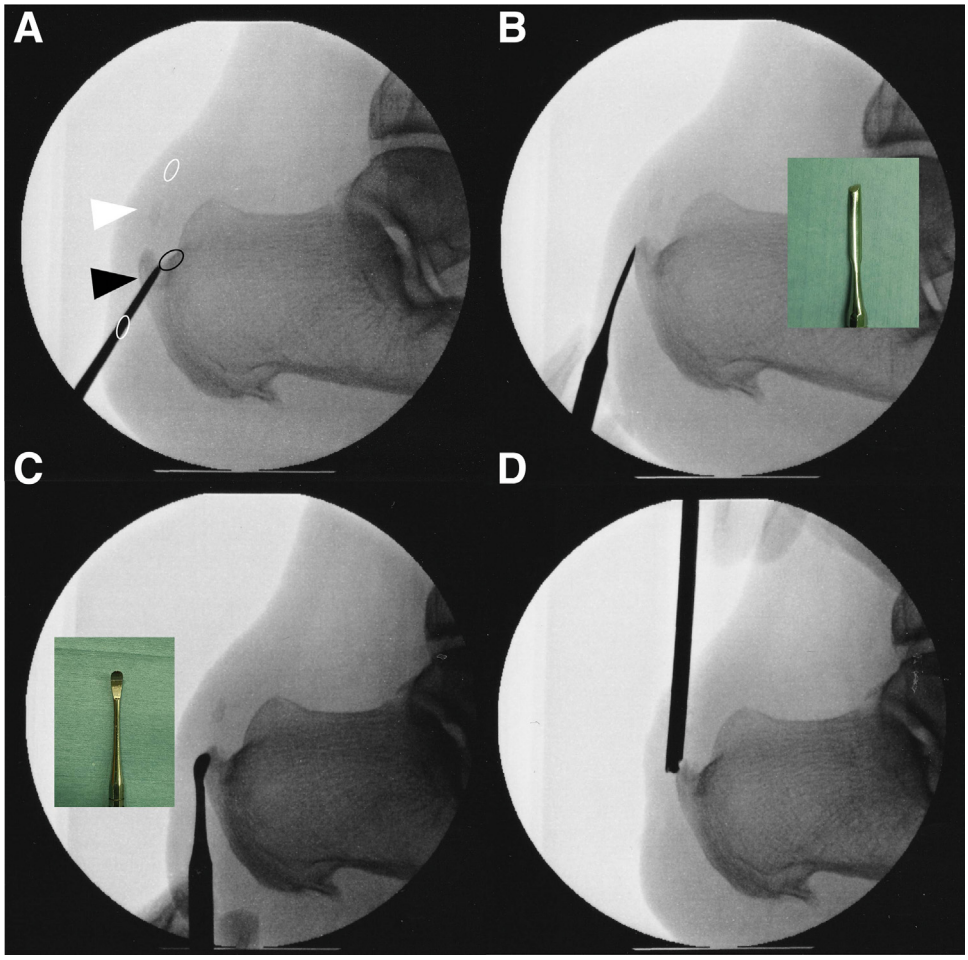

Fig 4. Fluoroscopic images of the lateral view of the right calcaneus during fluoroscopic and endoscopic calcaneal exostosis resection and Achilles tendon debridement for insertional Achilles tendinopathy. (A) A preoperative image. Portals are marked 1 cm proximal and distal from the calcaneal exostosis using a surgical pen (white circle). In this case, intratendon ossification is visible (white arrowhead). Thus, a proximal portal is placed 1 cm proximal from the ossification. The tissue forceps indicates the borderline of the exostosis to be resected (black arrowhead). Care is taken not to damage the normal Achilles tendon insertion during surgery (black circle). (B and C) Blunt dissection around the calcaneal exostosis using a raspatorium that is introduced through the distal portal. The raspatorium (Mineshima Art Line, Niigata, Japan) is flat on one side (B) and rounded on the other (C), making it convenient for dissection. (D) Fluoroscopic calcaneal exostosis resection. A 3.0-mm hooded abrasion bur (Formula, Stryker, Kalamazoo, MI) is introduced through the proximal portal, and the exostosis is resected under fluoroscopic guidance. The space left after resection of the exostosis is used as a working space for endoscopy.

and 5C). Intratendon ossification is endoscopically removed from the Achilles tendon using a punch or a bone curette under fluoroscopic guidance when it is visible fluoroscopically but not endoscopically.

Postoperative Radiograph

A postoperative radiograph is obtained in the operating room to confirm complete resection of the exostosis and intratendon ossification (Fig 6). Intratendon ossifications may be difficult to identify fluoroscopically owing to the low radiation dose, but they may appear on the radiographic image. When leftovers are identified on the radiograph, the surgeon again observes the positions of the ossifications identified on the radiograph fluoroscopically, internally and externally rotated the calcaneus, identifies the ossifications, and then excises them with a punch. A postoperative radiograph is again obtained to confirm the absence of leftovers. The wound is sutured using 4-0 nylon. A below-knee posterior splint is applied with the ankle in a neutral position.[1]

Postoperative Management

Full weight-bearing with a below-knee splint and active range-of-motion exercises without a splint are initiated 1 day postoperatively.[1] The sutures are removed 2−3 weeks after surgery, and the splint is removed 3 weeks after surgery. However, the splint is

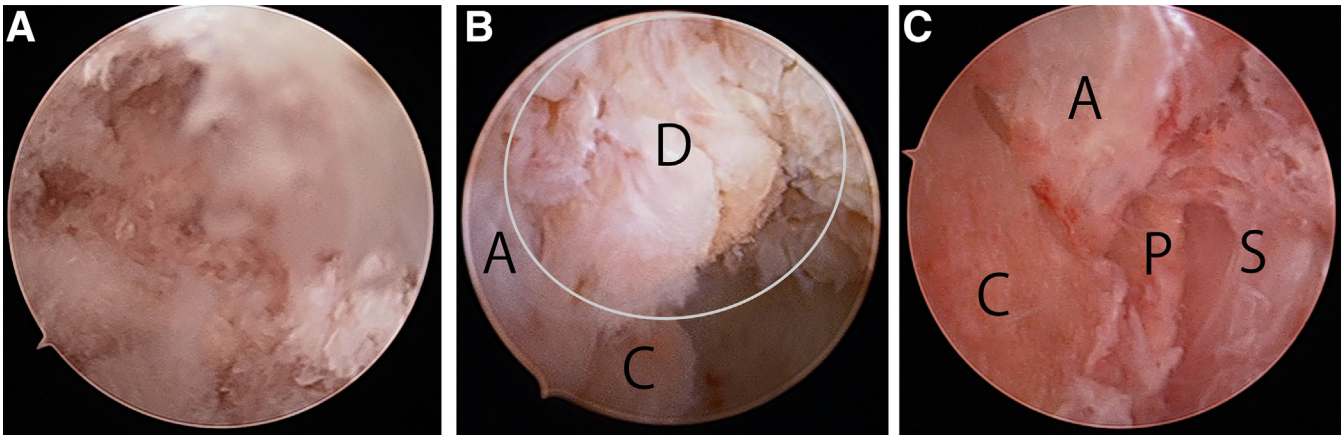

Fig 5. Endoscopic views of the left calcaneus from the distal portal using a 2.3-mm 30° arthroscope (Stryker) for fluoroscopic and endoscopic calcaneal exostosis resection and Achille tendon debridement for insertional Achilles tendinopathy. (A) The view immediately after introducing the endoscope with interfering abraded spur debris. (B) The view after cleaning the debris using a 3.5-mm cutter (Stryker) introduced through the proximal portal. The space left after the fluoroscopic resection of the calcaneal bone exostosis was a working space for endoscopy. The exostosis was resected, and the cancellous bone of the calcaneus was exposed (C). The intact anterior portion of the Achilles tendon was visible (A). The distal portion of the Achilles tendon that had attached to the exostosis was released by resecting the exostosis (D; ellipse). This portion was neither a normal tendon nor a normal bone but rather a hybrid, which was debrided endoscopically. (C) After endoscopic Achilles tendon debridement. A, Achilles tendon; C, calcaneus; P, paratenon calcified; and S, skin. This figure and figure legend were published in the report by Nakajima K. "Fluoroscopic and endoscopic calcaneal exostosis resection and Achilles tendon debridement for insertional Achilles tendinopathy results in good outcomes, early return to sports activities, and few wound complications." *Arthrosc Sports Med Rehabil* 2022;4:e1385-e1395; Copyright: the Arthroscopy Association of North America 2022.

removed 4 weeks after surgery for obese patients and those with large free bodies in the Achilles tendon. Jogging is initiated 2 months after surgery, and a return to unrestricted sports activities is allowed 3 months after surgery. However, these activities are delayed for an additional month for obese patients and those with large free bodies in the Achilles tendon. Postoperative MRI is performed to confirm that the remaining void space after resection is filled with tendon-like tissue (Fig 2B).

Postoperative pain varies among individuals, lasting from 1 month to 1 year. Some cases take nearly a year to improve; thus, reoperation decisions should not be made in haste. Therefore, reoperation is considered if pain resolution is insufficient 1 year postoperatively. Reoperation is performed using the same technique; the remaining osteophytes and loose bone are removed fluoroscopically and endoscopically. A postoperative splint is unnecessary.

Discussion

Table 1 summarizes the advantages and disadvantages of this minimally invasive procedure for insertional Achilles tendinopathy. The advantages include the natural repair of the Achilles tendon insertion

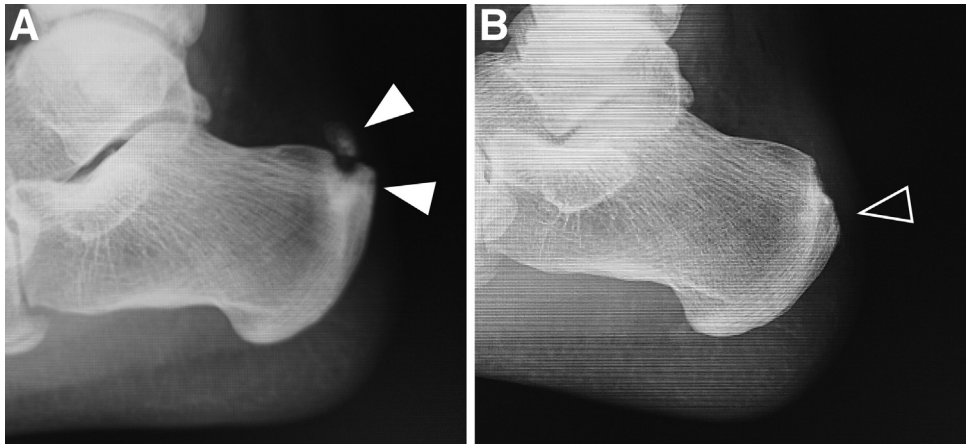

Fig 6. Preoperative and postoperative radiographs of the lateral view of the right calcaneus of a patient with insertional Achilles tendinopathy who underwent fluoroscopic and endoscopic calcaneal exostosis resection and Achilles tendon debridement. (A) A preoperative image showing intratendon ossification and calcaneal exostosis (white arrowheads). (B) A postoperative image showing that the intratendon ossification and the exostosis are resected (black arrowhead).

Table 1. Advantages, Disadvantages, and Limitations of Fluoroscopic and Endoscopic Calcaneal Exostosis and Achilles Tendon Debridement for Insertional Achilles Tendinopathy

Advantages
1) Minimally invasive
2) Technically easy
3) Clear visualization of the degenerated Achilles tendon
4) The technique can be applied for Haglund deformity resection.
5) Natural repair of the Achilles tendon insertion
6) The flexor hallucis longus tendon remains intact.
7) Immediate postoperative full-weight-bearing with a splint
8) Immediate postoperative active range of motion exercises
9) Quick return to sports activities
10) Low wound complication rate
11) Daytime outpatient surgery is possible with local anesthesia for patients with obesity or severe complications or those who prefer daytime outpatient surgery.
Disadvantages
1) Potential leftover calcaneal exostosis and intratendon ossifications due to a less-practiced surgeon, severe ossification, or a low fluoroscopy radiation dose.
2) Potential reoperation due to the leftovers
3) Temporary mechanical weakness of the Achilles tendon postoperatively
4) The prominence of the heel is not reduced by surgery because the space left after resection of the exostosis is filled with tendon-like tissue
Limitations
1) Comparative studies have not been conducted.
2) The regenerated Achilles tendon insertion has not been histologically examined.

(Fig 7), suggesting that the space left after resecting the exostosis is filled with tendon-like tissue.[1] We hypothesize that natural repair is possible for endoscopic surgery because the surgery's minimal invasiveness preserves the surrounding soft tissue. Conversely, reoperation is sometimes necessary. However, we believe that two potential minimally invasive surgeries are preferable to one invasive surgery[1] because one minimally invasive surgery may be sufficient. Furthermore, reoperations are easy, since most exostoses and ossifications are removed in the first surgery, and the flexor hallucis longus remains intact. Therefore, reoperations are a good treatment option, especially in severe cases, and surgeons should inform patients of this possibility from the beginning.

Acknowledgments

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