

Morphological Changes in Achilles Tendon Thickness Following an 8-week Heavy Load Eccentric Exercise Program

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Introduction

- Achilles Tendinopathy (AT) is an overuse injury characterized by pain, focal tenderness, and intratendinous imaging changes.
- Current protocols for treating mid-portion AT are not effective, likely due to not providing sufficient load to the tendon.
- Alfredson's eccentric protocol, which utilizes high repetition with low load, reduces pain with mid-portion AT in 60.3% of individuals (Van der Plas, 2011)
- Research indicates that heavier loading of the Achilles tendon yields superior results to high repetition with low load (Stevens, 2014)
- Tendons have demonstrated plasticity in their ability to adapt to heavy resistance training. Combined with knowledge that heavy loading leads to muscle hypertrophy, we aimed to determine if heavy load eccentric heel lowering would lead to hypertrophy of the Achilles tendon, and therefore increase tendon thickness.


Hypothesis

- Achilles tendon thickness will increase following an 8-week heavy load eccentric exercise program

Methods

- 5 healthy subjects without Achilles tendon pathology
- 1 repetition maximum (1RM) for single leg eccentric heel raise obtained
- 3 sets of 6-8 repetitions of eccentric heel lowering unilaterally at 85% 1RM for 8 weeks with standard seated leg press machine
- Sonographic examination using Aloka prosound alpha-6, using a 5 to 12 MHz linear array transducer: longitudinal measurement of tendon thickness in prone


Heavy Load Eccentric Protocol and Ultrasound Imaging



seated leg press Concentric double leg raise Transition to single leg Single leg eccentric lowering

	Load/Weight			# Repetitions		
	Mon	Tues	Thurs	Mon	Tues	Thurs
Week 1	135	135	135	8	8	8
Week 2	135	140	140	8	8	8
Week 3	140	145	150	8	8	8
Week 4	150	150	155	8	6	6
Week 5	155	160	160	6	6	6
Week 6	165	165	165	8	6	6
Week 7	170	170	170	8	6	8

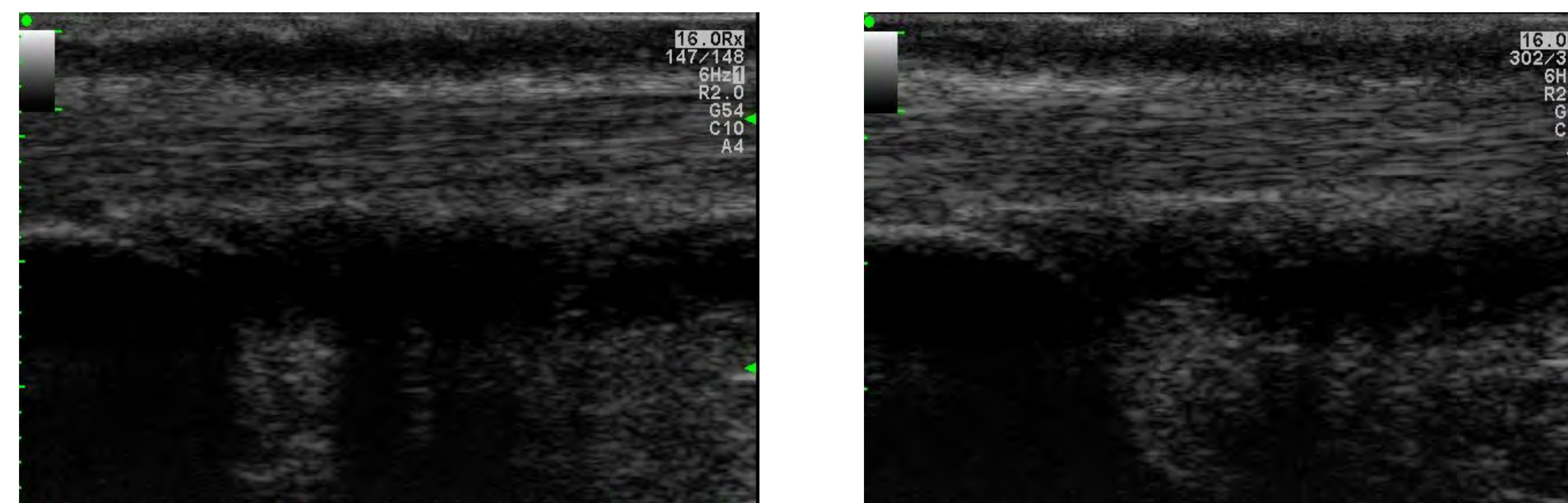
Sample exercise tracking



Ultrasound imaging of Achilles tendon

Results

- Initial 1RM ranged from 135 pounds to 300 pounds
- All participants increased eccentric load during the 8-week program
- 1RM increased an average of 20% at the end of 8 weeks
- There was an average increase of 8% in tendon thickness of the loaded Achilles tendon on the
- No change in tendon thickness was found on the control side.
- 2 participants developed midfoot and lateral ankle pain



Longitudinal ultrasound image of the Achilles tendon

Discussion

- The development of midfoot and lateral ankle pain in 2 participants implies that it may be necessary gradually increase the load to 85% of 1RM.
- 6-12 weeks of resistance training is required for muscle hypertrophy, indicating more changes may be observed in the tendon following an longer exercise program.
- Scaling during ultrasound was not done for 1 participant.
- While 8% increase in tendon thickness was seen, it is unknown based on this protocol what changes would be seen in symptomatic Achilles tendinopathy
- Our study was limited by low number of participants, short program duration, and protocol not being tested on symptomatic Achilles Tendons.

Conclusion

- Exercise programs aimed to reduce pain and improve function associated with mid-portion AT should include significantly higher loading at the Achilles tendon so that complete tendon remodeling can occur.
- This study shows that increasing the load of the Achilles tendon will result in tendon changes.
- More research needs to be done on what changes are occurring within the tendon, and how these changes would occur in a pathologic Achilles tendon
- Future studies should measure echogenicity of the Achilles tendon following the protocol to gain insight into collagen synthesis, as well as tendon stiffness

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