

Real-time Sonoelastography and Ultrasound Evaluation of the Achilles Tendon in Diabetic Patients With or Without Foot Ulcers: A Prospective Case Control Study

Berna Evranos¹, Ilkay Idilman², Ali Ipek², Sefika Burcak Polat¹, Bekir Cakir¹, Reyhan Ersoy¹

¹ Yildirim Beyazit University, Ataturk Education and Research Hospital, Endocrinology and Metabolism Department, Ankara, Turkey

²Ataturk Education and Research Hospital, Radiology Department, Ankara, Turkey

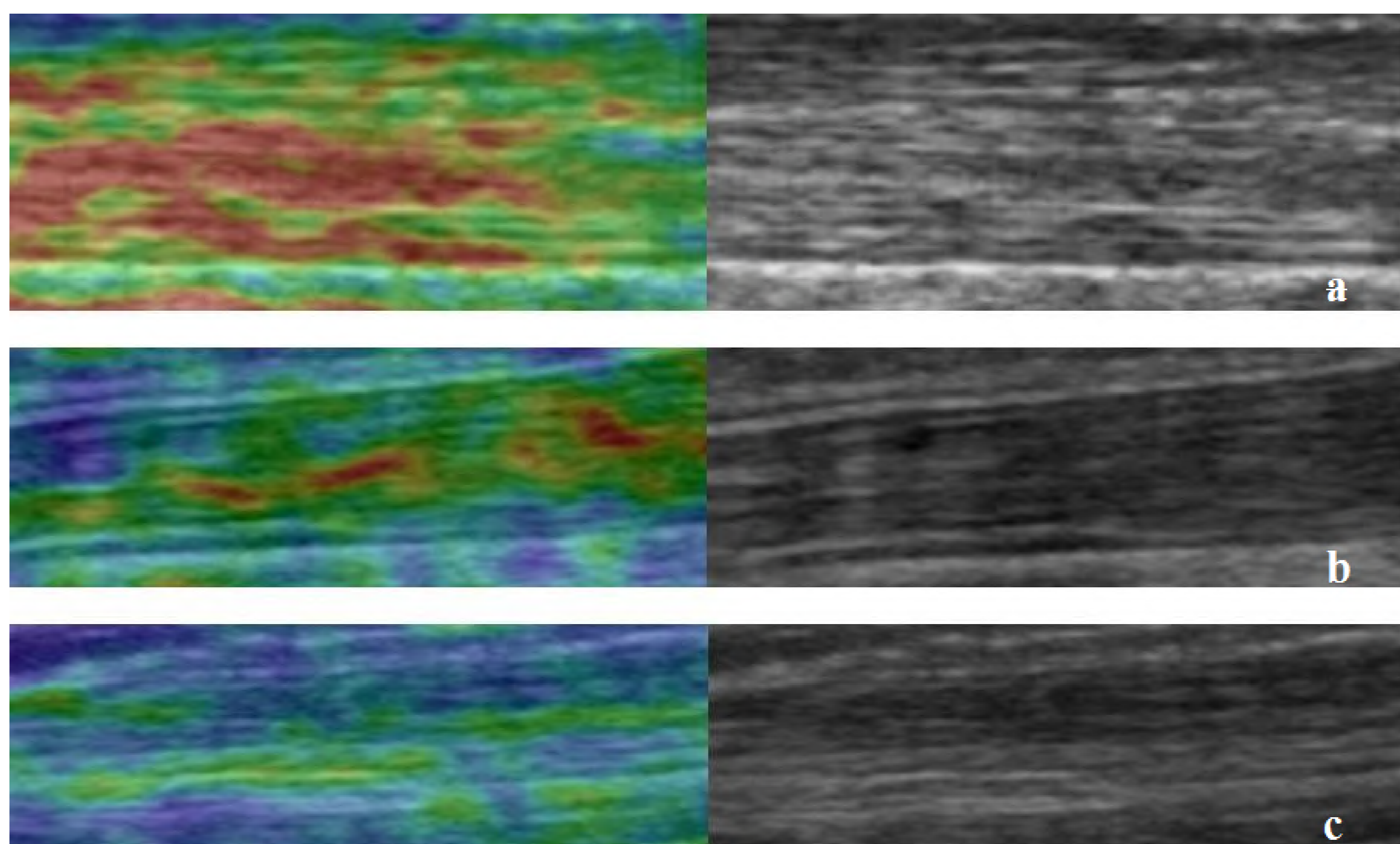
OBJECTIVES

Introduction: Diabetes mellitus (DM) is an endocrine disease characterized by metabolic abnormalities and long-term complications. The Achilles tendon (AT) plays an important role in foot biomechanics. We aimed to investigate the effect of DM on the Achilles tendon, which may contribute to long-term complications in the foot-ankle complex.

METHODS

78 diabetic patients with (35 patients) or without (43 patients) diabetic foot ulcers were recruited from the endocrinology clinic. Thirty-three age, gender, and BMI matched non-diabetic, healthy individuals with no history of Achilles tendinopathy were selected among hospital staff as controls. All participants underwent ultrasonography and sonoelastography of their Achilles tendons in order to evaluate Achilles tendon thickness (ATT) and stiffness (ATS). Each patient was also tested for fasting plasma glucose (FPG) and glycosylated hemoglobin (HbA1C) as a measure of diabetes control. Other chronic complications were also evaluated in all diabetic patients.

The elasticity of tendons by sonoelastography



(a) type 1a blue predominance; (b) type 1b green predominance; (c) type 2a small yellow/red areas within green predominance; (d) type 2b small green areas within yellow-red predominance. The elasticity of the tissue was in a spectrum ranging from hard to soft as the type progresses from 1a to 2b.

RESULTS

The Achilles tendon was significantly thicker in the diabetic patients with diabetic foot ulcers (Group I) compared to diabetics without any ulcer (Group II) and the controls ($p < 0.001$). HbA1C, FPG, and duration of diabetes were higher in Group I. We observed that ATT was positively correlated with neuropathy ($p = 0.001$), retinopathy ($p = 0.001$), nephropathy ($p = 0.006$), peripheral arterial disease ($p = 0.001$) and coronary arterial disease ($p = 0.005$) in Group II while this correlation was not detected in Group I. ATS was reduced in Group I more than Group II and control groups.

CONCLUSIONS

Changes in the structure of the Achilles tendon may precede foot ankle disorders in diabetic patients. This is the first study that reported the results of sonoelastography of Achilles tendon in diabetics and revealed the correlation between ATT and other chronic complications of diabetes.

References

- 1-Rao SR, Saltzman CL, Wilken J, Yak HJ: Increased passive ankle stiffness and reduced dorsiflexion range of motion in individuals with diabetes mellitus. *Foot & ankle international* 2006, 27(8):617-622.
- 2-Salsich GB, Mueller MJ, Hastings MK, Sinacore DR, Strube MJ, Johnson JE: Effect of Achilles tendon lengthening on ankle muscle performance in people with diabetes mellitus and a neuropathic plantar ulcer. *Physical therapy* 2005, 85(1):34-43.
- 3-Trevino SG, Buford WL, Jr., Nakamura T, John Wright A, Patterson RM: Use of a Torque-Range-of-Motion device for objective differentiation of diabetic from normal feet in adults. *Foot & ankle international* 2004, 25(8):561-567.
- 4-Batista F, Nery C, Pinzur M, Monteiro AC, de Souza EF, Felipe FH, Alcantara MC, Campos RS: Achilles tendinopathy in diabetes mellitus. *Foot & ankle international* 2008, 29(5):498-501.
- 5-Papanas N, Courcoutsakis N, Papatheodorou K, Daskalogiannakis G, Maltezos E, Prassopoulos P: Achilles tendon volume in type 2 diabetic patients with or without peripheral neuropathy: MRI study. *Experimental and clinical endocrinology & diabetes : official journal, German Society of Endocrinology [and] German Diabetes Association* 2009, 117(10):645-648.
- 6-Garra BS: Elastography: current status, future prospects, and making it work for you. *Ultrasound quarterly* 2011, 27(3):177-186.