Ankle Fusion by Screws

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23.1 Introduction

The ankle is one of the few major joints, in which arthrodesis is a valid treatment for end-stage arthritis. The fusion of the tibiotalar joint can result in a pain-free ankle that withstands the normal daily activities, even in a young, high-demand, active individual [1]. In addition, the alternative of total-ankle replacement is not a good option for all patients and entails higher complication and revision rates [2].

A variety of surgical approaches and methods of fixation have been described for ankle arthrodesis. Open or miniopen techniques have traditionally been associated with a number of complications like nonunion, delayed union, malunion, infection, wound necrosis, and neurovascular injury [1, 3].

Arthroscopic ankle arthrodesis (AAA) has been shown to be an effective option with high fusion rates and low complication rates [4]. Arthroscopic techniques compared to open demonstrated quicker time to union with equivalent or higher union rates and faster recovery [5]. In addi-

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tion, AAA techniques require shorter hospital stay and reduced costs, both relevant nowadays [6, 7].

The aim of this chapter is to describe the surgical technique, indications, and limitations of ankle fusion using screws and anterior ankle arthroscopy.

23.2 Indications and Limits

General indications for tibiotalar fusion include end-stage arthritis from any cause that cannot be controlled with conservative treatment, which includes physiotherapy, orthosis, NSAID treatment, and viscosupplementation. As previously reported in this book, ankle arthritis is most commonly posttraumatic in nature followed by primary arthritis due to rheumatoid arthritis, inflammatory arthropathy, infection, Charcot neuroarthropathies, and avascular necrosis.

Because of the minimal aggression to soft tissues, AAA is particularly suitable for patients with associated diseases that compromise wound healing like diabetes, chronic vascular disease, coagulopathies, and prolonged steroid therapy [8, 9]. Posttraumatic cases often present with previous scars and metalwork; in those, wound healing would be compromised when using open techniques. To avoid previous metalwork and scars, it may be necessary to modify the original technique when placing the screws [10].

The presence of active infection and active Charcot arthropathy is an absolute contraindication for both open and arthroscopic techniques. Avascular necrosis of the talus is a relative contraindication to traditional open arthrodesis, although it can be considered for the arthroscopic technique [10].

Correction of significant deformity is a relative contraindication to AAA. Historically, the AAA has been performed as an in situ fusion; fixed significant varus or valgus malalignments have represented the primary contraindication for AAA [1]. However, more recently, some authors have argued that with greater experience, 15° of deformity can be accepted [11].

Surgeon experience and steep learning curve are other limitations of AAA. Arthroscopy in posttraumatic cases with joint narrowing and big anterior osteophytes is challenging and requires an experienced ankle arthroscopist [11].

23.3 Surgical Technique

Authors' preferences are reported in Table 23.1.

23.3.1 Patient Positioning

The patient is positioned supine under spinal or general anesthesia. The use of a flow pump is not necessary and adequate flow is obtained by gravity. A thigh tourniquet is recommended and a bolster under the ipsilateral buttock helps control limb rotation. The affected extremity can rest on the table or on a thigh support below the knee. With the latter, both the hip and the knee are flexed approximately 45°, placing the leg parallel to the floor and the ankle free for range of motion.

The arthroscopy stack and C-arm are on the ipsilateral side while keeping the medial aspect free for screw insertion gestures.

A soft tissue distractor can be helpful to access the joint in tight ankles and to reach the most posterior cartilage. In any case, it is not routinely necessary and will depend on the surgeon's preference.

23.3.2 Surgical Instrumentations

A standard "knee arthroscopy set" comprised of a 4–4.5 mm 30° scope, and 3.5 or 4.5 mm motorized shaver and burr are used. Curettes and small osteotomes are helpful in removing articular cartilage and exposing the subchondral bone.

Table 23.1 Authors' preferences in performing arthroscopic ankle arthrodesis

– Spinal anesthesia and thigh tourniquet
– Sandbag under the ipsilateral buttock and affected extremity on a thigh holder located under the knee
– Assistant hand-made distraction when necessary
– 4.5 mm 30° scope and 3.5 or 4.5 mm full-radius shaver and burr ("knee arthroscopy set")
– Preparation of both medial and lateral gutter with curettes. Medial gutter requires switching of portals (anterolateral as viewing and anteromedial as working portal)
– If it is difficult reaching posteriorly: resections of more bone anteriorly and use of angled curettes
– Fixation with two crossed 6.5-mm cannulated screws

Finally, two 6.5 mm compression screws and instruments for their insertion are necessary for internal fixation.

23.3.3 Surgical Approach and Procedure

Routine anteromedial and anterolateral ankle portals are performed. To achieve initial visualization, it is seldom necessary to perform an anterior joint synovectomy with a shaver. Care must be taken to avoid damaging noble soft tissues by pointing toward the articular surfaces with the shaver blade. Once clear visualization is achieved, tibial osteophytes are removed with a burr. This step is important to allow neutral flexion at the time of fixation (Figs. 23.1, 23.2, and 23.3).

The articular cartilage of the tibial plafond and talar dome is completely removed, progressing from anterior to posterior with curettes, osteotomes, and burrs. Introducing a curette into each gutter is helpful in preparing the lateral and medial articular surfaces of the talus and malleoli. Although some authors suggest not to prepare the lateral gutter [11], it is the authors' preference to prepare both gutters in the same way.

If the posterior part of the joint is difficult to reach, one can use angled curettes, resect more bone anteriorly, or perform a posterolateral portal. In addition, sectioning the ATFL through a small anterolateral incision allows better joint distraction [12].

Fig. 23.1 Lateral and Anteroposterior view of patient with ankle arthritis. Joint narrowing and osteophytes on the tibia and talus are clearly seen on lateral view

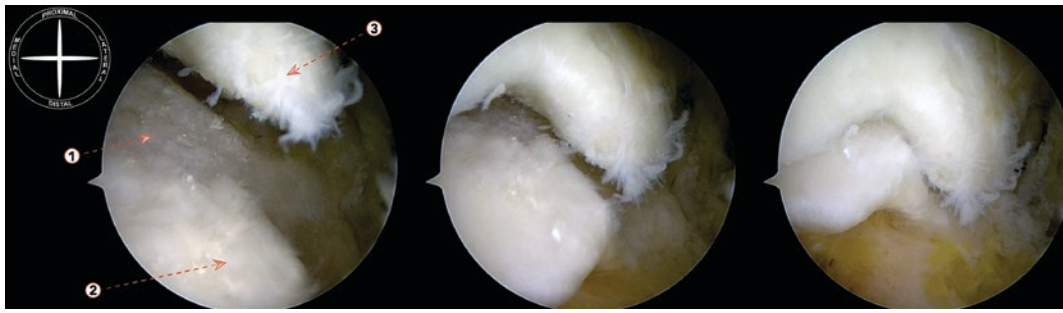

Fig. 23.2 Arthroscopic views showing talar cartilage (1), osteophytes on talar neck (2), and on distal tibia (3). Ankle joint is in plantarflexion (left), in neutral position (middle), and in dorsiflexion (right). In the latter, osteophytes perfectly engage with each other

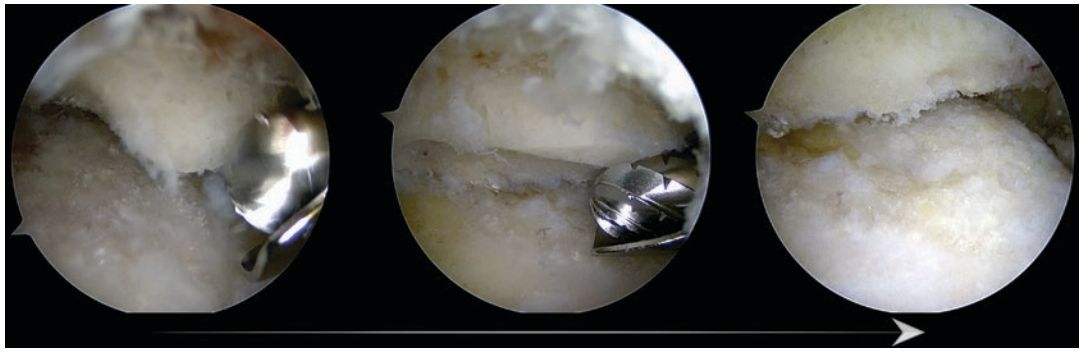

Fig. 23.3 Removing tibial osteophytes with a burr allows better visualization

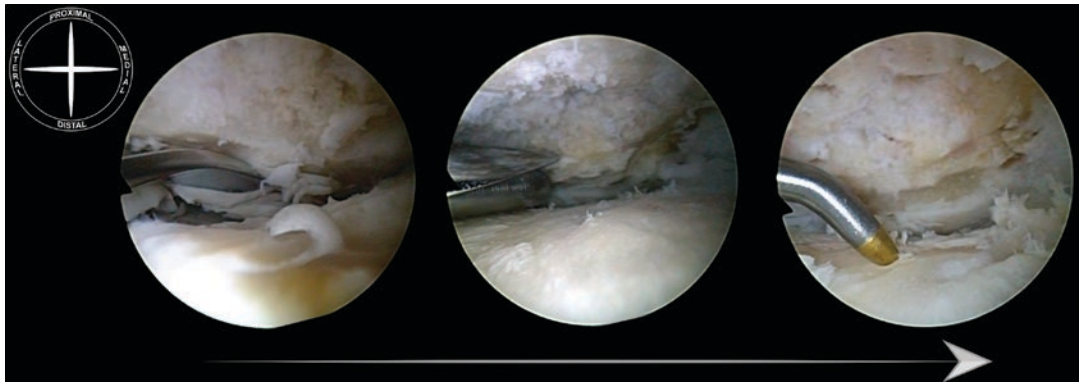

Fig. 23.4 The articular surfaces of both tibia and talar dome are prepared. Before articular cartilage is removed with angled curettes (left), a burr is used to expose underlying healthy cancellous bone (middle). Finally, microfractures (right) at both tibia and talar sides are performed

After excision of the articular cartilage, a burr is used to remove the thin layer of subchondral until bleeding cancellous bone is exposed.

At this point, axial corrections can be achieved by removing a thicker layer of bone on the medial or lateral aspect depending on the deformity. Surgeons must be aware that maintaining congruent bone contours of the talus and tibia is essential to maximize the contact of both surfaces and to achieve bone fusion. Some surgeons perform small holes in the talar dome and tibial plafond to increase bone bleeding in the area (Figs. 23.4 and 23.5, Video 23.1).

23.3.4 Fixation

Once the arthroscopic preparation of the joint surfaces is achieved, the fixation can take place under fluoroscopic control. The ankle must be fixed in neutral flexion, 0–5° of valgus and slight external rotation (5–10°).

In patients with an equinus foot deformity in whom neutral ankle position is not obtained, a percutaneous Achilles tendon lengthening may be necessary.

The arthrodesis is fixed with two 6.5 mm cannulated screws placed in a crossed or parallel fashion from the medial side. The authors' preference is to use two crossed, 6.5 mm cannulated screws.

The screws form an angle of about 50° on the anteroposterior view and 10° on the lateral, with the medial screw going slightly anterior and the lateral slightly posterior. Care must be taken to avoid penetration of the subtalar joint.

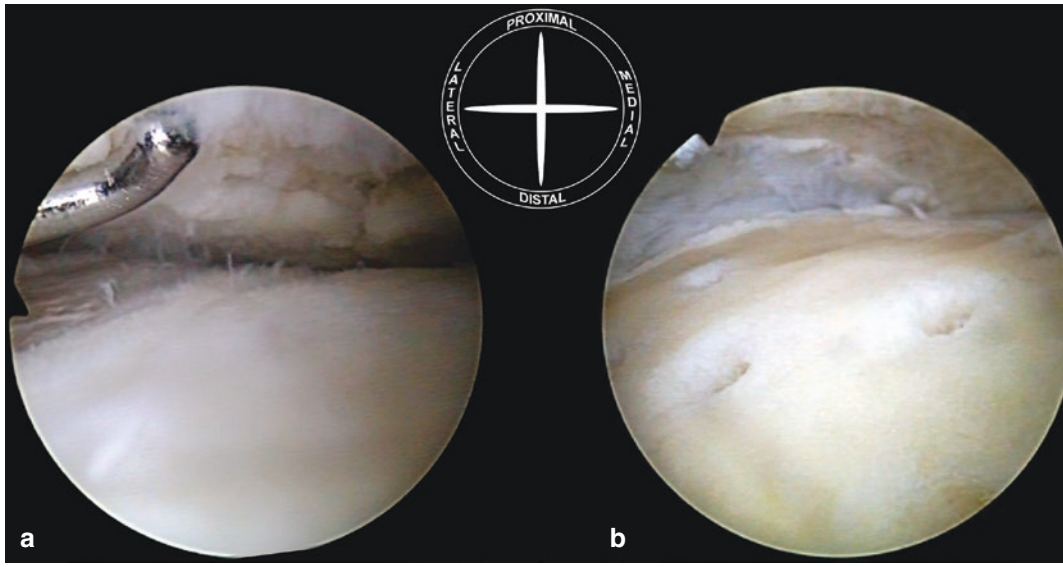

Fig. 23.5 Arthroscopic view from anteromedial portal before (**a**) and after (**b**) articular surfaces preparation

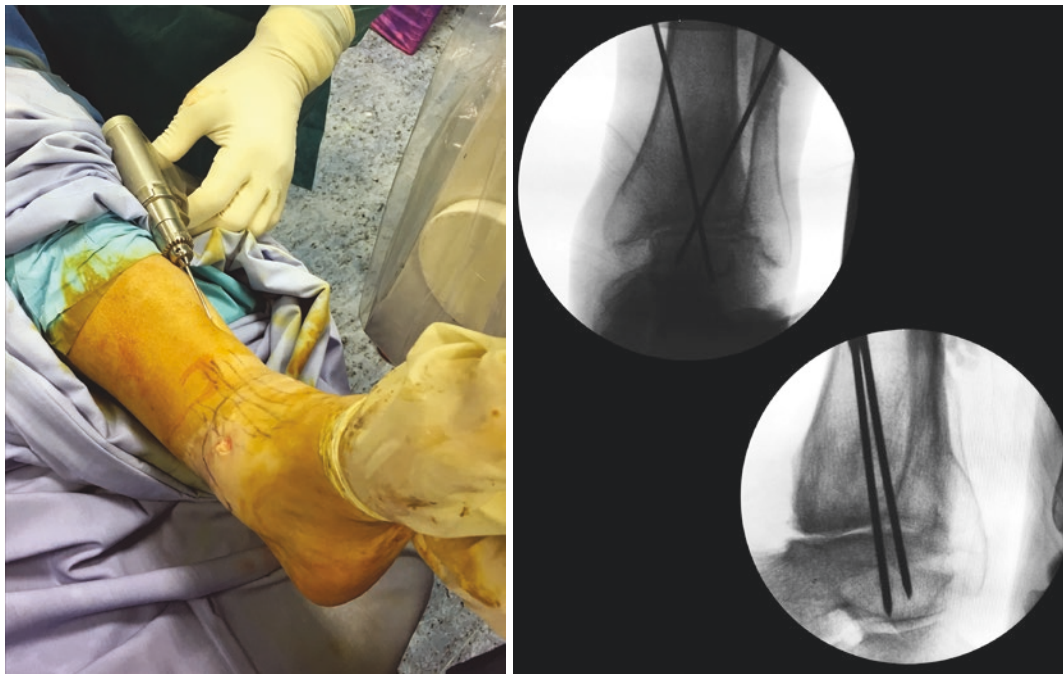

Fig. 23.6 Two crossed guide wires are placed with the ankle held in proper position (left). Good position of guide wires is confirmed using anteroposterior and lateral fluoroscopic views (right)

Fluoroscopic anteroposterior, lateral, and oblique views are obtained to check for screw placement and ankle position.

Wounds are closed with nonabsorbable sutures. A sterile compressive dressing and a walking boot are applied (Figs. 23.6 and 23.7).

23.3.5 Postoperative

Patients are discharged from hospital the day after surgery. Sutures are removed 1 week postoperatively. The walking boot is worn for approximately 3 months or until radiographic fusion is noted. Weight-bearing as tolerated is allowed at 4 weeks after surgery. Radiographs are performed at 1, 3, 6, and 12 months of follow-up.

Fig. 23.7 Preoperative anteroposterior radiograph (left) and final fluoroscopic anteroposterior control after arthroscopic ankle arthrodesis (right)

23.4 Results

The published results of AAA are reported in Table 23.2 [11, 13–19]. These studies revealed fusion rates between 90 and 100%. Three articles directly compared open versus arthroscopic techniques reporting equivalent fusion rates and clinical results with shorter hospital stays and operative times and faster fusion in the arthroscopic group [5, 15–17].

Complications reported for both open and arthroscopic techniques include infection, neurovascular injury, malunion, and nonunion. The latter is the main complication and has been reported in six of eight studies assessed in Table 23.2. These cases were significantly associated to smoking and successfully achieved union after an open technique [11, 14].

Finally, ankle fusion causes increased motion in the neighboring joints, resulting in long-term subtalar degenerative changes in 10–60% of patients [13, 14]. This has been documented as a cause of patient dissatisfaction after ankle fusion.

Table 23.2 Published results of arthroscopic ankle arthrodesis

Article	No.	Follow-up (months)	Union rate (%)	Good results (%)	Complications (no. cases)
Winson IG. J Bone Joint Surg 2005 [11]	105	65	92	79	11 major, 27 minor
Gougoulias NE. Foot Ankle Int 2007 [13]	78	21	98	80	2 major, 2 minor
Dannawi Z. Foot Ankle Surg 2011 [14]	55	63	91	82	5 major, 8 minor
Myerson MS. Clin orthop Relat Res 1991 [15]	17	23	94	–	None
Nielsen K. Foot Ankle Surg 2008 [16]	58	–	90		3 major, 15 minor
O'Brien T. Foot Ankle Int 1999 [17]	19	–	84	–	3 major
Bai Z. Foot Ankle Int 2013 [18]	10	21	100	80	1 minor
Yoshimura I. Arthroscopy 2012 [19]	50	42	92	–	4 major

23.5 Conclusions

The AAA is a suitable option for most patients who undergo an ankle fusion. It has showed favorable long-term results in cases of end-stage ankle arthritis. The arthroscopic technique shows equivalent clinical results and faster recovery when compared to open. Minimal soft tissue aggression makes AAA ideal for those patients with compromised wound-healing potential (e.g., diabetics). The surgeon must be aware that performing an arthroscopic ankle fusion may be challenging and broad experience in ankle arthroscopy is required.

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