Arthroscopic Ankle and Subtalar Fusion
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Arthroscopic Ankle Fusion

1918 - Takagi performed a knee arthroscopy in a cadaver
- Due to narrow joint ankle arthroscopy initially considered unsuitable.

1939 - Takagi described an arthroscopic technique for the ankle joint

1972 - Watanabe described the anteromedial, anterolateral and posterior portals

1983 - Schneider first developed techniques for arthroscopic ankle fusion

Ankle arthrodesis is now a well-established technique in the treatment of ankle arthritis. The alternative of ankle replacement is not appropriate for all patients and has higher complication and revision rates (Daniels 2014).

With increasing pressure on reducing hospital stays and improving speed and reliability of overall recovery, arthroscopic arthrodesis has emerged as a less invasive and viable option.

Advantages of arthroscopic ankle fusions include:
- Shorter hospital stay
- Quicker time to union with equivalent or higher union rates
- Faster recovery with potentially shorter operation time => Lower costs (Nielsen 2008; Peterson 2010; Townshend 2013; Pakzad 2014)

<table>
<thead>
<tr>
<th>Table 1: Summary of outcomes</th>
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<tbody>
<tr>
<td>AAA</td>
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<td>Type of Study</td>
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<tr>
<td>Abich &amp; Roukis, 2013</td>
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<td>Darno et al, 2012</td>
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<td>Gougoulias et al, 2007</td>
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<td>Watanabe et al, 2005</td>
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<td>Schneider et al, 2012</td>
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<td>Nielsen et al, 2008</td>
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<td>O'Brien et al, 1999</td>
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<td>Myerson &amp; Quill, 1999</td>
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Hospital stay in days given as mean ± standard deviation or mean (range).
Abbreviations: AAA, Ankle osteoarthritis scale score; OAA, open ankle arthrodesis.


Indications
- All causes of end-stage ankle arthritis
  - Particularly useful when soft tissue compromise is present:
    - Post-traumatic arthritis frequently associated with multiple scars from previous wounds and operative treatments
    - Inflammatory arthritis and older patients in whom skin healing suboptimal.
Contra-indications

- Absolute
  - Active infection

- Relative
  - Deformity
    - Published literature suggests otherwise (Winson 2005, Danawi 2011)
      - Location needs to be defined (through ankle or below ankle)
      - May be overcome by combining arthrodesis with osteotomy
  - Poor soft tissue quality
  - Avascular necrosis of the talus
    - BUT union in 15/16 patients (Kendal 2015)
  - Poor vascularity
  - Smoking
  - Neuropathy especially with early Charcot

Surgical Technique

Preoperative Planning

- Confirm that symptoms coming from the ankle
  - History and examination
  - Plain standing AP and lateral radiographs essential
  - The use of a targeted injection of local anesthetic

- Preparation and Patient Positioning
  - Prophylactic intravenous antibiotics
  - Usually GA + regional technique
  - Supine (+/- sandbag under ipsilateral buttock) with toes pointing to ceiling
  - Tourniquet on the thigh
  - The leg is prepared up to the knee to allow assessment of limb alignment

- Equipment
  - Traction useful but not essential
  - Fluid catchment drape (ACL drape)
  - Standard 4.5mm ; 30° scope (“Knee scope”)
  - 3.5 - 4.5mm arthroscopic shaver
  - 4 – 5.5mm arthroscopic barrel-shaped burr
  - Curettes and small osteotomes (straight and curved) to denude joint surface
  - Cannulated compression screw fixation (6.5-8mm)

Surgical Approach

- Standard anteromedial portal created after skin incision and blunt dissection
- Anterolateral portal created in same fashion and under direct vision
  - “Make it look like an ankle”
    - Resect anterior scar and reduce size of anterior osteophytes

- Remove residual cartilage with shaver and curettes
- Prepare joint surfaces with the burr +/- osteotomes
  - “Suction test” to determine depth of resection
    - Resect subchondral bone. Turn off fluid and turn on suction to confirm bleeding/viable bone is present
    - Resect reminder of subchondral bone to achieve the same level
  - Generally start with anterior talus and be systematic
    - Work in quadrants (talus then tibia) and from anterior to posterior
    - If difficulties in reaching posteriorly, usually more bone needs to be resected anteriorly and consider curved curettes/osteotomes
    - The lateral gutter cleared of osteophytes to allow reduction particularly in varus ankle, but joint surface preparation not essential
    - Medial gutter prepared thoroughly over the entire medial malleolus and reciprocal surface of the medial talus
- Joint positioning critical
  - Plantigrade (AVOID EQUINUS !!!) ; Neutral to slight valgus ; Slight ER
- Fixation
  - Fluoroscopic guidance required
  - 2 parallel guide wires are inserted from the posteromedial tibia into anterior half of talus through single short longitudinal or multiple stab incisions
  - Care is taken not to penetrate into the subtalar joint.
  - Compression screws of minimum 6.5 mm +/- washers inserted
  - Rigid fixation and compression essential
    - (3rd screw from lateral side may provide further stability)
- Skin closure performed and Plaster splint applied

**Post-Operative Care**
- Cast for 6/52
  - NWB 2-6/52
    - No difference between Non Weight Bearing (NWB) and Weight Bearing As Tolerated (WBAT) in union rate (Cannon 2004)
- Cam walker 6/52
  - WBAT
- Unprotected weight bearing after clinical and radiological union established (usually by 12 weeks)

**Complications**
- General
  - Neurovascular damage
  - DVT/PE
  - Infection
- Specific
  - Screw prominence
    - Ensure compression at time of arthrodesis to reduce screw ‘back out’
    - Consider headless screws
  - Non-union
    - Remove risk factors (Infection/smoking/nutritional deficiency …)
  - Malalignment
    - Avoid equinus
      - Inferior surface of calcaneum never divergent from distal end of tibia
  - Lateral Impingement
    - Ensure fibular osteophyte removal
  - Adjacent joint arthrosis –
    - related to pre-existing disease
Arthroscopic Subtalar Fusion

Introduction
- The published results of the open techniques are generally good
  o Union between 84% and 95% (Easly 2000, Mann 1998)
  o Complications include:
    ▪ Symptomatic hardware protrusion (20%)
    ▪ Infection (3%)
    ▪ Hindfoot misalignment (6%)
    ▪ Lateral impingement (10%)
    ▪ Sural nerve injury (9%)
- Arthroscopic technique first developed in 1994 by Tasto
  o Generally results in good functional results and high patient satisfaction
  o Potential advantages:
    ▪ Faster recovery
    ▪ Less pain and improved proprioception (less nerve damage)
    ▪ Higher and faster fusion rates
      • Decrease of 1.7 hospital days c.f open technique (Scranton 1999)
      • Average return to daily activities = 16 weeks after arthroscopic technique (Frey 2009)
      • Union rate of 84% in open cases Vs 97% in arthroscopic cases (Easly 2000) and healing time of 11.2 weeks (8.9–15 weeks)
  o BUT series generally small and may represent simpler (non-deformed) cases

<table>
<thead>
<tr>
<th>Author</th>
<th>N</th>
<th>Preoperative Diagnosis</th>
<th>Technique (portal)</th>
<th>Fusion Rate (%)</th>
<th>Average Time of Fusion (weeks)</th>
<th>AOFAS</th>
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<tr>
<td>Scranton</td>
<td>5</td>
<td>Subtalar arthritis</td>
<td>AL, PL, Lateral</td>
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<td>-</td>
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<td>Tasto</td>
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<td>Subtalar arthritis</td>
<td>AL, PL</td>
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<td>Glanzmann</td>
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<td>Primary arthritis, post-traumatic osteoarthritis, talar coalition</td>
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<td>Talar coalition</td>
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<td>El Shamy et al</td>
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<td>Posttraumatic arthritis (calcaneal fracture)</td>
<td>AL, AL, PL, PM</td>
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<td>11</td>
<td>30-64</td>
</tr>
</tbody>
</table>


Indications
- All causes of end-stage isolated subtalar joint arthritis
  o Particularly useful in cases of soft tissue or vascular compromise
  o Preserves talar and calcaneal blood supply
  o Protects surrounding soft tissues especially after previous trauma

Contra-indications
- Absolute
  o Active infection
- Relative
  o Deformity
    ▪ Single and multiplanar
  o Previous NON-UNION
  o Poor vascularity or soft tissue quality
  o Smoking
  o Neuropathy especially with early Charcot
  o Performance of concomitant midfoot or forefoot procedure (if using posterior portals)
Surgical Technique

Preoperative Planning
- Confirm symptoms are coming from the Subtalar joint
  - History and examination
  - Plain AP/Lateral radiographs +/- CT scans
  - The use of a targeted injection of local anesthetic
- Preparation and Patient Positioning
  - Prophylactic intravenous antibiotics
  - Usually GA + regional technique
  - Position depends on the portals to be used.
    - Supine, lateral, or prone
  - Tourniquet on the thigh and leg prepared above knee to allow assessment of limb alignment
- Equipment
  - Distraction
    - Soft tissue or Skeletal
    - Trocar or screw
  - Fluid catchment drape (ACL drape)
  - 2.9mm : 30° scope
  - 2.7-3.5mm arthroscopic shaver
  - 3.5mm arthroscopic burr
  - Curettes and small osteotomes (straight and curved)
  - Cannulated compression screw fixation (6.5 mm or similar)
Surgical Approach
- Portal placement
  o Anterolateral and Posterolateral (+/- Accessory lateral)
    ▪ El Shazly et al. 2009; Linz 2013
  o Posteromedial and Posterolateral
    ▪ Van Dijk 2000; Lee 2010
  o Posteromedial and Posterolateral + Sinus Tarsi (for distraction)
    ▪ Beimers 2009; Amendola 2007; Lee 2008
- Remove residual cartilage with shaver and curettes
- Prepare joint surfaces with the burr
  o “Suction test” or I/I to determine depth of resection
    ▪ Resection of 2 mm of subchondral bone required to achieve bleeding
    ▪ Tourniquet may be opened to verify bleeding before fixation
    ▪ Intraoperative fluoroscopy potentially useful to check the depth of joint debridement
  o Necessary to debride the posterior facet to obtain subtalar fusion
    ▪ In middle-anterior facet coalitions, a complete subtalar fusion may be required (Glanzmann 2007)
    ▪ Difficult to access middle and anterior facets through posterior portals (Frey 2009)
  o Potential advantage of preserving interosseous ligament to preserve the bone blood supply
    ▪ BUT open techniques resect interosseus ligament through sinus tarsi approach and do not report larger fusion times or AVN => theoretical
- Role of bone graft controversial
  o Recommended by some authors (Flemister 2000; Lee 2008, Glanzman 2007)
  o Deemed unnecessary by some authors (El Shazly 2009; Lee 2010)
- Fixation
  o No standardised method – usually talocalcaneal screws
    ▪ Prone position of the patient may facilitate insertion (Lee 2010)
    ▪ One or two screws generally used – no consensus
      ▪ High fusion rate with one cannulated 7-mm screw from talus to calcaneus (El Shazly 2009; Glanzman 2007)
      ▪ High fusion rate with two cannulated screws from calcaneus to talus (Lee 2010; Amendola 2007)
Post-Operative Care
- Cast for 6/52
  - NWB 2-6/52
- Cam walker 6/52
  - WBAT
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Complications
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  - Screw prominence
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  - Non-union
    - Remove risk factors (Infection/smoking/nutritional deficiency …)
  - Malalignment
  - Peroneal irritation