

The Effect of Tunnel Placement in the 2nd Metatarsal on the Ultimate Strength of the 2nd Metatarsal after Hallux Valgus Correction using the TightRope System

Arthrex Research and Development

Objective

The objective of this study was to determine if altering the tunnel placement in the 2nd metatarsal during hallux valgus correction using the TightRope system affects the ultimate strength of the 2nd metatarsal.

Methods and Materials

Three matched pairs of 2nd metatarsals (average age = 61 ± 9 , all male) were used to compare two tunnel locations. One specimen from each match pair was randomly selected to receive a 1.7 mm hole drilled 25 mm from the distal tip of the 2nd metatarsal (distal group). The contralateral specimen received a 1.7 mm hole drilled 45 mm from the distal tip of the 2nd metatarsal (proximal group). The tunnel placements are illustrated in Figure 1.

Figure 1: The red marks represent the distal (left) and proximal (right) tunnel locations.



The proximal end of the 2nd metatarsal was potted in a cylindrical fixture using PMMA. Each sample was positioned in the vise with the dorsal side facing down, and with an angle of 15° to the test surface. A Mini TightRope four-hole button was fixated to the lateral side of the bone using #2 FiberWire which was looped around a spring and turnbuckle fixture, which allowed a 15N static load to be applied medially to the bone.

The positioning of the sample is shown in Figure 2. An eyebolt attached to the custom fixture was adjusted for each sample in the superior/ inferior and anterior/posterior directions in order to apply the medial force along the direction of the tunnel. A load directed in the superior direction was applied from the cross-head at a rate of 2.54 mm/sec to the inferior distal condyle. As the plunger moved, the spring and turnbuckle fixture moved with it, maintaining the 15 N static medial load throughout the superior loading of the 2nd metatarsal.

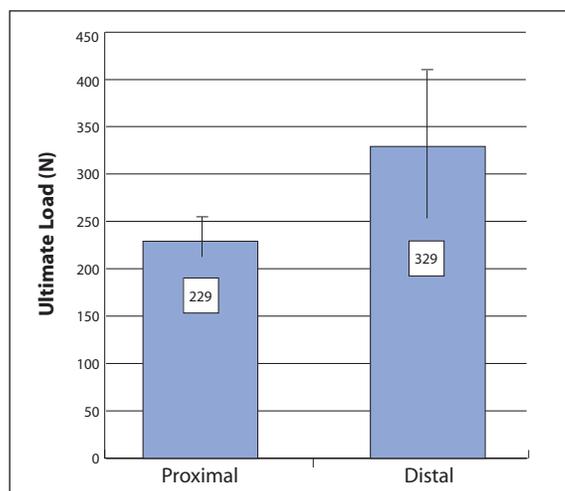
Figure 2: Test set-up



Results

The ultimate load of the samples with the proximally located tunnels was 229 ± 27 N, and the mode of failure for all three samples was the bone breaking in the diaphysis proximal of the tunnel. The ultimate load of the samples with the distally located tunnels was 319 ± 83 N. The mode of failure of two samples ($n = 3$) was the bone breaking across the tunnel, and one sample broke in the diaphysis proximal of the hole. The data can be seen graphically in Figure 3.

Figure 3: Testing results



Conclusion

The data suggests that a distally placed tunnel in the 2nd metatarsal results in a greater ultimate load of the 2nd metatarsal for this loading condition.