

*Institute for Orthopaedics and Sports Medicine*

## Total Ankle Replacement for Ankle Arthritis with Deformity

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### Disclosures

- Consultant, speaker bureau
  - Wright Medical
  - Integra

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### Successful TAR

- Patient selection
  - Surgeon experience
  - Prosthesis design
  - Alignment
  - Ligament stability
  - Rehabilitation

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### TAR and Deformity

- Most end-stage arthritic ankles
  - Post-traumatic
  - Instability
  - Deformity (33-44%  $>10^\circ$ )
  - Soft tissue contracture
- Asymmetric loss of articular cartilage
- Neighboring joint arthritis and deformity



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### TAR with Persistent Angular Deformity

- Progressive edge loading
- Polyethylene wear, subluxation
- Osteolysis
- Premature failure
- *Neutrally aligned prosthesis components have the best clinical outcomes including ROM and pain relief*  
(Barg et al, JBJS 2011)



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### TAR with Coronal Plane Deformity

Challenge to Regain Anatomical Alignment

- Joint replacement is a soft tissue procedure
- Ligament balancing needs to be predictable and has to be done before patient leaves OR to ensure component parallelism
- Need to achieve a plantigrade foot and ankle



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### TAR with Coronal Plane Deformity

Challenge to Regain Anatomical Alignment

- Release contracted tissues on concave side
- Reinforce tissues on convex side



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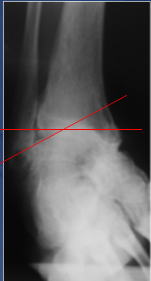
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### TAR with Coronal Plane Deformity

Challenge to Regain Anatomical Alignment

- Controversy on limits:
  - Coetzee :  $>20^\circ$  contraindication
  - Hobson :  $30^\circ$  can be managed
  - Kim, Queen, Sung: no difference
- Must achieve neutral alignment & stability *intra-op* to reduce subsequent wear



Coetzee, Foot Ankle Clin N Am, 2008. Hobson et al, JBJS Br, 2010. Kim et al, JBJS Br 2010. Queen et al, JBJS 2013; Sung et al, FAI 2014.

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### TAR with Deformity

Pre-op

- Ankle ROM, contractures
- Scars from previous operations
- Neurovascular status
- Examine gait, alignment, instability
  - Coleman block testing
  - Test deltoid competence!



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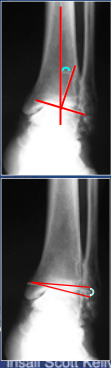
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### TAR with Deformity Radiographic Analysis

- Standing foot, ankle XR
- Alignment b/w tibia anatomic axis and perpendicular to talar dome
  - $>10^\circ$  = varus/valgus
- Talar tilt angle is the tibial and talar articular surfaces
  - $>10^\circ$  = incongruent joint



*Kim et al, JBJS Br 2010*

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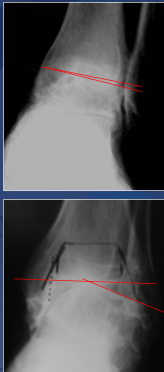
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### Joint Congruity

- Congruent:
  - $<10^\circ$  difference between talar and tibial joint lines
- Incongruent:
  - $>10^\circ$  difference between talar and tibia joint lines



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### TAR with Deformity Radiographic Analysis

- 3 joint standing film with large deformity
- HF alignment view
- MRI helpful for soft-tissue pathology, vascularity
- CT: deformity, bone loss, cysts, impingement
  - Use for patient-specific blocks



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### Radiographic Analysis

- Location of deformity determines procedure(s)
- At the joint
  - Bony cuts, soft tissue
- Proximal to the joint
  - Corrective osteotomy
- Distal to joint
  - Osteotomy, fusion, soft tissue



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### Balance Above or Below the Ankle Joint

Goals

- In patients with early OA (not TAR)
- Osteotomy to alter WB axis of LE to offload areas of asymmetric wear
- Concomitant intra-articular procedures
  - Osteophyte debridement
  - ? Chondral resurfacing
  - Injection
  - Otherwise ineffective w/o proper mechanical alignment!



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### Balance Above or Below the Ankle Joint

Goals

- In patients who need TAR
  - Adjuvant procedures to produce a neutral alignment
- Correct deformity
  - Especially with focal wear changes
- Simultaneous vs staged



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Barg et al, Foot Ankle Clin NA, 2012

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### Balance Above or Below the Ankle Joint

Goals

- Proximal tibia osteotomy (rotational)
- Distal tibia +/- fibular osteotomy
  - Oblique, opening/closing, dome
- Calcaneus osteotomy
- Tendon releases, transfers
- Ligament reconstruction



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### TAR with Deformity

Technique

- Anterior incision
- Adequate length (10-12 cm)
- Avoid self-retaining retractors that crush skin edges
- Avoid subcutaneous dissection to preserve skin vascularity



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### TAR with Deformity

Technique

- Debride osteophytes
- Assess intra-articular deformity
  - Ability to correct



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### TAR with Deformity Technique

- Balance the ankle, restore mortise
  - Laminar spreaders into joint
  - Pin distractor
  - Gutter debridement
  - Ligament releases



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### Balance the Joint: Etiology of Varus Deformity

- Medial tibial plafond erosion
- Post-traumatic arthritis
  - Congruent deformity
- Chronic ankle instability
  - Extra-articular at level of the joint
  - Incongruent joint
  - Talar tilt, tight medial ligaments, flat MM
- Cavovarus hindfoot malalignment



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### Balance the Joint: Varus

- Removal of periarticular osteophytes
- Debride gutters (M, L, posterior)
  - +/- separate lateral incision



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### Balancing the Joint: Congruent Varus

- Parallel joint lines
- Bony > soft tissue pathology
- Stiff subtalar joints
- Address deformity before cuts are made
- Often just adjust TAR cut
  - Slightly higher tibial cut



Coetzee, Foot Ankle Int 2010

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### Balancing the Joint: Incongruent Varus

- Greater than 10° difference in tibial and talar joint lines
- Obvious soft tissue imbalance
- Cannot be corrected by bony cuts alone
- Deltoid ligament release (deep +/- sup)



Easley, Advanced Reconstruction Foot and Ankle 2, 2015

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### Balance the Joint: Varus

- Laminar spreader into medial joint
- Posterior capsule release
- Medial malleolar osteotomy
  - When deltoid lengthening is not enough
  - With severe intra-articular varus deformity



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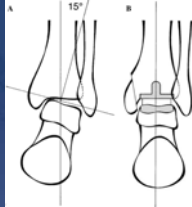
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### Varus Correction Medial Malleolar Osteotomy

- *Doets et al, FAI 2008*
- Medial gutter debridement
- Osteotomy is done half way down the malleolus
- Medial to shoulder
- Hindfoot deformity correction



*DeOrio, Clin Podr Med Surg, 2013.*

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### 60 yo male, history of instability



*DeOrio, Clin Podr Med Surg, 2013*

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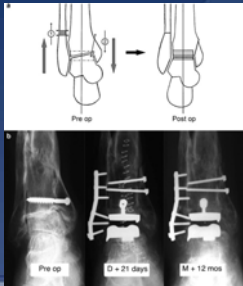
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### Varus Correction Lateral Malleolar Shortening Osteotomy, Medial Malleolar Lowering Osteotomy



*Trincat et al, Orth & Traum, 2012*

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### Balance the Joint: Varus

- Talonavicular capsule release
- Posterior tibial tendon recession at m-t
- Flexor retinaculum release



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TAR, deltoid release,  
PTT/PL → PB,  
cavovarus correction,  
ST/TN fusion



Schuberth et al, J Ft Ankle Surg 2016

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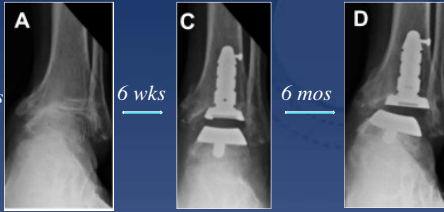
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### Beware Persistent Instability, Malalignment

60 yo male, history of instability



24° varus      6 wks      6 mos

DeOrto, Clin Podr Med Surg, 2013

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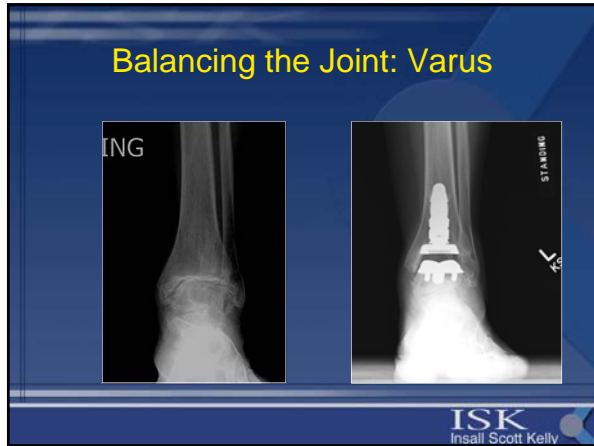
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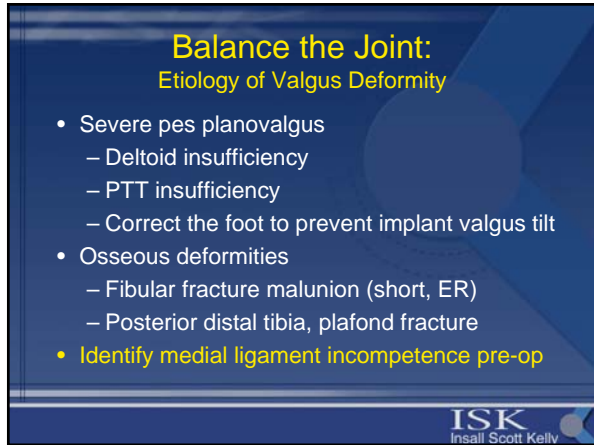
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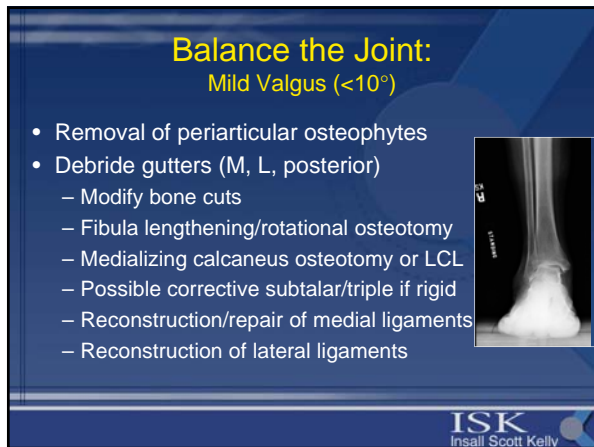
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**Balance the Joint:**  
Mild Valgus (<10°)



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**Balance the Joint:**  
Severe Valgus (>10°), supramalleolar

- Supramalleolar osteotomy
- TAR
- Hindfoot still in valgus?
  - Fibula lengthening/rotational osteotomy
  - Medializing calc osteotomy or HF fusion
  - Cotton osteotomy
  - Reconstruction of medial ligaments
  - Reconstruction of lateral ligaments



Gougoulias, Maffuli, Clin Podr Med 2015. Trincat et al, Orth & Transp, 2012

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**Balance the Joint:**  
Severe valgus (>10°) inframalleolar

- (PTTD)
  - Reconstruction vs arthrodesis
    - PF osteotomy medial cuneiform
    - PB→PL
  - TAR
  - Fibula lengthening/rotational osteotomy
  - Reconstruction of medial ligaments
  - Reconstruction of lateral ligaments



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### TAR with Deformity Technique

- Once joint is balanced, can make cuts
  - +/- place in jig
  - Heel cord lengthening
  - Deformity correction in jig
  - Maintain correction with IM rod
  - Precise tibial, talar cuts
  - If anything, **under** resect bone!
  - Posterior capsulectomy



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### TAR with Deformity Technique

- Implant components
  - Maximize cortical support, stems?
  - Stability
- Test ankle stability with trial components in place
  - Favor fixed bearing implants



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### TAR with Deformity Technique

- Peri-articular bony procedures
  - Hindfoot
- Ligament reconstruction
- Foot alignment correction



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### TAR with Deformity Technique

- Hindfoot/midfoot deformity?
  - Reconstruction, osteotomy
- If peroneals, eversion weak
  - PTT/FDL/FHL → PB
- AT transfer to middle cuneiform
  - With severe varus



*Easley, Advanced Reconstruction Foot and Ankle 2, 2015*  
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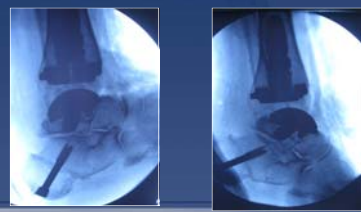
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### TAR with Deformity Technique

- Test full ROM with final components, trial poly
- Layered closure over Hemovac drain



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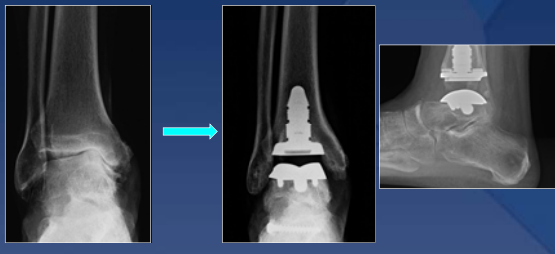
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### Balanced TAR with Varus Deformity



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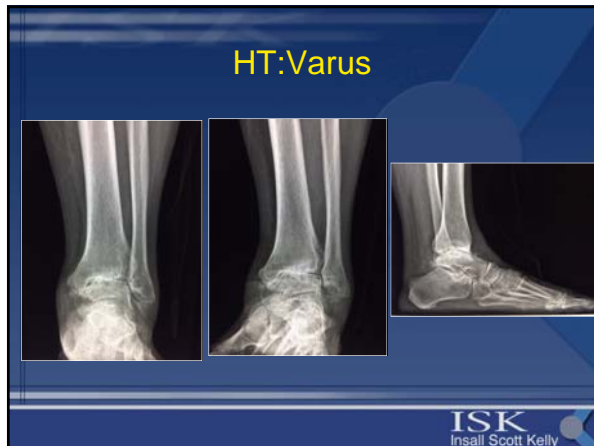
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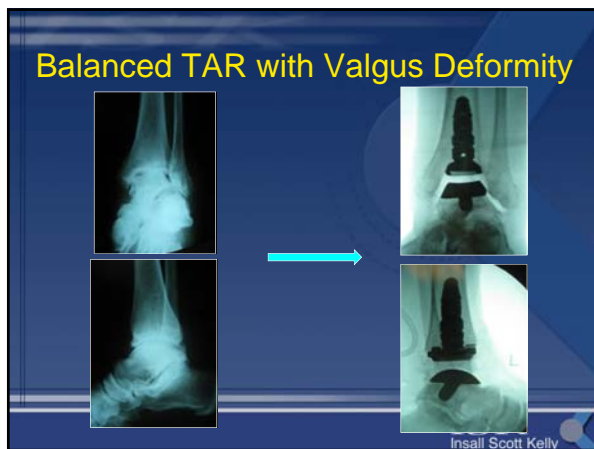
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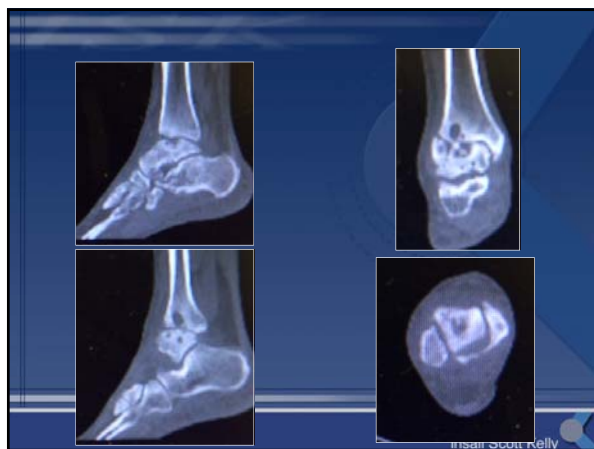
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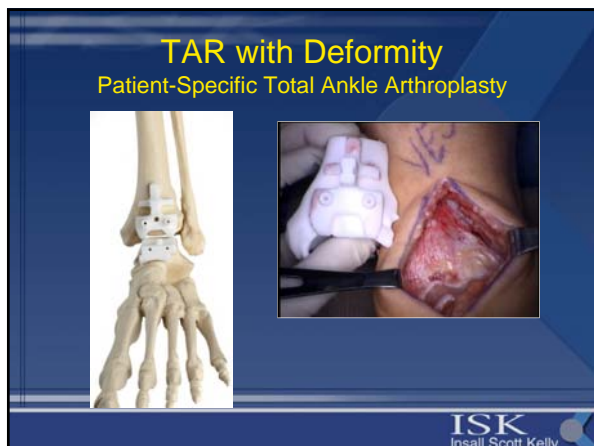
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### TAR with Deformity

#### Patient-Specific Total Ankle Arthroplasty

- Goal is to restore mechanical, kinematic joint axes
- Improved implant alignment
  - Neutral coronal and sagittal alignments obtained for all TAR cases regardless of preoperative deformity (*Hsu et al, FAI 2015*)
- Improved accuracy, reproducibility
- Decreased surgical time
- Decreased flouro time (12 min)



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### TAR with Deformity

#### Patient-Specific Total Ankle Arthroplasty



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### Patient-Specific Total Ankle Arthroplasty:

#### Cannot Blindly Rely on Technology

- MRI: avascular necrosis 50% talus, plafond
- Erosion anterior tibial plafond



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### Patient-Specific Total Ankle Arthroplasty: Cannot Blindly Rely on Technology

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### Patient-Specific Total Ankle Arthroplasty: Cannot Blindly Rely on Technology

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### My Preference With Deformity

- With severe foot deformity I prefer to stage
- With moderate HF arthritis with minimal symptoms, I prefer TAR by itself
  - Provides good pain relief and function
  - TAR usually markedly improves foot alignment
- Always try to protect the talar blood supply
  - Limit ST preparation to the posterior facet avoids inferior talar neck blood supply
  - Also avoid inferior talar head w/TN preparation

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**Conclusions**

- Tibiotalar coronal malalignment is not uncommon in end-stage arthritis and should not be a contraindication to TAR
- But still a challenge to correct
- Balancing is vital to outcomes
  - Surgeon experience is important
  - Different constraints with different prostheses
  - More refined techniques of ligament balancing

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**Conclusions**

- Figure out pre-operatively where the deformity is coming from
  - Above the ankle
  - The ankle joint itself
  - Below the ankle
- Address deformities systematically either concurrently or staged
  - Soft-tissue, bony, fusion
- Beware of an incompetent deltoid!

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**Conclusions**

- Stable neutral alignment
- Achieve a plantigrade, balanced foot & ankle
- Restore component parallelism
  - Reduce eccentric wear
  - Reduce component loosening
  - Reduce subsidence
  - Reduce reoperation and failure

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