

A Biomechanical Analysis of Biotenodesis Screw Versus Bone Tunnel Methods in Flexor Hallucis Longus Tendon Transfer for Chronic Achilles Tendon Ruptures

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Background: Neglected Achilles tendon ruptures often require surgical intervention to restore functional properties, most commonly achieved by the transfer of Flexor Hallucis Longus (FHL) tendon through a bone tunnel drilled into the calcaneus. Recently, biotenodesis screws have gained popularity to secure the tendon, but the biomechanical properties of this method are not clear. The objective of this study was to test our hypothesis that biotenodesis screws would provide equal or stronger mechanical properties as compared to bone tunneling method.

Methods: Calcaneus from sixteen cadaver ankles was harvested along with FHL and Achilles tendons. FHL tendon transferred using either a biotenodesis screw or bone tunnel method. The biomechanical properties of the transferred tendon (peak stress, Young's modulus, failure strain and strain energy) were determined under displacement control using a custom-designed fixture and an Instron machine. Paired and unpaired Student's t-test tests were performed (Excel or SYSTAT) to determine the differences between groups ($\alpha = 0.05$).

Results: There was no decrease of peak stress and failure strain between groups. A slight decrease of Young's modulus ($19 \pm 7\%$, $p = 0.029$) but an increase of strain energy ($37 \pm 22\%$, $p = 0.028$) were found in the biotenodesis screw group as compared to the bone tunnel group. 88% of the bone tunnel groups failed in the suture site due to the tearing of FHL tendon.

Discussion: These findings support our hypothesis that biotenodesis screws provide spontaneous mechanical properties similar to that of bone tunneling method. Further animal and clinical studies are, however, needed to determine their long-term properties. Since this method is technically easier to perform, with a single versus two incision approach and without the disruption of the normal interconnections between FHL and flexor digitorum longus tendons, our study shows that the biotenodesis screw is a good alternative surgical technique to restore the functional properties of the Achilles tendon.