Foot and Ankle Arthroscopy
Arthroscopic Ankle Arthrodesis
INTRODUCTION

Recently evidence based indications for ankle arthroscopy have been published [1] supporting the use of arthroscopy for the treatment of ankle impingement, osteochondral defects, loose bodies, ankle instability, septic arthritis arthrofibrosis and ankle arthrodesis. This publication is intended to provide guidance for the surgical procedure of arthroscopic ankle arthrodesis.

End Stage Ankle Arthritis (ESAA) has a severe effect on patients’ health related quality of life [2]. When non-operative treatments fail, ankle arthrodesis surgery or Total Ankle Arthroplasty (TAA) can improve pain, function and health related quality of life [3, 4]. For patients with isolated ESAA and minimal deformity outside the ankle requiring osteotomies or fusions, ankle (COFAS type 1 and 2 [5]) arthrodesis remains the mainstay of operative treatment.

Arthroscopic ankle arthrodesis allows the surgical goals of ankle fusion to be achieved without the extensive dissection and resultant pain, swelling and discomfort of an open ankle fusion. Arthroscopic ankle arthrodesis has been shown to be an effective technique to achieve tibio talar arthrodesis [1], with low rates of nonunion and other complications [6, 7]. In appropriate patients (Table 1) arthroscopic arthrodesis may be performed as an outpatient procedure and thus be less costly to patients and third party providers. Furthermore it is an anatomic sparing procedure with minimal bone resection that will preserve anatomy for future options.

This technique is authored by Dr. Mark Glazebrook, associate professor of Orthopaedic Surgery at Dalhousie University, Halifax, Canada, and Dr. Alastair Younger, associate professor, Department of Orthopaedics at the University of British Columbia, Vancouver, Canada.

<table>
<thead>
<tr>
<th>Indications:</th>
<th>Absolute Contraindications:</th>
<th>Relative Contraindications:</th>
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<tr>
<td>All patients with ESAA (COFAS stage 1 or 2) are candidates for arthroscopic ankle arthrodesis especially those patients with high risk of healing complications.</td>
<td>Active untreated infection</td>
<td>Smokers not willing to quit smoking</td>
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<td>Charcot Arthropathy</td>
<td>Severe bone loss</td>
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<td>Severe bone loss</td>
<td>Severe Intra-articular Deformity (COFAS Type 2)</td>
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<td>Severe Extra-articular Deformity requiring osteotomy (COFAS Type 4)</td>
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Table 1.
ANKLE ARTHROSCOPY ANATOMY

Anterior View

The superficial peroneal nerve (1) divides into a medial (2) and lateral branch (3), the division being above or below the joint line. Injury can cause painful neuroma at the joint line and numbness on the dorsum of the foot. The tendon of peroneus tertius (4) can be seen next to the lateral portal.

The deep peroneal nerve (5) and anterior tibial artery (6) lie right on the joint just anterior to the synovium in the mid line. The nerve supplies the extensor digitorum brevis muscle and the first web space sensation.

Posterior View

On the medial side in the back of the ankle lies the tibialis posterior tendon (1) in a fibro osseus tunnel directly behind the medial maleolus (2).

The neurovascular bundle (3) lies in a separate fibro osseus tunnel in the flexor retinaculum, with the bundle lying between flexor digitorum longus (4) and flexor hallucis longus (5), and a little posterior to both tendons. Within this sheath lies a vein, the posterior tibial artery and nerve medial to lateral.

The flexor hallucis longus can be seen from within the ankle in the posterior synovium if the great toe is flexed and extended. The muscle extends distally and can be seen at the level of the ankle. The tendon passes within a fibro-osseus tunnel comprising the talus on the anterior and lateral sides, and a fibrous band posteriorly and medially.
Patient Positioning with Distractor

Dr. Glazebrook Technique

For arthroscopic ankle fusion, posterior OCD lesions and synovectomy the posterior ankle joint must be accessed. For fusion, curved curettes and osteotomes can debride part of the posterior ankle. For posterior debridement, use a medial portal that is next to the tibial nerve. For this reason it has to be used cautiously but can be very useful for debridement of the back of the ankle.

Setup on bed: The patient should be positioned in a semi beach chair position with the bed flexed at hips and knees. A sandbag positioned under the ipsilateral hip will assist with positioning the Foot and Ankle with toes straight up.

Ankle Position: The non-invasive distraction device is positioned after sterile preparation and draping of the Foot and Ankle. To assure posterolateral and posteromedial portal access, the bottom portion of the bed should be flexed enough to allow working space posterior to the ankle.
Patient Positioning without Distractor
Dr. Younger Technique

The patient is placed on the OR table in the supine position with the foot to the bottom of the bed. A bean bag is used under the ipsilateral hip to internally rotate the hip so that the foot points up towards the ceiling. The bean bag is shaped so that the leg can be moved into abduction away from the table. The left leg is cupped within the bean bag to prevent it falling off the bed. A thigh tourniquet is used and the leg free draped to the level of the knee.

After prepping the limb the bed is elevated to the surgeon’s waist height. A tensor (ace) bandage is tied around the ankle tightly with the knot placed next to the medial malleolus. The surgeon passes the bandage around his/her waist and tightens the bandage so that the limb is held and traction can be applied by the surgeon leaning back. The bandage is tied next to the lateral malleolus so that the ankle is distracted instead of being plantar flexed.

The ankle can be dorsiflexed by the surgeon leaning into the limb. The surgeon's hands are free to use the instruments. To access the back of the ankle the leg is abducted.
PORTAL PLACEMENT

Anatomic landmarks should be traced on the patient preoperatively while the patient is awake. Anatomic landmarks should include, malleoli, distal anterior edge of Tibial plafond, Extensor Digitorum Longus (EDL) tendon, Tibialis Anterior (TA) tendon.

**Note:** The tip of the knife is used to incise the skin and blunt dissection (e.g. spread with hemostat) should be used as branches of the saphenous and superficial peroneal nerve are at risk. A central portal is not recommended.

**Anterior Ankle Scope Portals**

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**Anteromedial Portal**

The anteromedial portal is the safest and is always made first, just medial to TA tendon, lateral to medial malleous and 1 cm below Tibial Plafond.

**Anterolateral Portal**

The anterolateral portal is made next, just lateral to EDL tendon and 1 cm below Tibial Plafond.

**Medial Malleolus Portal**

Skin markings: the incision is just behind the medial maleolus over the tibialis posterior tendon. The incision is more distal than the anterior medial portal as the posterior joint line is more distal. The skin is incised only – no sharp object should be placed deep to the skin. A blunt probe or hemostat is placed into the ankle in anterior lateral direction and visualized from within the joint using the arthroscope in the anterior lateral portal (Fig 1). A shaver is then inserted which will be able to debride the posterior talus to the midpoint, the posterior syndesmosis, the posterior medial gutter, and the posterior synovium while the patient is still in the supine position (Fig 2).

**Safety points for medial portal use**

Always make sure that the shaver is within the joint before turning it on by visualization from another portal.

Never blindly shave the posterior ankle area.

Place the shaver or burr on the target area of the joint then turn it on.

Turn the shaver off before moving it to another area of the joint.

If the shaver slips from the joint, pull it out immediately and turn it off outside the ankle.

Always use blunt dissection under the skin when using this portal.
Performing an arthroscopic ankle fusion will require instrumentation of the entire ankle joint. The goals of an arthroscopic ankle fusion are as follows:

- The entire joint must be debrided of cartilage.
- The subchondral bone should be penetrated to stimulate new bone formation.
- The ankle joint should be reduced to a neutral position after removal of the arthroscopy instruments.
- Provisional fixation should be obtained with a K-Wire, guide wire or drill bit.
- Stable compression fixation should be obtained.
- Radiographic confirmation of hardware position.

Anterior arthroscopy is performed first. A synovectomy and osteophyte removal will allow access and visualization of the joint. An aggressive shaver such as a ConMed Linvatec Gator® should be used for this part of the surgery.

Prior to cartilage removal, a final check of the anterior and posterior ankle should be performed (Fig 3):

- Has ankle arthritis been confirmed?
- Are there any major bone defects that prevent apposition of the bone surfaces?
- Can the joint be completely visualized?
- Can the joint be brought to a neutral position in three planes of translation and rotation?

Depending upon these observations the surgeon may choose to abandon the fusion or convert to an open fusion.

Cartilage Removal (Fig. 4)

After it has been determined to go ahead with an arthroscopic ankle fusion, cartilage removal should be performed. With cartilage removal a 2.9mm or 4.0mm arthroscope may be beneficial to improve visualization and inflow fluid speed.

From the lateral portal, the anterior and lateral talar cartilage can be removed using curette, full radius resector and a ConMed Linvatec Lightning® Bur. The cartilage on the tibial surface is best removed first on the lateral side. The bur is then gradually brought further into the joint while removing cartilage. At the extreme of range of the bur, the talar dome will prevent access to the posterior side of the joint.

The talar surface is then burred in sweeps from anterior lateral to posterior medial. The limit of cartilage removal will occur when the talar dome curves away from the bur. The lateral gutter is then approached and the cartilage removed from the fibula and talus.
The ankle should also be dorsiflexed and the anterior talar cartilage removed. The scope is then switched to the medial portal and the shaver to the lateral portal. The cartilage is then removed from the tibia in sweeps from the anterior medial corner, the talus from the corner, and down the medial gutter. This will leave cartilage on the posterior side of the tibia and talus. Therefore the bur is then placed in the posterior side of the joint and sequential sweeps are made from the posterior medial corner of the talus and tibia. This will then often leave a ridge of cartilage on the top of the talus outside the reach of the shaver from any portal. This residual cartilage can be removed using a curved curette or curved osteotome from the anterior medial or anterior lateral portal.

After complete cartilage removal has been confirmed, use a ConMed Linvatec Spherical Bur to penetrate subchondral bone. At completion a curved osteotome can be used to feather the subchondral surfaces.

Reduction

The ankle joint is brought to neutral with the hindfoot in five degrees of valgus and neutral dorsiflexion (with the midfoot held inverted and dorsiflexed). While the surgeon holds the ankle position, the assistant obtains provisional fixation with guidewire. The position is rechecked before hardware is placed.

Fixation (Fig. 7)

Fixation can then be performed using percutaneous cannulated or solid screws with the ankle held in a neutral position. Fixation can go from the lateral talar process to the medial distal tibia, the medial tibia to the talar neck, or the lateral tibia to the medial talus or talar neck. Care is taken to ensure that the fixation does not penetrate the subtalar joint and the talonavicular joint. An AP and lateral of the ankle and foot are therefore required. Proximal to distal fixation should therefore be directed from posterior to anterior to ensure that the widest part of the talus is transfixed. The medial talus is slightly wider than the lateral talus.

After confirmation of position of the hardware, the wounds are closed after deflation of the tourniquet using nylon suture. The patient will require a plaster slab in neutral and padding. This is kept on until the first postoperative visit.

Fig 5: Arthroscopic view showing subchondral bone penetration.

Fig 6: Arthroscopic view post debridement and subchondral penetration with screw guide wire.

Fig 7: X-rays showing reduction with large fragment cannulated lag screw fixation.
**Postoperative care**

The patient will require 6 weeks of non-weight bearing. Suture removal is performed at two weeks. After x-rays, at 6 weeks the patient is remobilized under the supervision of physiotherapy. A walker boot or cast is used until 10 weeks, and final x-rays performed at 12 weeks.

**Alternative  Solid Screw Placement**

**Dr. Younger Technique**

Solid screws can be placed from the sinus tarsi to the distal tibia, and from the distal tibia to the talar neck region. With solid screws, the ankle joint is held neutral after removal of the arthroscopic instruments. A small incision is made on the edge of the sinus tarsi and provisional fixation achieved using a K-wire or drill bit with the ankle held in a neutral position. Two lagged large fragment cortical screws can then be placed from the lateral side of the talus and the junction between the talar neck and body into the distal tibia. A screw can also be placed from the tibia into the talar neck from just in front of the fibula, through the fibula or just behind the fibula.
REFERENCES


Below is a suggested list of the instrumentation for use in foot and ankle arthroscopic surgery.

**ENDOSCOPY OPTIONS**

4.0MM, 30 DEGREE HD ARTHROSCOPE AND SHEATH SET (170MM WORKING LENGTH)
4.0mm, 30 degree HD Eyecup Scope....................... HD4300
4.0mm, 30 degree HD Cartridge Scope....................... HD4301
5.5mm Single Stopcock Sheath Set .................. QL5531
5.5mm Double Stopcock Sheath Set .................. QL5532

2.9MM, 30 DEGREE ARTHROSCOPE AND SHEATH SET (152MM WORKING LENGTH)
2.9mm, 30 degree Eyecup Scope............... T2930
2.9mm, 30 degree Cartridge Scope............... T2931
4.0mm Small Joint Single Stopcock Sheath Set .................. T4031
4.0mm Small Joint Double Stopcock Sheath Set .................. T4032

2.5MM, 30 DEGREE ARTHROSCOPE AND SHEATH SET (72MM WORKING LENGTH)
2.5mm, 30 degree Eyecup Scope............... T2530
2.5mm, 30 degree Cartridge Scope............... T2531
3.5mm Double Stopcock Sheath Set (w/30 Degree Tip) .................. C3252-30

1.9MM, 30 DEGREE ARTHROSCOPE AND SHEATH SET (60MM WORKING LENGTH)
1.9mm, 30 degree Eyecup Scope............... T1930
1.9mm, 30 degree Cartridge Scope............... T1931
2.8mm Single Stopcock Sheath Set .................. C3101

**POWER AND ACCESSORIES**

MPower* 2 - Two Trigger Modular Handpiece .................. PRO6202M
9.6V NiCad Autoclavable Battery .................. PRO3010
Two Trigger Wire Driver Attachment .................. PRO6228
Two Trigger Pin Driver Attachment .................. PRO6240
1/4 inch Chuck Attachment .................. PRO2041

**FLUID MANAGEMENT & RESECTION**

ARTHROSCOPIC FLUID PUMPS & TUBING SETS
10k* Irrigation Console (Inflow Only) .................. 10K
24k* Irrigation Console (Inflow/Outflow/Suction) .................. 24K
10k*/24k* Arthroscopy Inflow Tubing Set .................. 10K100
24k* Arthroscopy Outflow/Suction Tubing Set .................. 24K100

SHAVERS HANDPIECES
Ergo ” Two-Button Shaver Handpiece... D4240
Advantage Turbo ” Two-Button Shaver Handpiece .................. D9924

SHAVERS
2.9mm Gator* .................. C9961A
3.5mm Gator* .................. C9264
4.2mm Gator* .................. 9263A
3.5mm Great White* .................. 9399A
4.5mm Great White* .................. 9299A

BURS
4.5mm Lightning* Bur .................. H9133
4.5mm Vortex* Router Bur .................. H9131

**GENERAL INSTRUMENTS**

Arthroscopic Probe
Shutt* Graspers
Pituitary Rongeur
Assorted Curettes:
00, 0, 01 curved and straight
Awls/Chondral Picks:
45 & 90 degree
Metacarpal Osteotomes:
2mm – 5 mm curved and straight
K-Wires

WIRELESS FOOTPEDAL
Zen* Wireless 3 Pedal Footswitch ........ W1000
Wireless Adapter .................. W1100