

Distal Tibia Anatomic Bone Density and its Role in Total Ankle Survivorship: A Retrospective Review of Consecutive Cases

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STATEMENT OF PURPOSE

Total ankle replacement (TAR) survivorship has been reported at 5 years to range from 78% to 95.5% (±5). The leading reason for TAR revision is attributed to aseptic loosening which has been reported to be between 26% and 68% of all revisions (6-9). Loosening tends to occur early after surgical implantation (10). Recent studies have looked into the volume and geometry of bone resected with different implant systems and their impact on implant stability. Utilizing rounded cuts and minimizing bone resection has been found to help preserve peri-prosthetic bony density and support (1, 11, 12). Epiphyseal scars of long bones are known to be a narrow belt of denser cancellous bone than the bone on either side (13). No study, to our knowledge, has correlated the location and preservation of the distal tibia epiphyseal scar and its impact on TAR survivorship. The epiphyseal scar has been a topic of research for medial malleolus fractures. Studies recommend engaging the epiphyseal scar, while avoiding placement within the less dense metaphyseal bone (14, 15). This study is intended to introduce and assess the significance of preserving and engaging the epiphyseal scar during TAR surgery based on radiographic review and short-term follow-up.

METHODOLOGY AND PROCEDURE

Methodology: Retrospective review of weight bearing CT scans to determine the presence and location of both the epiphyseal scar and distal 5% of the tibia in relation to the tibial component and their role in survivorship of TAR in 17 consecutive patients who underwent TAA.
Procedure: Digital weight bearing CT images were analyzed to measure the distance of the epiphyseal scar location and distal 5% mark of the tibia from the tibial plafond.

Gender	Total	Percentage
Males	7	38%
Females	11	62%
Laterality		
Right	10	55%
Left	8	45%
Variable		
Age (Years)	64.2 (43-78)	

Figure 1. Measuring Distal – Most 5% to Tibial Plafond

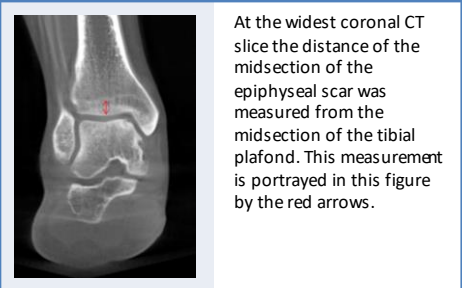


Table 2. Distal Tibia Bone Anatomy

Measurement of interest	Male: Mean ± SD (mm)	Female: Mean ± SD (mm)
Distal – Most 5% to Tibial Plafond	20.9 ± .518	19.4 ± .485
Epiphyseal Scar to Tibial Plafond	10.1 ± .479	10.2 ± .453

Figure 2. Measuring Distal – Most 5% to Tibial Plafond

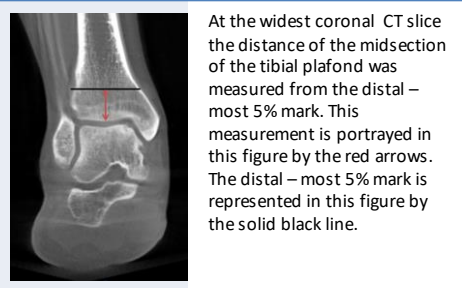


Figure 3. Ideal Zone to Remain Within

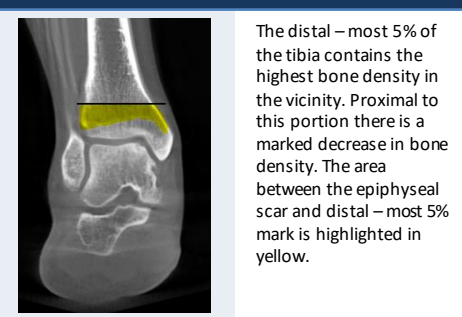
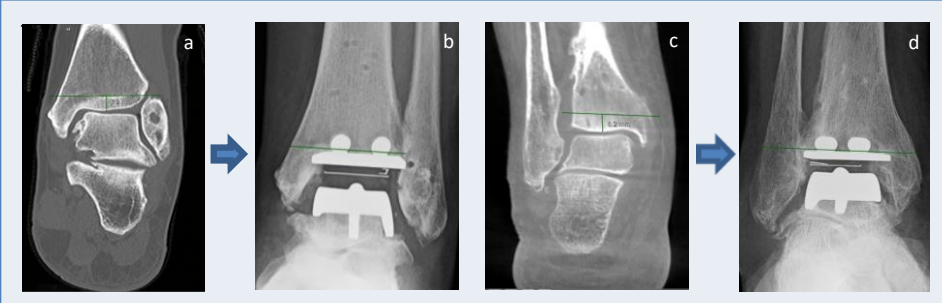


Figure 4. Total Ankle Arthroplasty Engaging Epiphyseal Scar



Bone resection is minimized in attempts to allow the the tibial component barrels to reside within the epiphyseal scar (a,b, c, d).

RESULTS

A total of 97 CT scans were evaluated in uninjured ankles. 18/97 underwent TAA for treatment of ankle arthritis. The epiphyseal scar was on average 10.1 mm (6.6mm-19.9mm) from the tibial plafond. The distal 5% mark of the tibia was 12 mm (7.9mm-18.2mm) proximal to the epiphyseal scar. Chart review found no associated complications through 6 months follow-up when either of these two areas were maintained.

Table 3. Results

Total Number of Patients	18
Distal – Most 5% to Epiphyseal Scar	20.9 ± .518 (mm)
Epiphyseal Scar from Tibial Plafond	10.1 ± .479 (mm)
Tibial Component Position Maintained at 6 Months with Epiphyseal Scar or Distal 5% Maintained	18/18

ANALYSIS & DISCUSSION

Recent TAR focused research has been on distal tibia bone anatomy and its density (1, 11). Results have highlighted the fact that preservation of bone within the distal tibia when placing the components would result in denser bone for component placement. With a higher density than the surrounding cancellous structures, the epiphyseal scar could be a useful landmark when determining the optimal TAR system and placement. The total bone mineral density decreases significantly proximal to the distal 5% mark of the tibia; we recommend avoiding this area (12). Literature looking into medial malleolus screw length is suggestive that these screws should engage the epiphyseal scar, but not violate the metaphyseal bone proximal to it (14, 15). A tibial component that engages the epiphyseal scar and does not violate the distal 5% mark would be ideal.

REFERENCES

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