

Anatomical Preparation Method for Achilles Tendon Allograft in Anterior Cruciate Ligament Reconstruction

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Introduction: Achilles tendons are commonly used today as replacements for torn anterior cruciate ligaments. Allografts are used in almost half of primary reconstructions, one-fifth of which are Achilles tendons. Achilles tendons are used because of their strong tensile strength and donor availability. However, in the past, this allograft preparation has been plagued by a high failure rate. This study hypothesize that the high failure rate may be due in large part to the current preparation method of Achilles tendons.

Objectives: Using our anatomical approach, thereby cutting the tendons in a parallel fashion with the fiber orientation, allows the tendon to preserve a larger cross sectional area and possibly high tensile strength, making it a good option for a bone-tendon configuration allograft. The present study aims to determine whether the anatomic preparation of Achilles tendons has a higher tensile strength than the traditional central one-third preparation.

Methods: Twelve sets of de-identified cadaver Achilles tendons were procured from the UMTB (Vivex Biomedical Inc., Miami, FL). Tendons were prepared as pairs, with right and left from a single donor. Within a tendon pair, the right and left tendons were randomized to a preparation method. This ensured that both preparation methods were represented in every tendon pair. Tendons would then be prepared using either the central 1/3 method (standard of care) or the novel anatomical preparation method. Tendons were tested on the MTS machine. Results were analyzed with one-tailed paired t-test, using SPSS.



Figure 2 Specimens were mounted with a 4 cm working length, left. The grips were frozen and the specimen pulled at 100% strain/second, right.

Results: Twelve pairs of Achilles grafts were tested, for a total of 24 tendons. All of the tendons included in the analysis achieved mid-substance rupture when tested on the MTS machine. A paired t-test was used to evaluate the difference between the two preparation method means. It revealed a statistically significant difference between the two groups, with the anatomical preparation being stronger, Central third $2519.7 \text{ N} \pm 873.8$ vs. Anatomic 3171.6 ± 751.4 (95%CI 73.2-1230.6 N, $t(11)=2.479$, $p=0.012$). The Anatomic preparations were also significantly stiffer than the central third, $381.0 \text{ N/mm} \pm 114.3$, vs. anatomic, 463.7 ± 121.2 . The two preparations were not significantly different in ultimate strain, Central third $38.7\% \pm 57.2$ vs. Anatomic $41.8\% \pm 39.4$. The study has a power of 0.79.

Description of 2 preparation methods

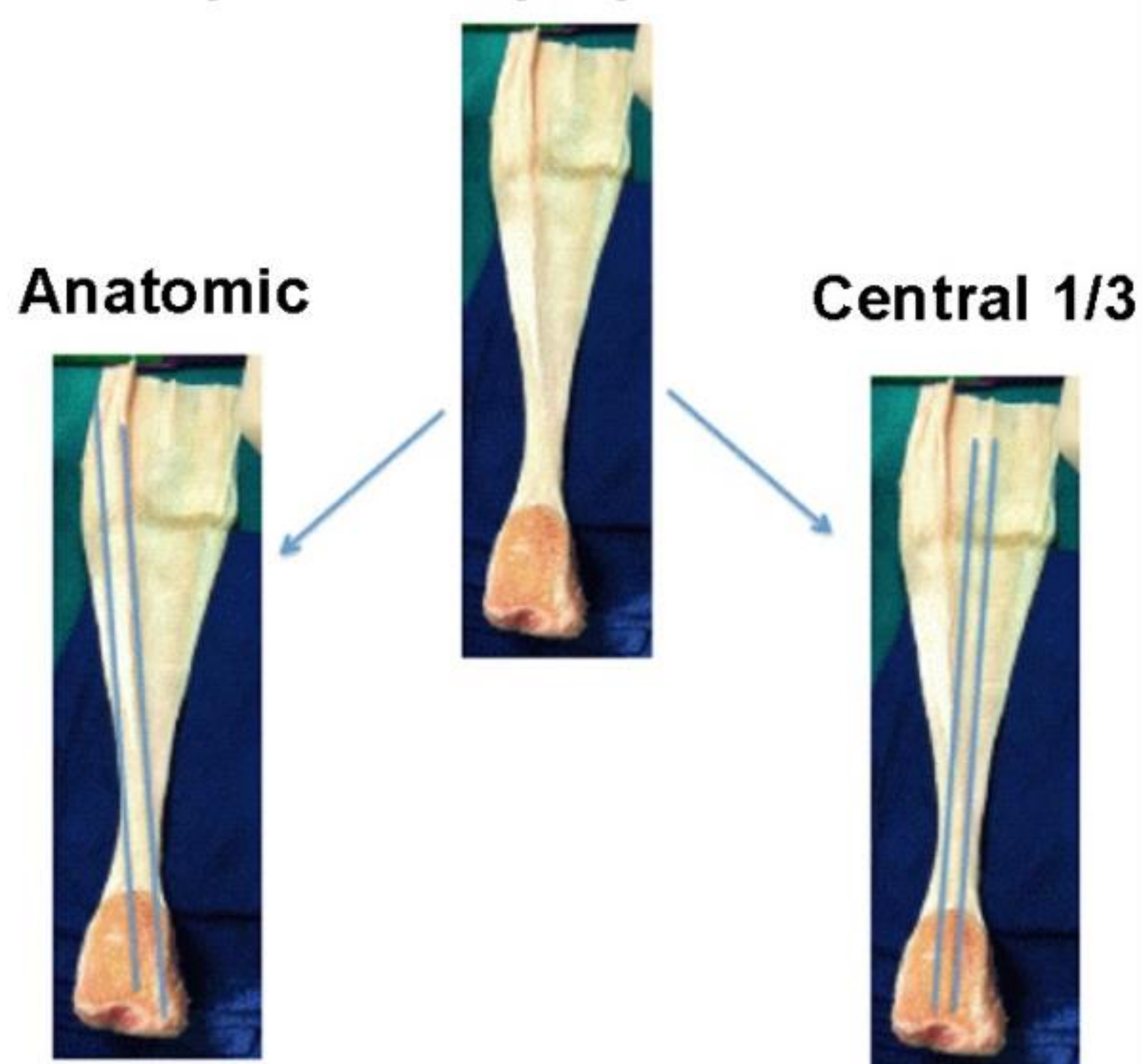


Figure 1 Identify the major band (middle), and mark a pair of tendons for preparation, one side for central 1/3rd, (right), the other anatomic, (left).

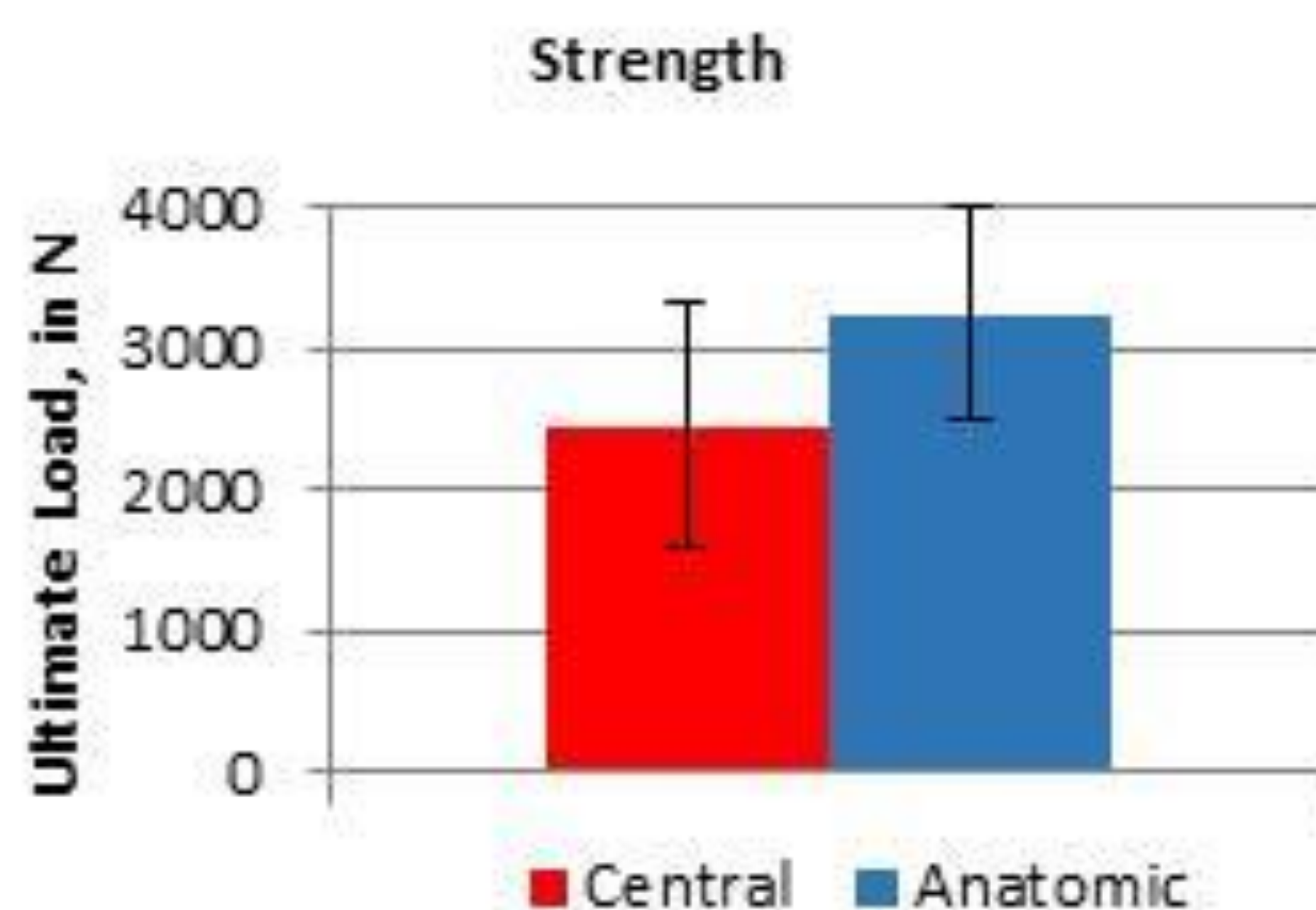


Figure 3 Ultimate strength of the central third of the Achilles tendons vs. the anatomically prepared graft.

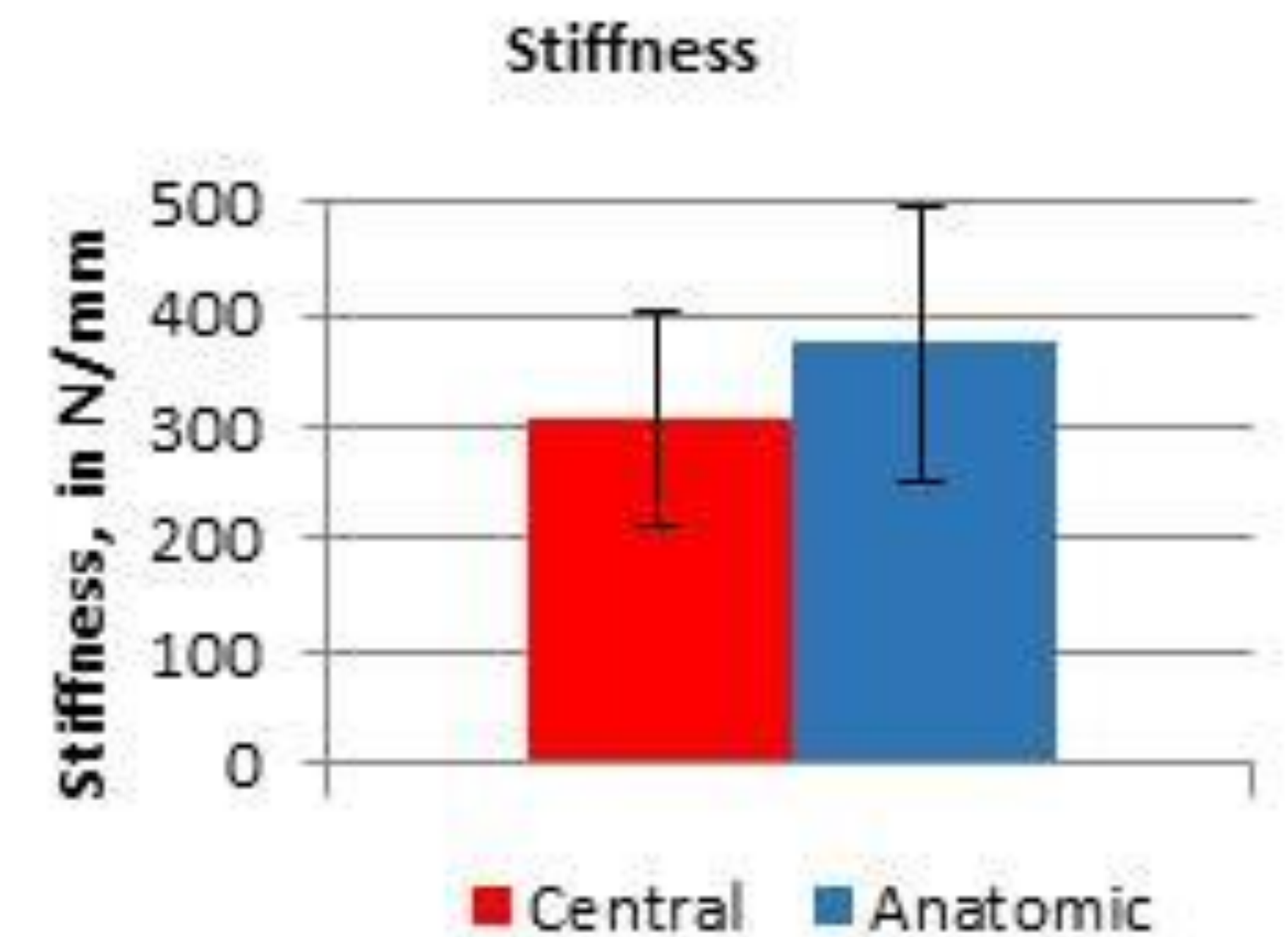


Figure 4 The stiffness of the central third of the Achilles tendons vs. the anatomically prepared graft.

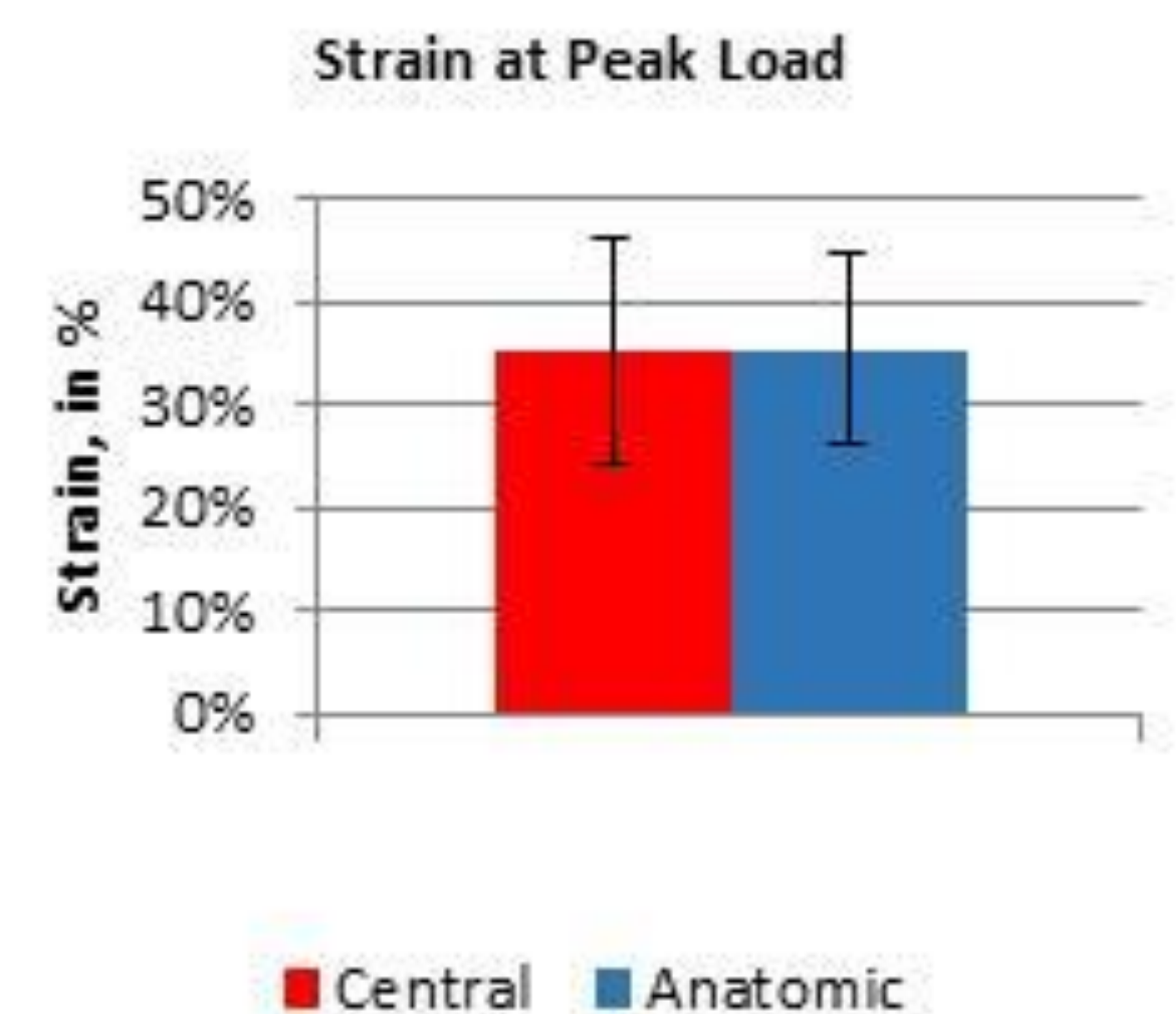


Figure 5 Ultimate strain of the central third of the Achilles tendons vs. the anatomically prepared graft.

Conclusions: The data from our study indicate that the anatomic preparation method of achilles tendons is significantly stronger than the central one-third method. This challenges the continued use of the central one-third method in ACL reconstructions, given their relatively high failure rate; however, our favorable *ex vivo* results do not necessarily translate to improved clinical outcomes *in vivo*.

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