



Comparison of Transfer Sites for Flexor Digitorum Longus in Treatment of Posterior Tibialis Tendon Dysfunction



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INTRODUCTION

- Dysfunction of the posterior tibialis tendon (PTTD) has been shown to cause adult acquired flatfoot deformity.
- Stage 2 PTTD is commonly treated with a flexor digitorum longus (FDL) tendon transfer to replace the deteriorated posterior tibialis tendon (PTT).
- The purpose of the FDL transfer is to regain control over the transverse tarsal joints and the inverting and plantar flexing abilities of the hindfoot.

PURPOSE

- The objective of this study was to assess the kinetic and kinematic outcomes of FDL tendon transfers to the navicular, medial cuneiform and residuum of PTT using cadaveric gait simulation.

METHODS

- Study Design/Tissues Studied**
 - 8 cadaveric lower limb specimens (distal leg, ankle, foot) were obtained and checked for pathological abnormalities.
- Laboratory Methods/Data Collected**
 - Each specimen was radiographed before and after the following flattening process:
 - Attenuate hindfoot and medial midfoot supporting ligaments using several 1-2 cm parallel incisions.
 - Section the spring ligament and talonavicular capsule.
 - Cycle from 10N to the donor's body weight for 20,000 - 35,000 cycles at 2 Hz on an MTS Mini Bionix 858 materials testing machine.
 - Each specimen was tested on the Robotic Gait Simulator (RGS) under 4 conditions: flatfoot (FF); and then in randomized order: FDL transfer to navicular (NAV); medial cuneiform (CUN); and the residuum of PTT (rPTT).
 - The stance phase of gait was simulated in 4.09 s at 50% of the donor's body weight.
 - A Novel emed-sf platform measured pressure and a 6-camera Vicon system tracked the motion of 10 bones.
 - Outcomes**
 - Peak plantar pressure (kPa) and kinematic changes (i.e., bone-to-bone range of motion and peak angles) for 10 bones were the primary outcomes.

RESULTS

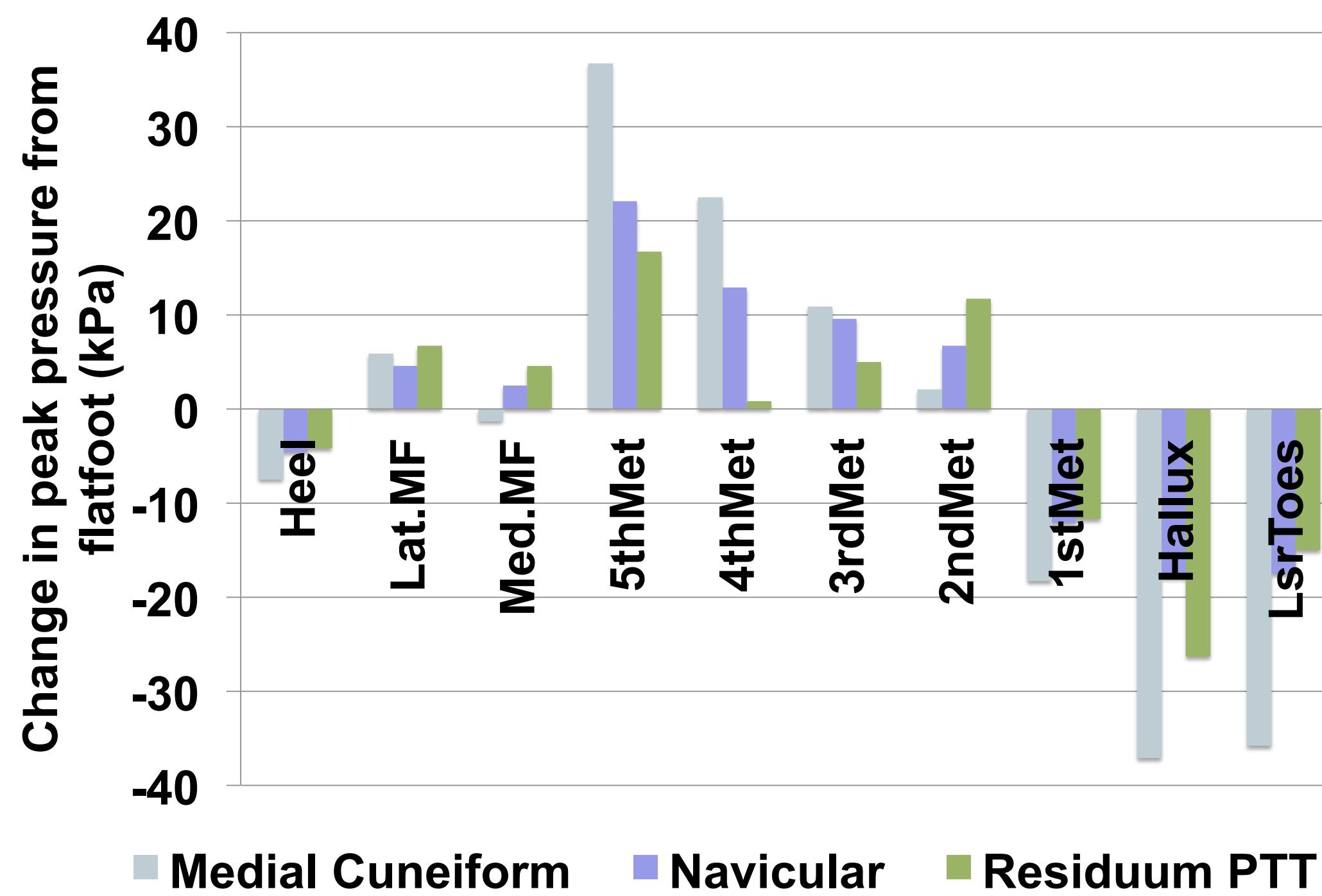


Figure 1: Average changes in peak pressure (kPa) compared to FF for the CUN, NAV, and rPTT procedures.

Table 1: Average range of motion (ROM) [SD] and peak angle [SD] data during stance phase for FF and three surgical conditions for navicular with respect to talus (NAV wrt TAL); the peak angles shown are peak dorsiflexion, eversion, abduction.

NAV wrt TAL Angle (°)	Sagittal plane		Frontal plane		Transverse plane	
	ROM	Peak Angle	ROM	Peak Angle	ROM	Peak Angle
FF	5.9 [3.3]	-17.1 [13.4]	15.6 [3.2]	26.4 [10.6]	12.8 [4.0]	-9.7 [6.3]
rPTT	4.9 [1.6]	-17.8 [13.3]	15.9 [2.8]	26.0 [10.4]	12.9 [4.4]	-10.2 [5.6]
NAV	5.2 [1.9]	-18.1 [13.2]	16.0 [3.0]	25.5 [10.6]	12.6 [4.3]	-10.0 [5.5]
CUN	4.9 [1.8]	-18.3 [13.2]	16.1 [3.4]	25.2 [10.4]	11.9 [3.9]	-10.3 [5.4]

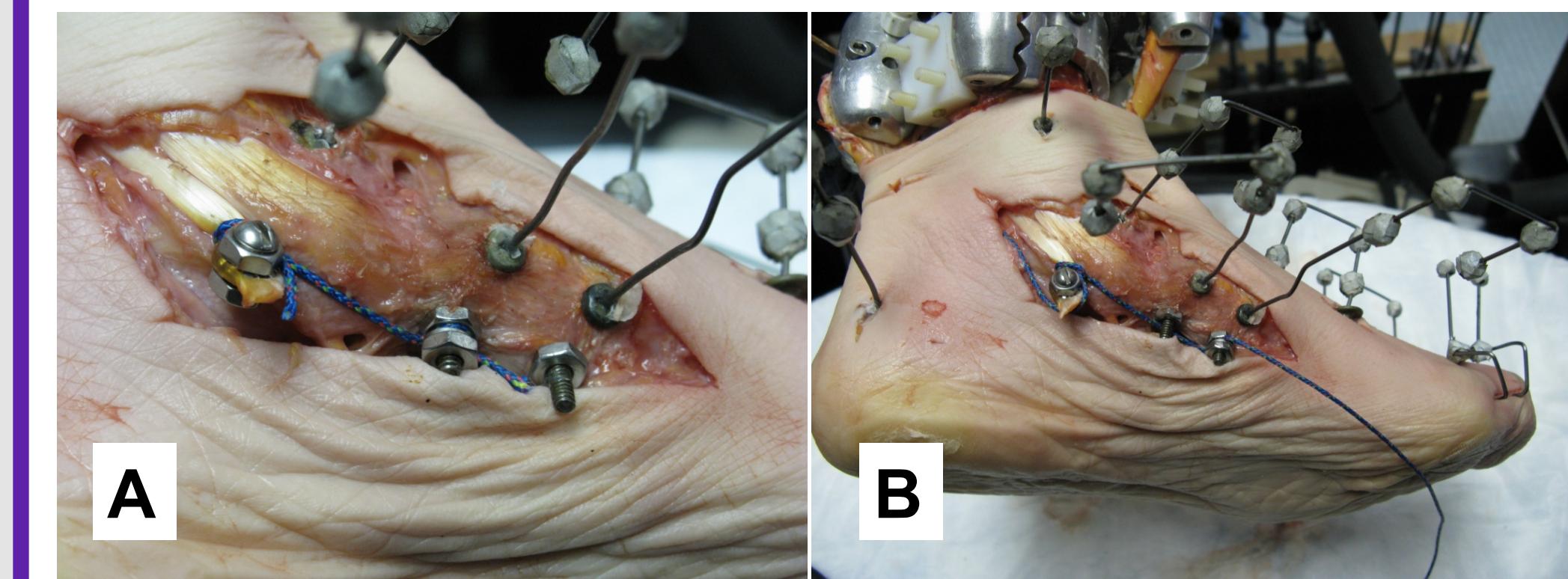


Figure 2: Specimen with bony markers and FDL transfer to A) navicular (NAV), and B) medial cuneiform (CUN).

CONCLUSIONS

- Analysis of pressure data showed that the surgical procedures resulted in a lateral shift in peak pressure.
 - CUN procedure showed the largest increase in pressures at the 4th and 5th metatarsals.
 - NAV procedure resulted in more balanced peak pressure increases across the 2nd - 5th metatarsals.
- Kinematic findings showed no noticeable differences between the surgical procedures and the flatfoot model.
- Despite inconclusive kinematics, pressure data indicated a mechanical advantage for the cuneiform attachment that most appreciably altered the peak plantar pressure.

SIGNIFICANCE

- In quantifying the kinematic and kinetic differences associated with the three FDL transfer procedures, the results of this study should:
 - Supplement previous research efforts involving the FDL transfer procedure and the treatment of PTTD.
 - Provide clinicians with a better understanding of biomechanical outcomes when selecting an FDL transfer location for future patients.

ACKNOWLEDGEMENTS

- Financial support for this research was provided by VA RR&D grant A4843C and the University of Washington School of Medicine MS RTP program.