Posterior tibial tendon transfer: Biomechanical evaluation of circumtibial, above-retinaculum and below-retinaculum transmembranous transfer.

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Introduction/Purpose: Posterior tibial tendon transfer (PTTT) is performed for a variety of pathologies where loss of dorsiflexion is compensated by the transfer, e.g. cavus foot, neurologic foot (dropfoot), etc. Transfers can be performed subcutaneously through a circumtibial way or deeply through the interosseous membrane (transmembranous). The latter is classically routed above the extensor retinaculum. We evaluated the circumtibial (CT), above-retinaculum transmembranous (ART) and below-retinaculum transmembranous (BRT) transfers gliding resistance and kinematics in a cadaveric model during ankle range of motion (ROM).

Our first hypothesis was that the CT would be the transfer with more gliding resistance and with more kinematic alteration. Our second hypothesis was that the ART would not show significant differences against the BRT transfer.

Methods: 8 cadaveric foot-ankle – distal tibia were prepared, identifying all extensor and flexor tendons proximally. The skin and subcutaneous tissue were kept intact. Each specimen was mounted on a special frame, and luminous markers were attached to the skin to adapt it to the Oxford Foot Model. A dead weight equal to 50% of the stance phase force was applied to each tendon, except for the Achilles tendon. Each specimen served as its own control, testing dorsiflexion when pulling the tibialis anterior (TA), recording the kinematics and gliding resistance. Then, dorsiflexion was tested with the transfers already described (CT, ART and BRT PTTT). A 10-repetition cycle of dorsiflexion and plantarflexion was performed for each condition. The movement of the foot was recorded using high speed cameras, and the force needed to achieve dorsiflexion was registered in every cycle. Statistical analysis was performed using the SPSS software.

Results: The circumtibial transfer showed the highest gliding resistance (p<0.05). The ART and BRT transfers increased the least the gliding resistance over the control, with no difference between them (p>0.05). Regarding kinematics, all transfers decreased ankle ROM, being the CT transfer the condition with less range of motion (-9 degrees, p<0.05). ART and BRT transfers did not show differences relative to ankle ROM among them. The CT transfer significantly produced more supination of the forefoot over the hindfoot (p<0.05). The ART and BRT transfers did not differ from the control group relative to supination/pronation. Finally all the transfers produced a significant abduction motion of the forefoot compared to the control, with no difference between them.

Conclusion: The circumtibial transfer had the highest tendon gliding resistance and the worst kinematics of all transfers. It achieves less dorsiflexion and in an inverted position. Interestingly, there was minimal difference in gliding resistance between the above and below retinaculum transmembranous transfers. Per our results, we suggest that when performing a PTTT the transmembranous route should be the transfer of choice. The potential bowstringing effect which may be painful and not cosmetic for patients when performing a PTTT subcutaneously (ART) could be avoided if the transfer is routed under the retinaculum, without significant compromise of the final function.