Nerve Structures at Risk during Tibialis Anterior Tendon Transfer

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Study performed at the International Center for Limb Lengthening, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore, Baltimore, Maryland

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Problem

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Tibialis anterior tendon transfer (TATT) is a common procedure for recurrence in club feet treated with the Ponseti method.

53% Cooper and Dietz

J Bone Joint Surg Am. 1995;77(10)

21% Bor et al.

Clin Orthop Relat Res. 2009;467(5)

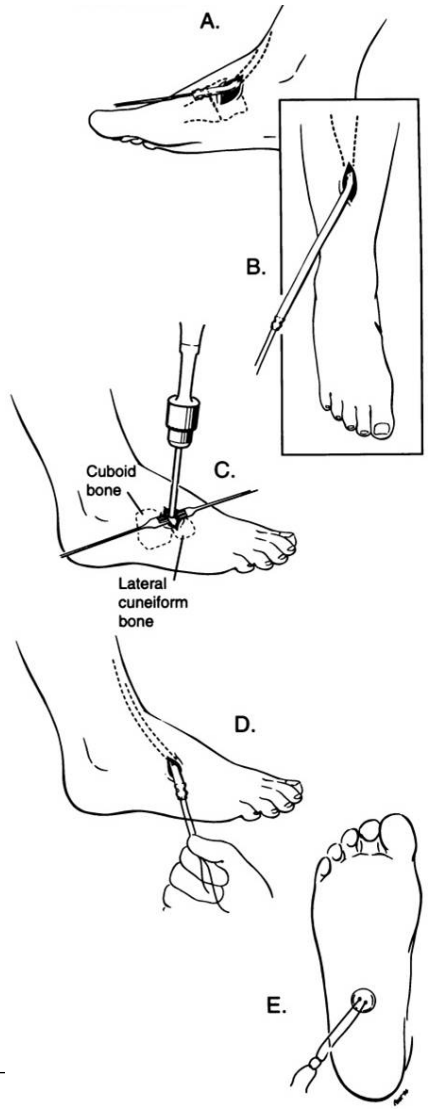

Illustration from: Kuo KN, Hennigan SP, Hastings ME. Anterior tibial tendon transfer in residual dynamic clubfoot deformity. J Pediatr Orthop. 2001;21:35-41.

Problem

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Fixation includes passing the tendon through a drill hole in the lateral cuneiform.

Drilling of the tunnel and passing the sutures to the plantar side of the foot holds potential for neuro-vascular damage.

We conducted a cadaveric study to evaluate plantar nerve structures at risk during TATT.

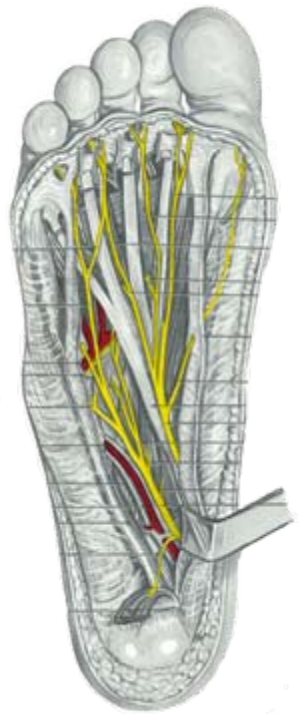

Image (right) from: Sarrafian SK. *Anatomy of the Foot and Ankle*. Lippincott Williams & Wilkins: 1993.

Materials & Methods

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- **Cadaveric study of 12 fresh frozen cadaveric limbs**
- **TATT to the lateral cuneiform using 4 different inclinations of the drill (3 specimens in each group)**
- **Layered dissection after drilling and passing of the sutures (Keith needles passed 20 times per foot)**
- **Distance from nerve structure to drill hole was measured**
- **Injury to nerve structure was noted**

Materials & Methods

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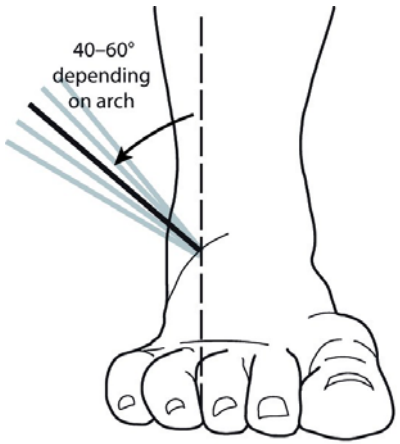
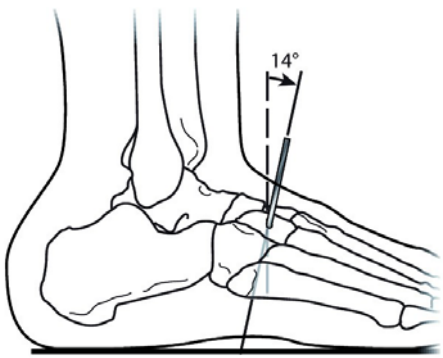
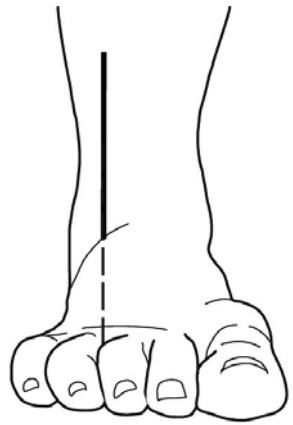
4 Drill Inclinations:

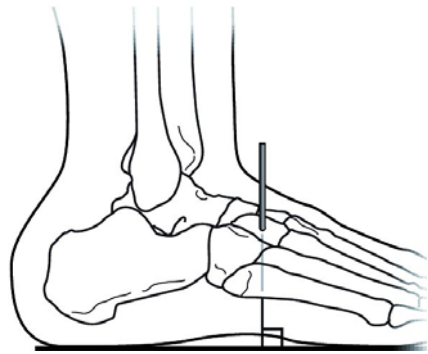
- **Perpendicular to the surface of the lateral cuneiform (Group A)**





- **Perpendicular to the weight bearing surface of the foot (Group B)**





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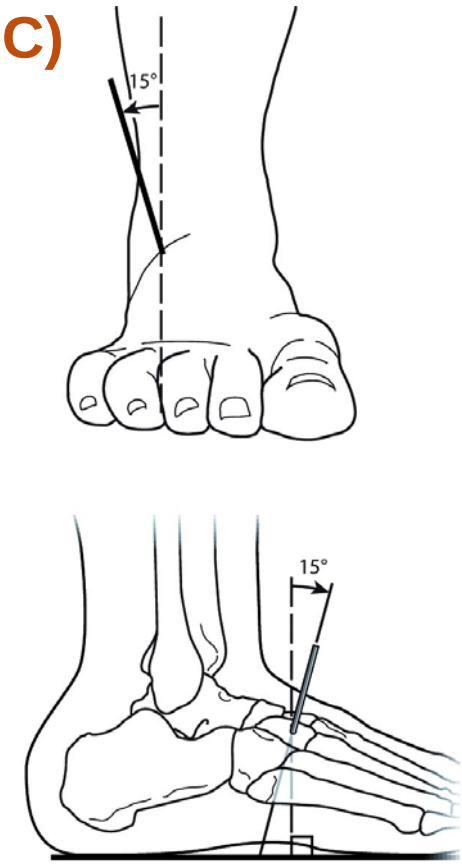
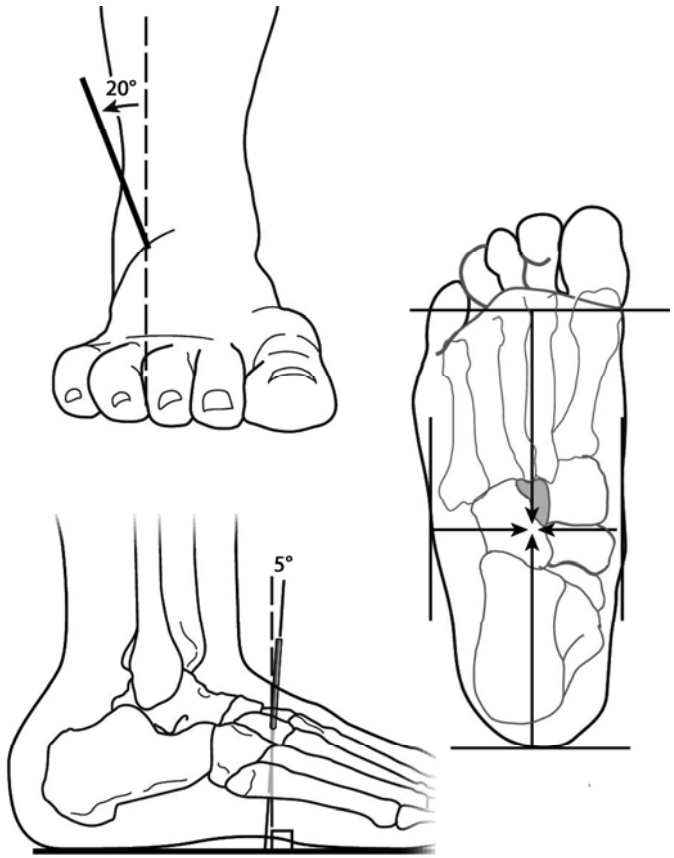
4 Drill Inclinations:

- **Directed at 15 degrees in the frontal and sagittal planes (Group C)**



- **Aimed at the middle of the foot (Group D)**



Results (Group A)

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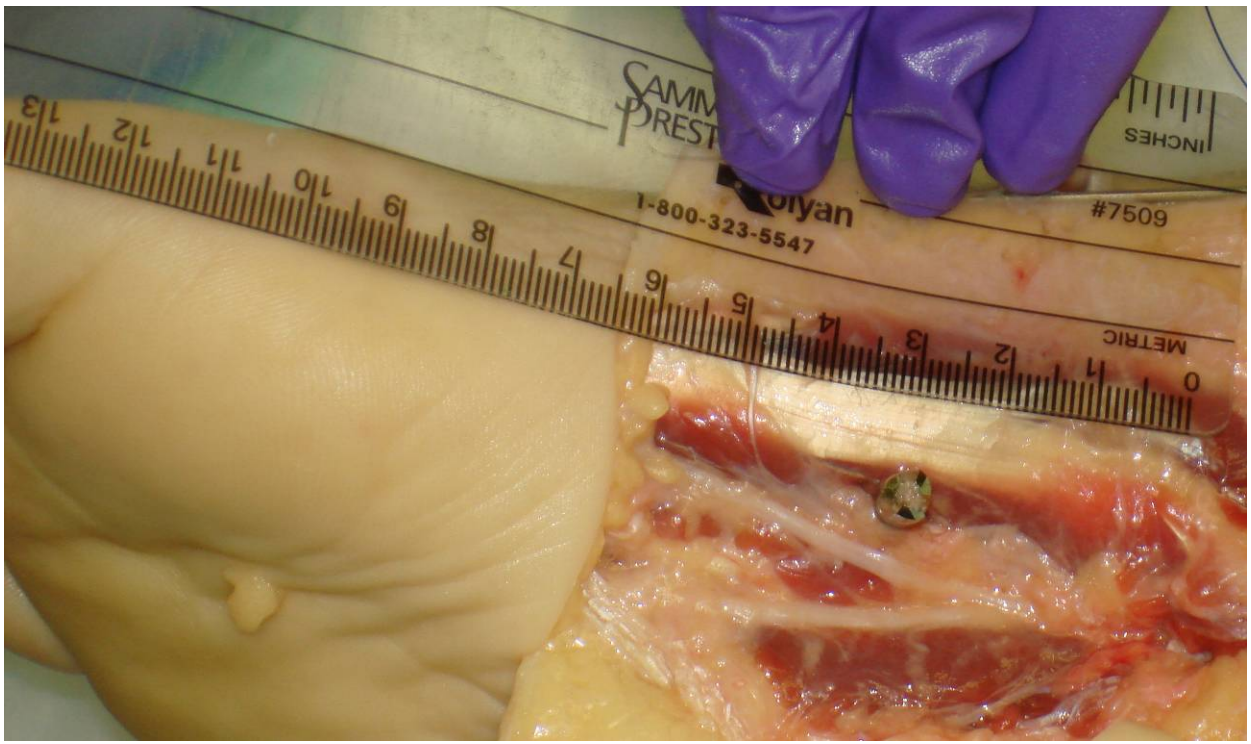
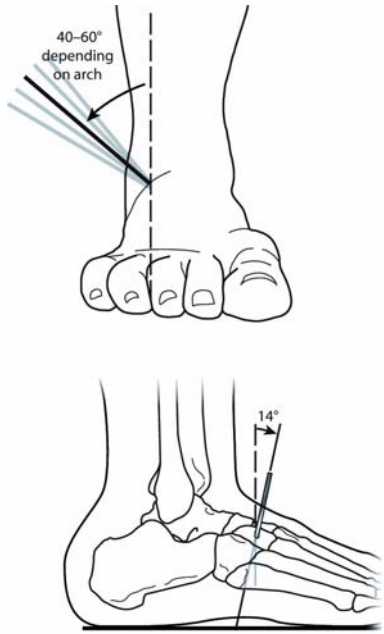
Drill hole near branch of medial plantar nerve
- Average distance 1.7 mm (range, 1-3 mm)

Bifurcation of the main nerve more proximal
- Average distance 5 mm (range, 2-9 mm)





Results (Group B)

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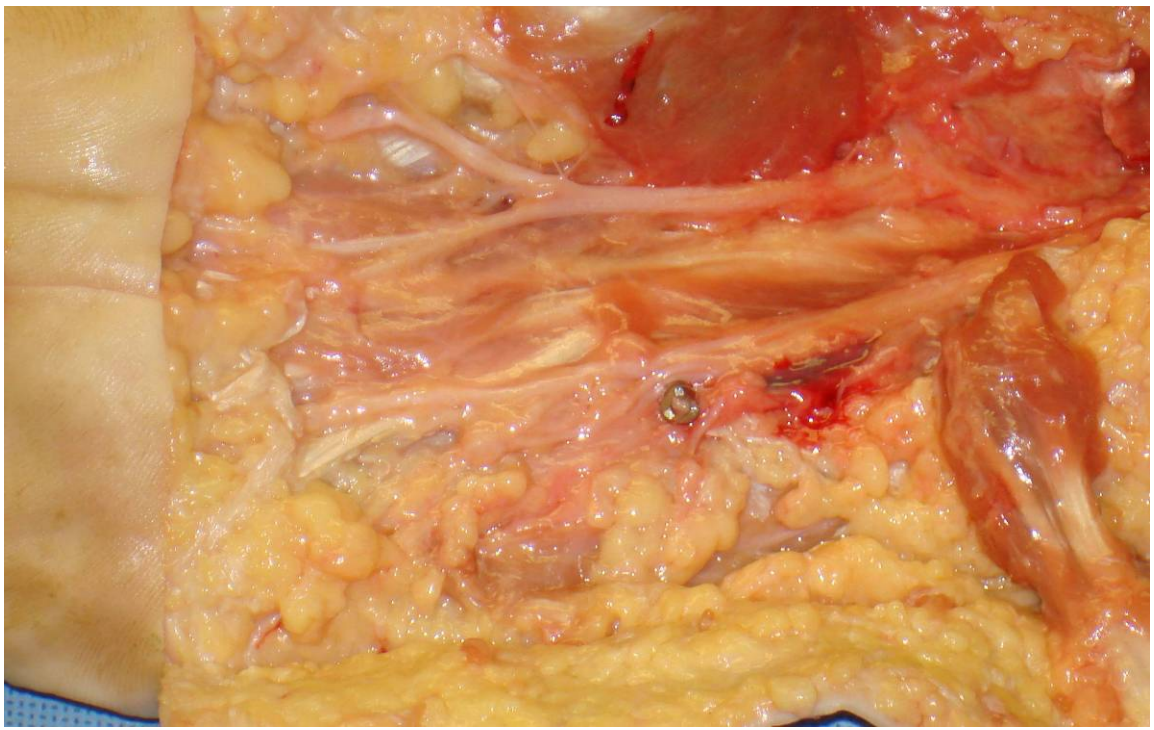
Drill hole near branch of lateral plantar nerve
- Average distance 0.3 mm (range, 0-1 mm)

Bifurcation of the main nerve more proximal
- Average distance 25.3 mm (range, 16-37 mm)



Results (Group C)

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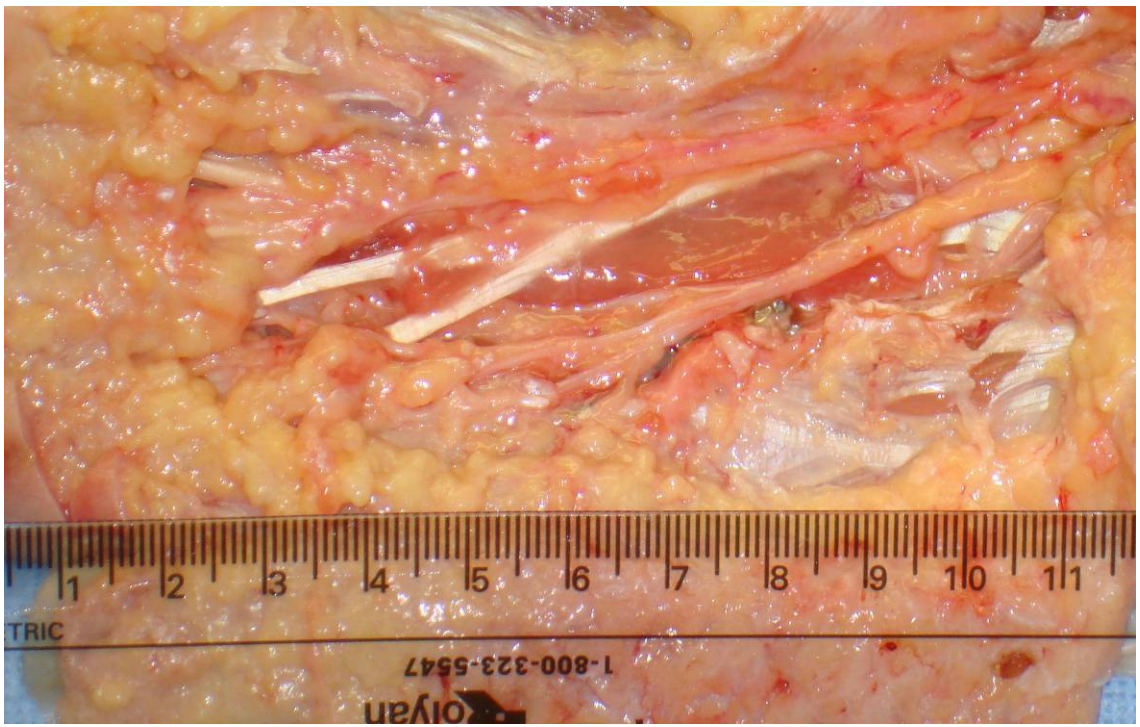
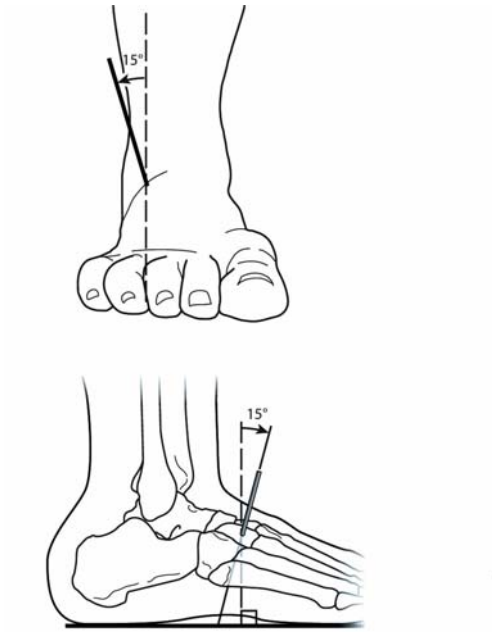
Drill hole near bifurcation of lateral plantar nerve
- Average distance 1.7 mm (range, 0-3 mm)

Near a branch of the lateral plantar nerve in one case (1 mm)





Results (Group D)

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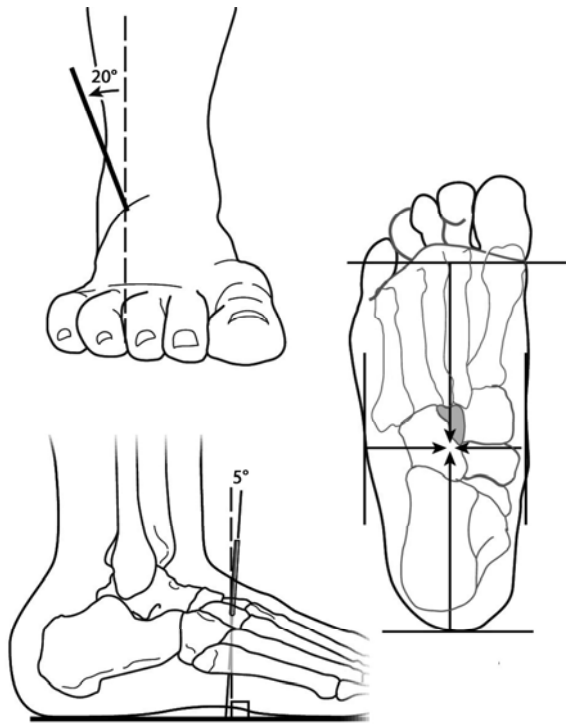
Drill hole in the middle of the plantar surface

- Average distance 7.7 mm (5-11 mm) to branch of medial plantar nerve
- Average distance 13 mm (10-18 mm) to bifurcation of medial plantar nerve
- Average distance 4.3 mm (3-6 mm) to branch of lateral plantar nerve
- Average distance 14.7 mm (11-19 mm) to bifurcation of lateral plantar nerve



Results

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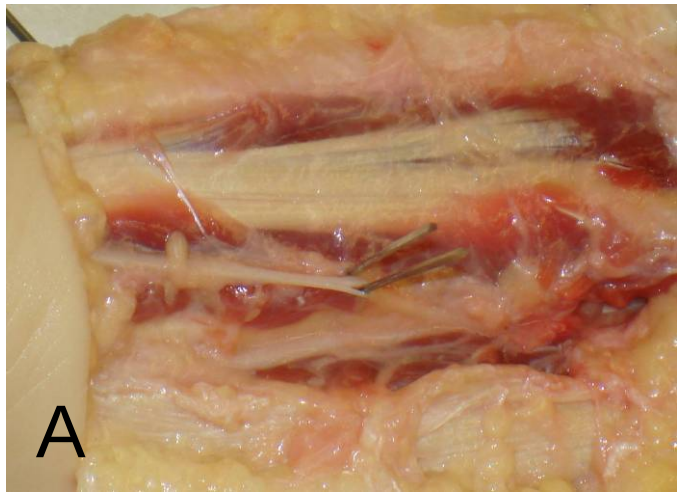
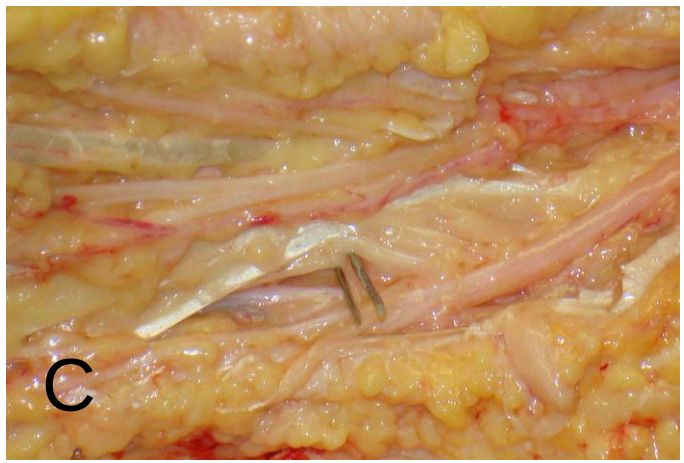
	Number of injuries to nerve or bifurcation	Number of injuries to nerve branch
Group A	5	7
Group B	0	20
Group C	0	6
Group D	0	1

No nerve injury when passing a modified Keith needle with blunted tip 20 times for each foot





Discussion - Weaknesses

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- No “in vivo” conditions
- Dissection of tissue structures can change anatomic relationships
- Measurement bias/error
- Anatomic variations possible
- Adult specimens

Discussion

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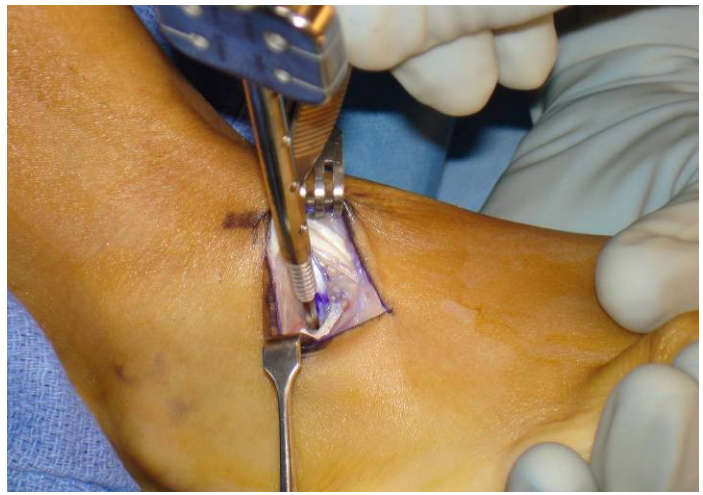
Alternative Fixation

- **Biotenodesis screw**
  (pull-out sutures still necessary for tensioning)
- **Staples, anchors**
- **Periosteal suture fixation**



Alternatives to Full TATT

- **Split transfers with fixation to cuboid**
- **Cuneiform bone tunnel aimed medially or laterally to avoid plantar puncture**

Conclusions

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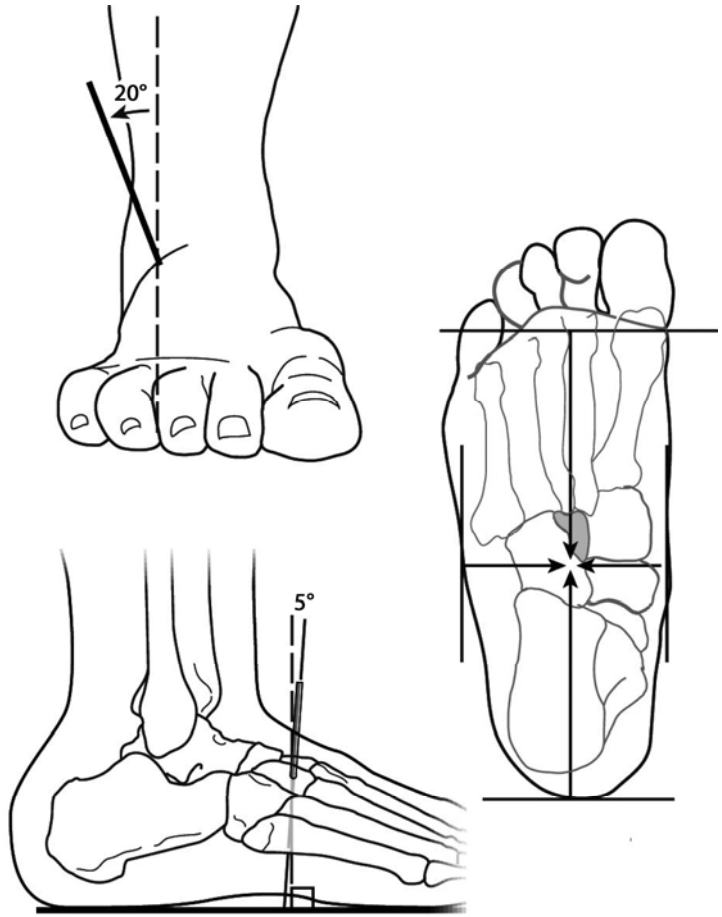
- **Neurovascular damage can be minimized by a drill inclination of ≈20° to the plantar surface in the frontal plane and 5° in the sagittal plane.**
- **Using a blunt needle may further help to prevent damage to nerves or vessels.**



Group D

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