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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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)

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.
Materials & Methods

- 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

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Materials & Methods

4 Drill Inclinations:

- Perpendicular to the surface of the lateral cuneiform (Group A)
- Perpendicular to the weight bearing surface of the foot (Group B)
Materials & Methods

4 Drill Inclinations:

- Directed at 15 degrees in the frontal and sagittal planes (Group C)
- Aimed at the middle of the foot (Group D)

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Results (Group A)

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)

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)

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Results (Group C)

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)

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Results (Group D)

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

<table>
<thead>
<tr>
<th></th>
<th>Number of injuries to nerve or bifurcation</th>
<th>Number of injuries to nerve branch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Group B</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Group C</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Group D</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

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

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Discussion - Weaknesses

• No “in vivo” conditions

• Dissection of tissue structures can change anatomic relationships

• Measurement bias/error

• Anatomic variations possible

• Adult specimens

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Discussion

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

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Conclusions

• Neurovascular damage can be minimized by a drill inclination of \( \approx 20^\circ \) 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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