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SPECIAL FOCUS

Ankle Arthrodesis With an Anterior Approach

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ABSTRACT

Ankle joint arthrodesis is described in many different ways using different approaches and fixation techniques. The key point is the fixation in axial alignment at 90 degrees in the sagittal plane to obtain painless function. The use of the anterior approach has been more widely used since this incision has become the standard approach for ankle joint prosthesis. The anterior approach is indicated in cases without massive deformity. The approach, preparation, and internal screw fixation technique using 3 screws are described.

Keywords: ankle arthrodesis, screw position, ankle fusion, anterior approach, internal fixation, and open ankle fusion

HISTORICAL PERSPECTIVE

The primary indication for an ankle arthrodesis is pain from severe ankle arthritis that limits daily activities. The most common indication nowadays is the posttraumatic degenerative joint disease following an ankle fracture.

Historically, a wide variety of techniques for ankle arthrodesis have been reported. The first report of an ankle arthrodesis dates back to 1882 when Albert described the first fusion of the tibiotalar joint in paralytic legs. Most early reports for ankle arthrodesis published before the 1950s contain few recommendations regarding the use of internal or external fixation[1]; most patients were merely given a cast. In 1932, Key described an operation to fuse the tuberculous knee joint by applying positive pressure across the arthrodesis site by means of a turnbuckle causing compression between supracondylar femur and proximal tibial pins.[2] In light of this publication, Charnley used this principle for the ankle joint and reported his experience in 1951.[3] The development of internal fixation also changed the evolution of the ankle arthrodesis. Plates, cannulated compression screws, and staples nowadays are in use to achieve internal compression across the arthrodesis site.

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Selection of an ankle arthrodesis technique depends on whether realignment of a deformity is necessary. Wide surgical exposure is needed for deformity, and limited exposure is sufficient for in situ fusion.

More recently, arthroscopically assisted techniques for the ankle fusion have gained popularity among surgeons who routinely perform arthroscopy of the ankle. The success of this technique depends on the surgeon's skill; sometimes, extended surgery time is needed.

INDICATIONS AND CONTRAINDICATIONS

The indications for the ankle arthrodesis using the anterior approach are as follows:

1. Painful posttraumatic or idiopathic osteoarthritis of the ankle joint that is unresponsive to nonoperative care or anticipated failure of further nonoperative care,
2. Posttraumatic malalignment of the ankle or chronic ankle instability in combination with osteoarthritis,
3. Paralytic ankle instability that cannot be stabilized or improved by joint preserving methods,
4. Ankle arthritis secondary to rheumatoid diseases and systemic diseases,
5. Joint destruction after infection, and
6. Failure of ankle joint replacement.

Contraindications include the following:

1. Severe varus and valgus deformity of the ankle joint with bone destruction that cannot be corrected using the anterior approach. In these cases, the lateral approach with fibula osteotomy is recommended.
2. Acute osteitis and joint infection. In these cases, external fixation may be an alternative.
3. Poor skin and soft tissue conditions
4. Peripheral arterial occlusive disease and deep vein thrombosis

Preoperative Planning

Radiographs should include weight-bearing anteroposterior views with the leg in 20 degrees of internal rotation and weight-bearing lateral views of both entire feet (Figs. 1A, B).

Computed tomography and magnetic resonance imaging of the ankle with coronal and axial reconstruction

FIGURE 1. A and B, Preoperative radiographs of a typical posttraumatic arthrosis of the ankle joint. No malalignment, good indication for anterior approach with anatomic resection.

are optional in cases with unclear symptoms and if large cyst formation or talus necrosis is suspected.

Recommended surgical instruments and implants are the following:

1. A 7.3-mm cannulated self-cutting cancellous screws in all lengths are preferable;
2. Instruments for harvesting and shaping bone, saws, drill, sharp curettes;
3. Two small lamina spreaders are useful; and
4. An intraoperative image intensifier is absolutely necessary.

TECHNIQUE

The procedure is generally performed under general anesthesia or spinal block with tourniquet hemostatic control. The patient is placed in supine position; a pillow is placed under the buttock of the affected side to avoid external rotation the leg. Further preparation includes free draping of the limb, allowing abduction and elevation of the entire leg, which is necessary for internal fixation and guidewire positioning under image intensifier control. Ipsilateral iliac crest draping is necessary.

Surgical Technique

A 10-cm longitudinal incision is performed 1 cm lateral to the tibial anterior tendon proximal and distal to the midline of the ankle joint (Fig. 2). Care is taken to avoid any damage to the terminal branches of the superficial peroneal nerve—the intermediate and the medial dorsal cutaneous nerve. These nerves cross the incision from lateral to medial with some anatomic variation. Sometimes, resection of those nerves cannot be avoided; this possibility should be included in the informed consent. The superficial fascia and the extensor retinaculum are then divided longitudinally.

The further deepening of the incision is done in between the tendon of the extensor hallucis longus on the medial side and the extensor digitorum longus lateral. The neurovascular bundle (anterior tibial artery and vein, deep peroneal nerve) lies just laterally to the extensor hallucis longus tendon and can be mobilized laterally with the surrounding tissues and extensor digitorum longus tendon (Fig. 3). The ankle joint capsule and tibial periosteum are incised longitudinally; Hohmann retractors are placed medially and laterally to facilitate further intraarticular and subperiosteal exposure. Synovectomy provides additional exposure (Fig. 4).

Resection of any anterior exostosis provides better access to the joint. Laminar spreaders can be inserted to distract the joint, which allows inspecting the joint surface (Fig. 5). Release of the medial and lateral

FIGURE 2. A 10-cm longitudinal skin incision is performed lateral to the tibialis anterior tendon.

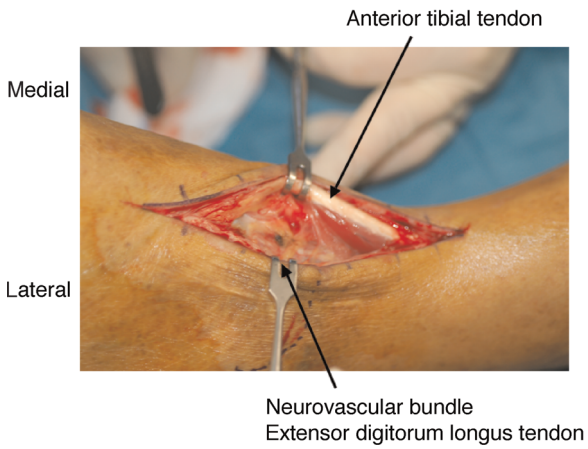

FIGURE 3. The neurovascular bundle is gently mobilized; the tibialis anterior tendon is retracted medially and the extensor digitorum longus tendon laterally.

collateral ankle ligaments may be necessary to achieve adequate exposure of the joint surfaces. Then the remaining articular cartilage from the talar dome and tibial plateau is removed using chisel, curette, and, if necessary, a sharp bur. If a high-speed bur is used, care must be taken to avoid heat necrosis. Cartilage must be removed from the joint surfaces of the lateral malleolus and the medial malleolus. Changing the positions of the laminar spreaders is often necessary for these maneuvers. An anatomic resection[4] of the joint surfaces maintains the curvature and alignment of the joint, which maximizes stability of the arthrodesis construct and minimizes rotational malalignment.

FIGURE 4. Two Hohmann retractors are inserted, one medial and one lateral to the ankle joint.

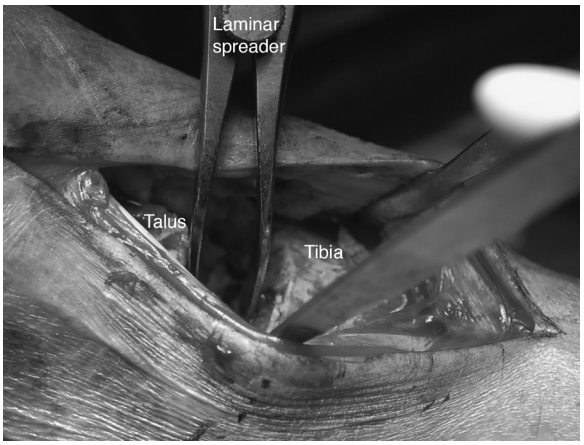

FIGURE 5. A laminar spreader can be inserted to distract the joint which better visualization of the joint surface.

Any preexisting subluxation or malalignment of the ankle joint must be corrected during preparation. The talar dome must fit into the mortise before fixation is completed. Varus or valgus malalignment must be corrected with a bone graft. Iliac crest corticocancellous bone graft is preferable for larger defects, whereas small defects without axial malalignment can be filled with cancellous bone graft.

Anterior malposition of the talus is common in posttraumatic ankle osteoarthritis. This malposition must be corrected by pushing the talus and the foot posteriorly. Intraoperative image intensifier helps to find the correct position. In the lateral view, the longitudinal axis of the tibia runs through the center of the talar dome or through the posterior portion of the processus lateralis tali. Achilles tendon lengthening is necessary if equinus or equinovarus malposition cannot be corrected with joint surface resection and preparation.

Stable fixation is essential to achieve osseous healing in the correct position; 7.3-mm cannulated self-cutting titanium screws (Synthes) are preferable for good stability and are easy to handle. The screws must be available in all lengths. Using this 7.3-mm cannulated self-cutting cancellous screws,[5,6] the guidewires in the set are positioned as follows (Figs. 6A, B):

Wire 1 is inserted anteriorly from 3 to 4 cm proximal to the joint space at an angle of approximately 15 to 30 degrees to the tibial axis and aiming at the central dorsal part of the talar dome.

Wire 2 is inserted from an incision approximately 3 cm proximal to the medial malleolus from dorsal and is directed into the lateral part of the tarsal neck. This wire is inserted at 30 degrees with respect to the long axis of the tibia.

Wire 3 is introduced through a lateral incision at the lateral facet of the tibia, just anterior to the fibula. The wire is directed in the central medial part of the talar dome. In

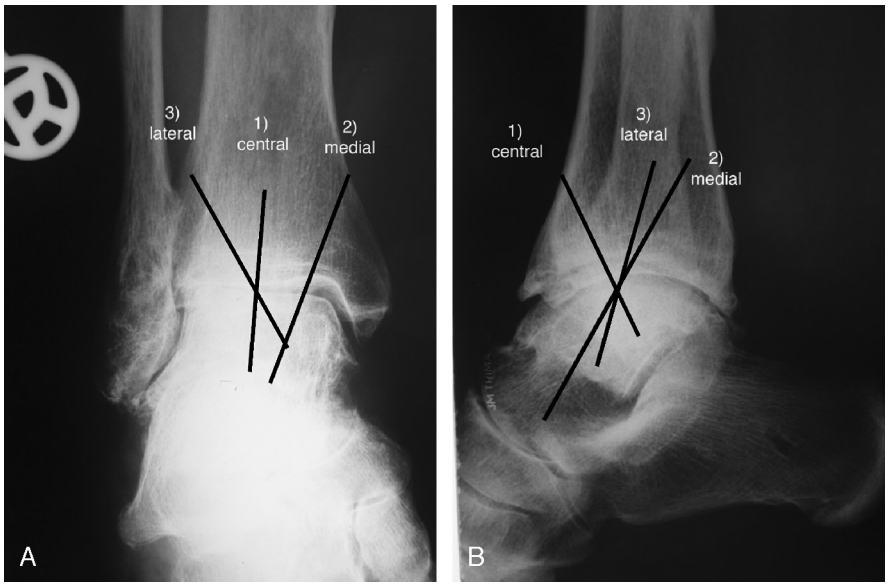

FIGURE 6. A and B, Positioning of the guidewires is a key point for stable fixation in the correct position. Images drawn on the radiograph show the position in the anteroposterior and the side view. The first guidewire for the 7.3-mm cannulated self cutting screw is inserted from the anterior tibia into the talus. The second guidewire is inserted from the medial tibia into the anterolateral corner or the talar neck. The third guidewire is inserted from the lateral tibia into the medial corner of the talar body.

the anteroposterior view, this wire crosses wire 1. Crossing proximal to the fusion site has been shown to optimize stability in a finite element analysis.[5]

Careful inspection of guidewire placement is necessary with the image intensifier in the frontal and sagittal plane to ensure the screws will pass each other when placed (Fig. 7). If the position of the wires is correct, the 7.3-mm cannulated self-cutting screws are inserted over the guidewires. Predrilling of the tibia may be necessary in very hard bone. Image intensifier control should confirm correct screw length (Figs. 8A, B) and avoid protrusion of the screws into the subtalar and Chopart joints. Plate osteosynthesis is not recommended because compression and stability are better using the screws.

FIGURE 7. Image intensifier is recommended for anteroposterior and side view control of the alignment of the ankle and the position of the guide wires.

After release of the tourniquet, homeostasis is performed. A suction drain is placed exiting the skin proximal to the joint line. Suturing of the joint capsule, extensor retinaculum, subcutaneous tissue, and the skin completes the surgery.

■ COMPLICATIONS

If the skin incision is placed too much laterally, the neurovascular bundle is at risk to be injured. Wound healing may be a problem especially in patients with posttraumatic skin defects. Scar adhesions may occur at the anterior tibial tendon and the extensor tendons. Not filling the defects in the subchondral bone with bone graft may lead to nonunion. Inaccurate positioning of the talus into the mortise can be followed by varus/valgus or rotational malposition. Anterior talar position must be avoided as it leads to subtalar joint dysfunction. It can only be corrected by completing the resection at the posterior part of the ankle at the talar site. Excessive resection of the articular surface may result in relative over-length of the fibula, leading to lateral impingement syndrome.

■ POSTOPERATIVE MANAGEMENT

A below-knee split cast is made in the operating room and maintained until swelling and bleeding of the wound are stopped. Elevation of the limb for the first

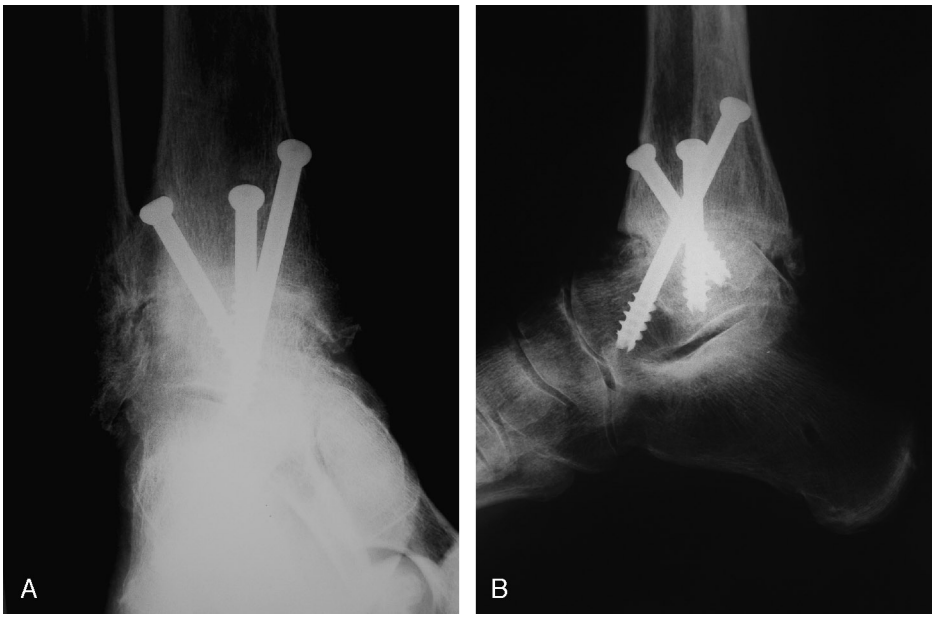

FIGURE 8. A and B, Radiograph of the ankle arthrodesis after screw fixation. Care has to be taken to choose the right length of the screws. Overlength has to be avoided to protect the subtalar joint.

postoperative days is recommended. The patient is mobilized with crutches non–weight bearing for 2 weeks. The cast is changed to a closed below-knee cast after 4 to 7 days. The cast is changed with changing of wound dressing after 2 weeks. Full weight bearing in the cast is permitted at this time. The cast is removed 8 weeks postoperatively if radiographic and clinical evaluation confirms adequate healing.

RESULTS

Our own results[7] were presented at the meeting of the German Foot and Ankle Society in Bielefeld, Germany 2007. Thirty-two patients were included in this follow-up study. The average age of the patients at the time of the surgery was 60.5 years (range, 34–79 years). Indications for surgery included posttraumatic arthritis (n = 18), primary arthrosis (n = 5), rheumatoid arthritis (n = 3), and other indications (n = 6). Four patients were excluded because of nonunion (n = 3) and deep infection (n = 1). All remaining patients underwent clinical and radiographic examination, gait analysis, and pedobarography with an average follow up of 34.4 months. The average patient satisfaction was graded 1.4 by the patients, on a scale from 1 (excellent) to 4; the average American Orthopaedic Foot and Ankle Society ankle-hindfoot score was 74 (range, 46–90). Our nonunion rate (9.4%) was much lower compared with most reports in the literature.[8,9]

CONCLUSION

Key factors for successful ankle arthrodesis are positioning the talus directly underneath the tibia at 90 degrees relative to the longitudinal axis of the tibia in the sagittal plane and stable fixation comprising at least 2 screws inserted at 30 degrees with respect to the long axis of the tibia. The screws should cross proximal to the fusion site to maximize stability.[5] A third screw started posteriorly improves sagittal plane stability.

Advantages of the anterior approach over the transfibular approach include no fibular osteotomy, better primary stability, and a smaller incision.

Advantages of the anterior approach versus arthroscopic surgery include the ability to correct small deformities and the ability to deal with stiff, fibrotic joints and sclerotic bone. Furthermore, surgeons who perform arthroscopic arthrodesis must include the anterior approach in their toolbox as it may be necessary to manage complications.

Finally, surgeons with experience in ankle joint replacement will feel familiar with the anterior approach.

The main limitation of the anterior approach is that it does not provide sufficient exposure to correct severe varus and valgus deformities.

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