

Changes in Achilles Tendon Thickness Following a 10-Week Heavy Load Eccentric Exercise Program

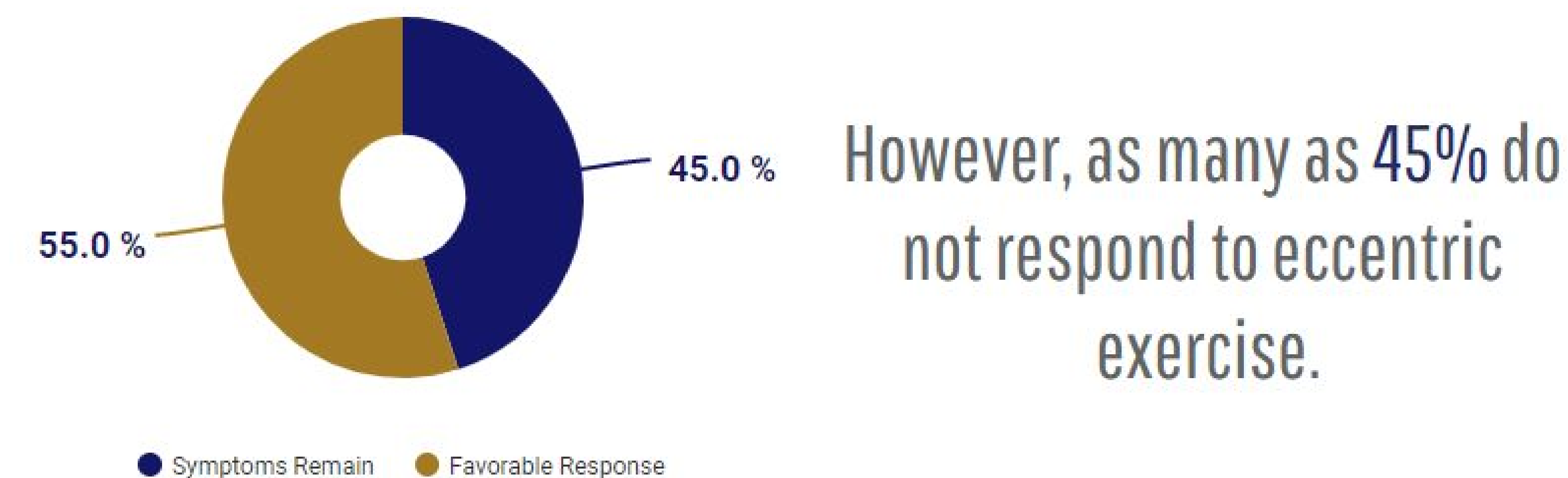
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Introduction

Achilles tendinopathy often presents with increased tendon thickness, lower echogenicity, and decreased stiffness.¹ Interestingly, tendons are also able to adapt their structural and mechanical characteristics in response to loading.^{2,3,4}

Eccentric exercise for Achilles tendinopathy continues to be the recommended treatment. The majority of individuals with midportion achilles tendinopathy have shown favorable response to eccentric exercise.



Current eccentric exercise protocols for Achilles tendinopathy that load the tendon with one body weight alone may not stress the tendon enough to induce physiological adaptations of decreased tendon thickness and decreased hypoechoic areas.

Hypothesis

Subjects with midportion achilles tendinopathy will demonstrate the following in response to a 10-week heavy-load resistance protocol:

-  Decrease in tendon thickness (ultrasonography)
-  Increase in function (VISA-A score)

Methods

Figure 1: Participant performs bilateral heel raise.



Figure 2: Participant initiating a single-leg heel lowering exercise.

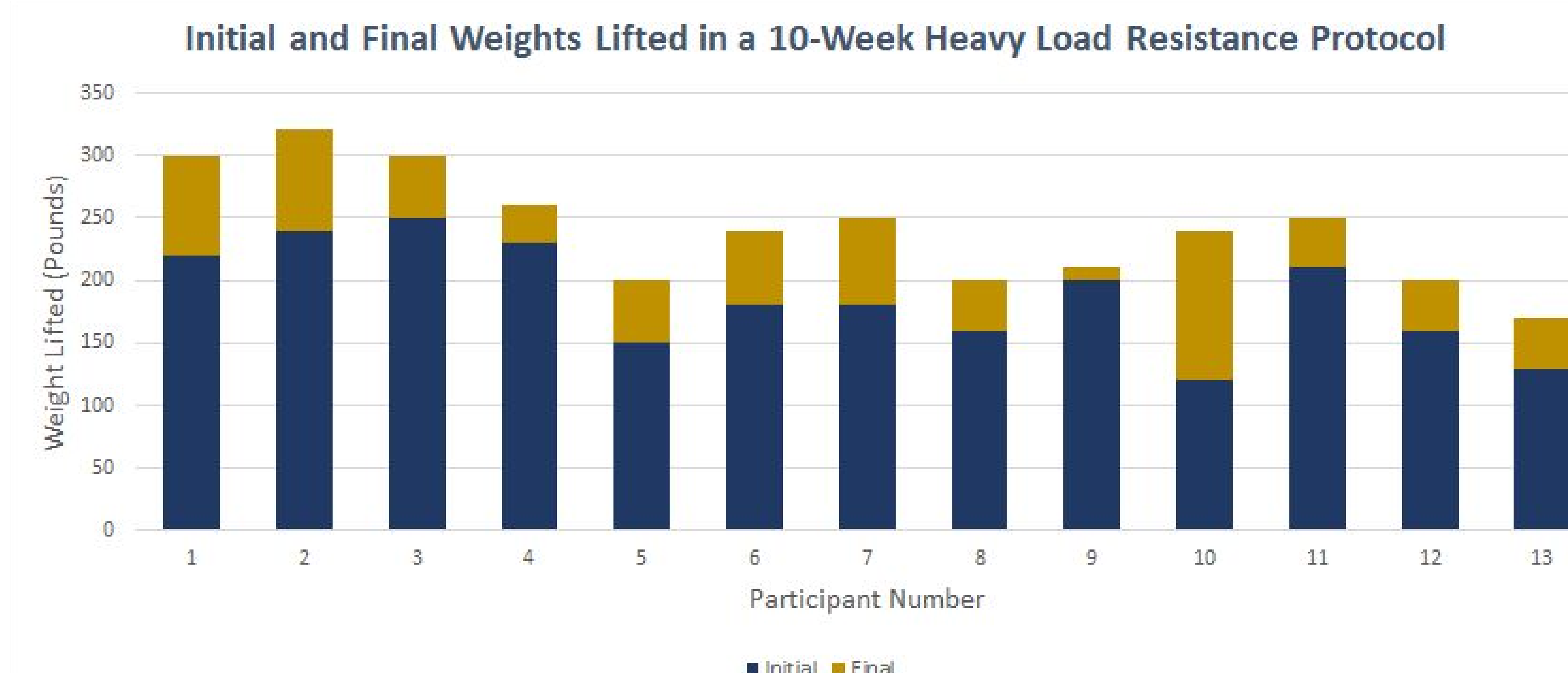


Figure 3: Participant completing a single-leg heel lowering exercise.



Thirteen participants with chronic Achilles tendinopathy (7 male, 6 female) were compared to six healthy participants (2 male, 4 female). All participants completed a progressive 10-week resistive eccentric exercise program aimed at maximally loading the Achilles tendon. Each participant's concentric 1 repetition maximum (1RM) was obtained. The 1RM was then used to calculate the starting eccentric load for 3 sets of 6-8 repetitions. As load tolerance improved, weight was progressed to maintain 6-8 repetitions to ensure maximal tendon loading. Exercises were performed using a Body Masters 117 Super Leg Press. Participants were asked to maximally plantar flex using both legs; then in a controlled manner using a single leg, eccentrically lower to a position of slight ankle dorsiflexion (Figures 1-3). To evaluate physical function and tendon thickness, participants completed the VISA-A and underwent ultrasonography prior to, and immediately following, the 10-week resistance program.

Results



Results (cont.)

Tendon Thickness Before and After a 10-week Heavy-Load Resistance Protocol

Subject (#)	Tendon Thickness (cm)		Change (%)
	Initial	Final	
1	0.64	0.48	-25
2	0.71	0.49	-30
3	0.64	0.59	-7
4	0.52	0.45	-14
5	0.59	0.40	-31
6	0.56	0.44	-21
7	0.53	0.55	+4
8	1.01	0.94	-7
9	0.56	0.49	-8
10	1.25	1.10	-12
11	0.87	0.87	0
12	0.51	0.43	-16
13	0.44	0.46	+5
Average	0.68	0.59	-14

Change in Average VISA-A Score at Initial, Final, and 6-Month Follow-Up Date

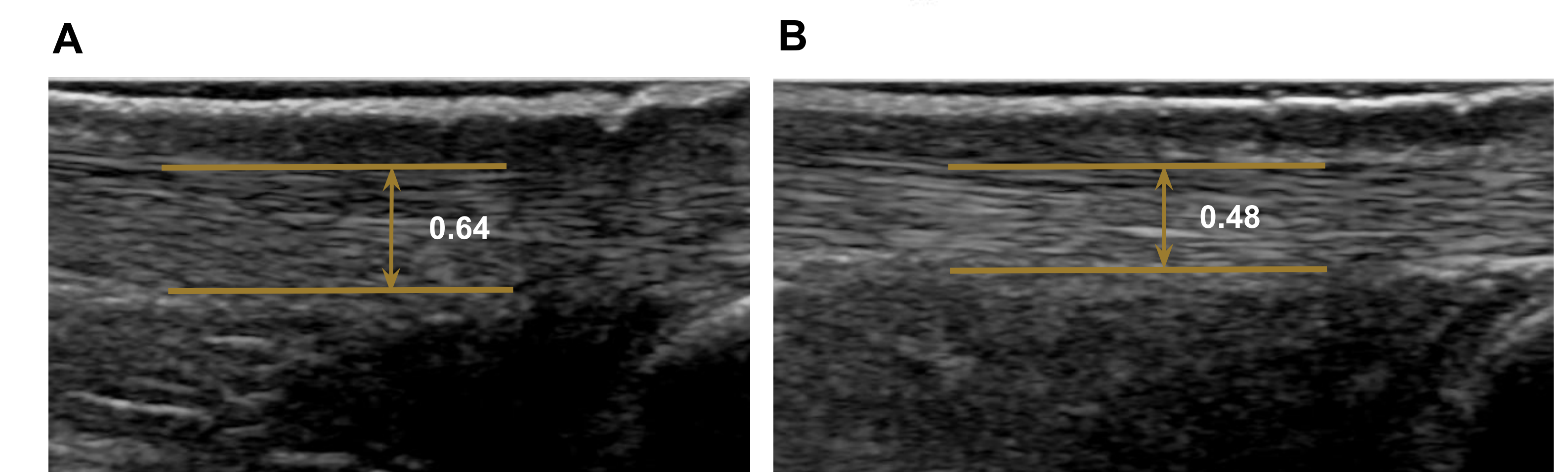
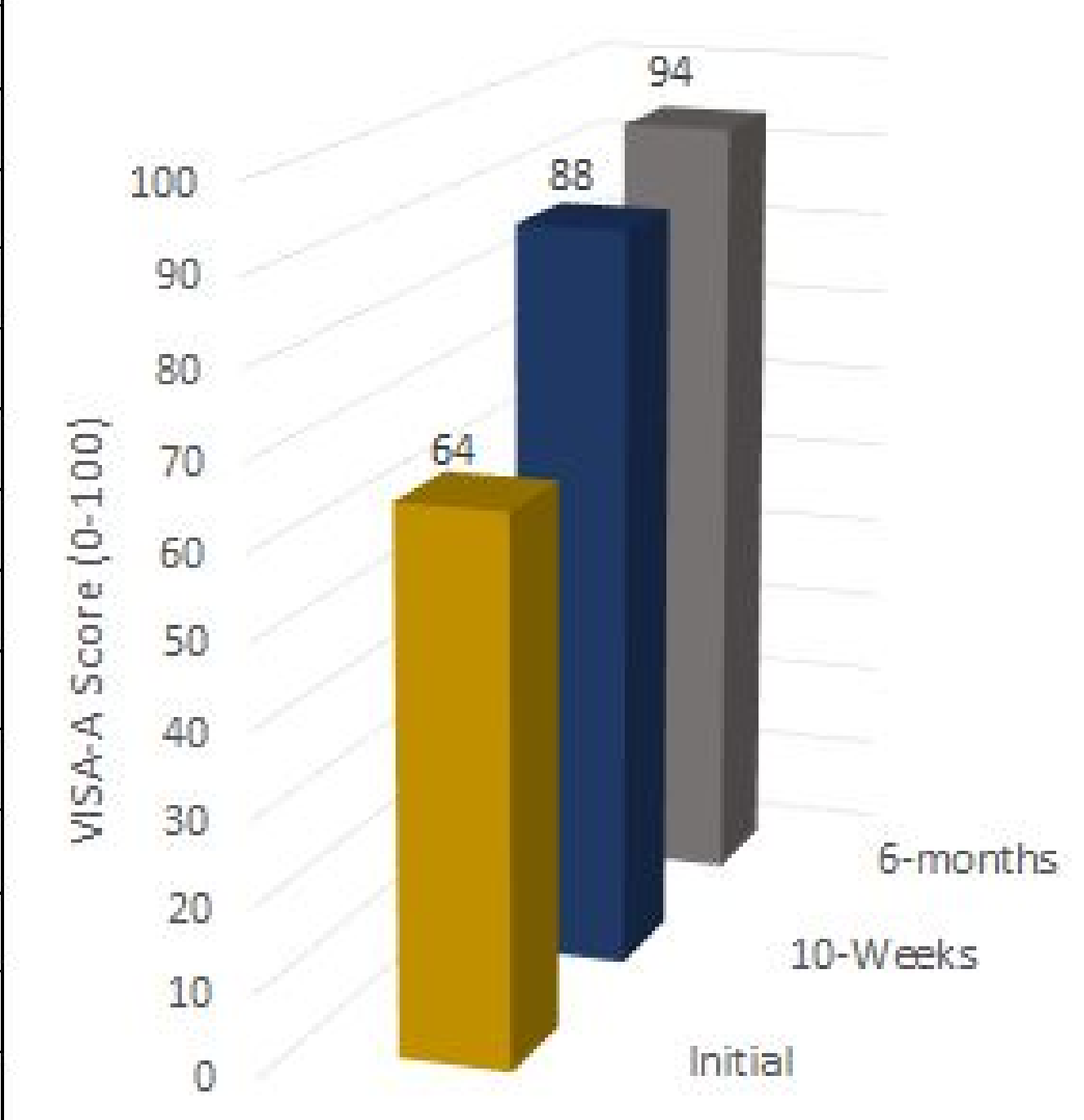


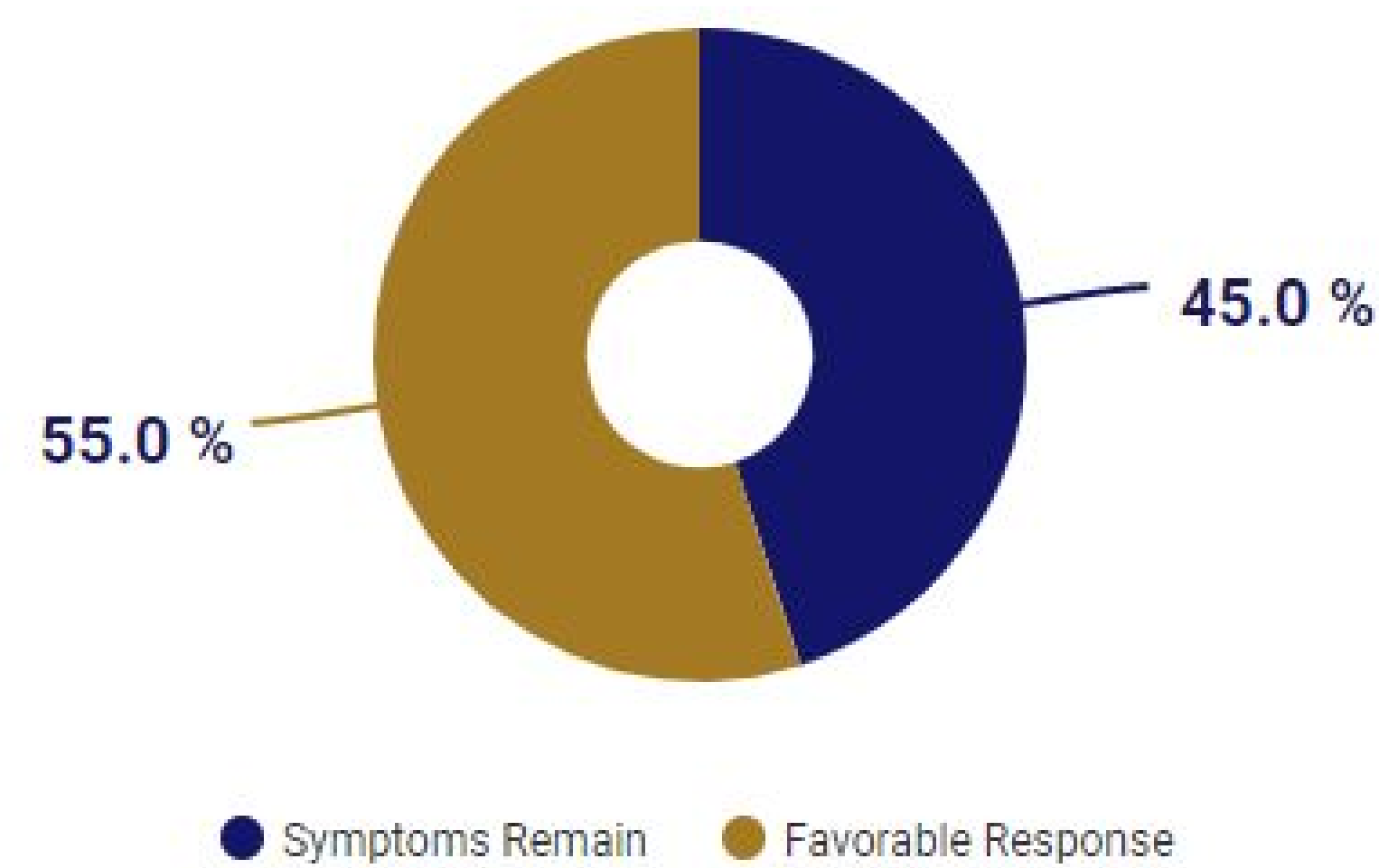
Figure 4A: Longitudinal section of the middle 3rd of the Achilles tendon before exercise. **B:** Longitudinal section of the middle 3rd of the Achilles tendon after exercise.

Discussion

- Participants can tolerate very heavy loads at the Achilles tendon (nearly two times body weight) over a 10-week exercise program
- Participants with chronic Achilles tendinopathy may benefit most from a decrease in overall repetitions and an increase in weight or load
- Further studies could aim to include functional heavy load activities; such as single-leg hopping may also improve tendon characteristics such as stiffness and thickness

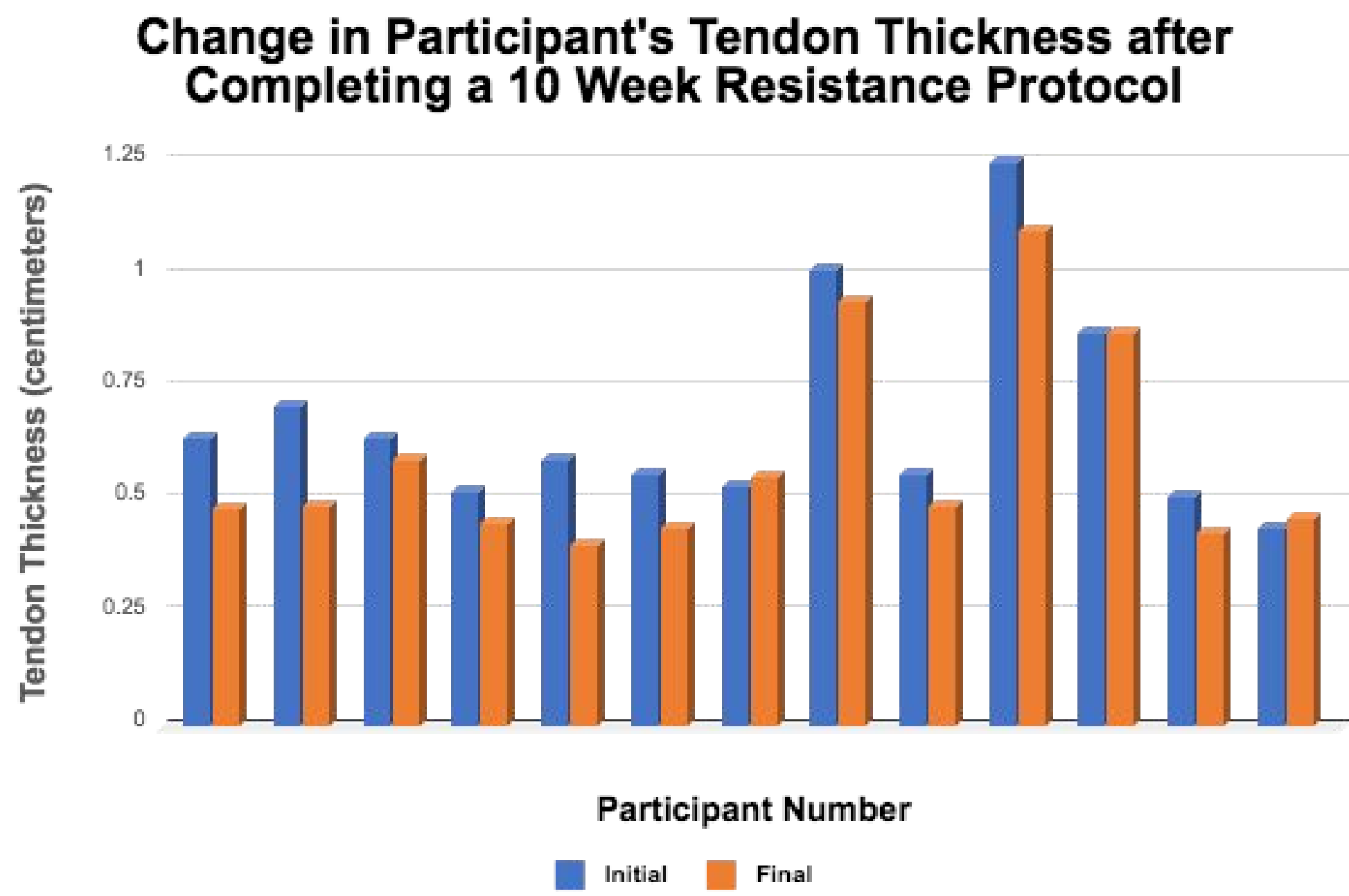
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In addition, 30% either had continued symptoms or developed new symptoms at 5-year follow up:

However, as many as 45% of subjects may not respond to eccentric exercises. Responses may be related to lack of knowledge about the effect of loading parameters.



Tendon Thickness (cm) Before and After 10-week Heavy Load Eccentric Exercise Program			
	Pre-test	Post-test	Change (%)
Sub 1	0.64	0.48	-25
Sub 2	0.71	0.49	-30
Sub 3	0.64	0.59	-7
Sub 4	0.52	0.45	-14
Sub 5	0.59	0.40	-31

Beginning and Ending Weights during a 10-week Heavy Load Eccentric Exercise Program (lbs)

	Pre	Post	Change (%)
Sub 1	220	300	27
Sub 2	240	320	25
Sub 3	250	300	17
Sub 4	230	260	11
Sub 5	150	200	25
Sub 6	180	240	25
Sub 7	180	250	28
Sub 8	160	300	47
Sub 9	200	210	5
Sub 10	120	240	50
Sub 11	210	250	16
Sub 12	160	200	20
Sub 13	130	170	24
Avg	187	249	25

☐ 25% increase in load lifted over 10-weeks

VISA-A Before, After, and 6-Mo post 10-week Heavy Load Eccentric Exercise Program				
	Pre	Post	6-Mo	%Δ (pre-post)
Sub 1	76	100	100	24
Sub 2	64	73	75	9
Sub 3	53	92	94	39
Sub 4	59	75	-	16
Sub 5	70	96	100	25
Sub 6	100	100	100	0
Sub 7	52	100		48
Sub 8	69	85		19
Sub 9	62	84		26
Sub 10	34	69		51
Sub 11	78	98		20
Sub 12	89	89		0
Sub 13	30	79		62
Avg	64	88		26

increase in tendon thickness
decrease in tendon thickness in healthy subjects
reduction of pain during exercise occurred in all subjects
improvement by 26%

