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Structural Properties at Failure and Material Properties According to Tendon Source

Prior to the study, sixteen other aseptically processed, nonsterilized tibialis allografts were tested in tension to failure to demonstrate that the tibialis tendon source did not have an effect on the biomechanical properties.

Four tendons (left anterior, right anterior, left posterior, and right posterior) were procured from each of four donors (all male; age range, forty-nine to sixty-two years) and tested with use of the same procedure described in the Materials and Methods. Two sets of t tests were performed to detect differences due to location (anterior compared with posterior) and to side (left compared with right). No significant differences were found ($p > 0.05$ for all) (Table E-1).

Tendons That Failed During Cyclic Loading

Table E-2 summarizes the cycle, load at failure, and relevant observations (if any) made during testing of the specimens that failed during the sub-failure cyclic loading. This premature failure of both tibialis and BTB allografts during the cyclic phase of the testing was unexpected, and further investigation into possible causes did not elucidate reasons for this behavior. A medical history review for all donors from which these grafts had been recovered did not reveal any apparent causes for the weaker tissues. Two of the four tibialis tendons were from the youngest donor used in the study (a forty-year-old woman), whereas two of the three BTB allografts were from one of the oldest donors (a seventy-two-year old woman); thus, age did not appear to be a sole factor in the tissue failures. Some fraying of both tibialis tendons from one donor was observed, and a small notch or cut became apparent on another tibialis specimen during cyclic loading. Although extreme care had been taken during tissue recovery and processing as well as during trimming of the specimens to the 3:1 gauge length ratio, it is possible that excessive physical manipulation or cuts extending beyond the intended borders may have mechanically compromised these grafts. That possibility is recognized as a limitation of this study, and additional care will be taken in the future to more thoroughly inspect specimens prior to testing. ■

TABLE E-1 Properties of Additional Tibialis Allografts Tested to Failure, According to Location*

Location	Max. Displacement *(mm)*	Max. Load *(N)*	Stiffness *(N/mm)*	Max. Stress *(MPa)*	Max. Strain *(mm/mm)*	Elastic Modulus *(MPa)*
Anterior	11.19 ± 1.98	1105.17 ± 189.53	170.55 ± 66.99	33.40 ± 7.03	0.20 ± 0.04	287.28 ± 104.34
Posterior	11.79 ± 3.29	901.90 ± 320.68	171.86 ± 62.49	26.19 ± 5.01	0.19 ± 0.04	303.37 ± 74.39
P value	0.688	0.177	0.970	0.860	0.627	0.513
Left	11.88 ± 1.98	990.90 ± 319.06	160.90 ± 55.80	29.92 ± 7.79	0.21 ± 0.03	277.88 ± 71.00
Right	11.10 ± 3.27	1016.17 ± 245.35	181.51 ± 70.98	29.67 ± 6.60	0.18 ± 0.05	312.77 ± 104.08
P value	0.598	0.861	0.555	0.202	0.585	0.335

*The values are given as the mean and the standard deviation.

TABLE E-2 Failures That Occurred During Cyclic Loading

Tendon Type	Treatment	Cycle at Failure	Max. Load *(N)*	Observations
BTB	E-beam high	1594	211.86	Failed by osseous avulsion
BTB*	E-beam low	20	198.34	None
BTB*	Gamma	702	189.75	None
Tibialis†	E-beam high	903	167.90	Some tendon fraying
Tibialis	E-beam low	1522	185.11	Small notch or cut on tendon edge
Tibialis†	Gamma	140	149.20	Some tendon fraying
Tibialis	Nonsterile	1902	135.84	None

*From the same donor. †From the same donor.