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Technical note: Real-time sonoelastography evaluation of Achilles tendon

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Abstract

Sonoelastography (SE) is a new USG-based technique that is being used to assess the elasticity and pliability of various tissues and lesions. We evaluated normal and abnormal Achilles tendons and correlated SE findings with those of high-resolution USG. This article briefly discusses the principle and technique of sonoelastography and the variations in elasticity and pliability between normal and abnormal Achilles tendons.

Key words: Achilles tendon; real-time sonoelastography; ultrasound

Introduction

Sonoelastography (SE) is a new imaging technique that provides information on the elastic properties and stiffness of tissues. SE was first described by Ophir *et al*. in 1991.[1] Elasticity or hardness of tissue is the physical and mechanical property that prevents displacement when pressure is applied on it.[2] This inherent property varies between different tissues in the body and in the same tissue in different pathologies.[2] SE has shown promising results in the evaluation of the breast,[3] thyroid,[4] prostate,[5] and lymph nodes.[2]

There are a few publications regarding the applications of SE in the musculoskeletal system.[6-8] In this article we aim to discuss our experience with SE of the Achilles tendon in healthy adults, in the asymptomatic geriatric population, and in geriatric patients with achillodynia; we discuss the differences between the elasticity/stiffness of the tendon in these three groups.

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Sonoelastography Principle

SE is based on the principle that structures/lesions deform according to their molecular makeup and consistency when external pressure is applied on them. Free-hand real-time SE can be performed for superficial accessible structures and lesions that are amenable to compression by an ultrasound probe. In general, structures with a soft consistency show a slight deformation when pressed with the probe. The amount of deformation can be automatically computed by specialized software, which displays the information on the monitor as a color-coded image superimposed on the B-mode image. Hard structures that show no significant deformation on application of pressure are represented in shades of blue, while soft deformable structures are represented in shades of red. Structures with intermediate firmness/consistency are represented with green color. During SE, in order to prevent artifacts, care must be taken to apply minimal, uniform, and repetitive free-hand pressure on the structure in a direction perpendicular to its long axis. No strain ratios or quantification methods have been described as yet for musculoskeletal SE, unlike for breast SE where a few vendors provide quantification methods of strain/deformability calculations.

Sonoelastography Technique

For evaluation of the Achilles tendon, the patient is placed in the prone position with the leg hanging from the edge of the bed. We perform ultrasound and SE with an elastography-compatible linear probe of 10-12 MHz frequency

(Voluson E8®; GE Healthcare Technologies, Milwaukee, WI, USA). The probe is held perpendicular to the tendon to avoid anisotropy. The tendon is first assessed on B-mode ultrasound for bulk, echotexture, and other changes that may be present. A real-time SE is then performed by applying mild, repetitive, uniform manual pressure on the distal one-third of the Achilles tendon. Care is taken to avoid tissue shifting or application of lateral pressure as this can produce color artifacts. The adequacy of the compression is standardized with the help of a graph that appears on the right side of the bottom of the screen. This graph depicts the amount and the uniformity of the pressure applied. The quality of the image and the adequacy of color pickup are standardized with the help of a color bar that appears on the left side of the screen. The same color scale is used in all patients. Artifactual color depiction in the image is identified with the help of this scale and images that have such artifacts are discarded. SE is performed in both the transverse and the longitudinal planes. SE information is obtained as a color-coded image overlaid on the B-mode image. Red represents areas of relative softness, green indicates areas of firmness/intermediate consistency, and blue represents hard areas.

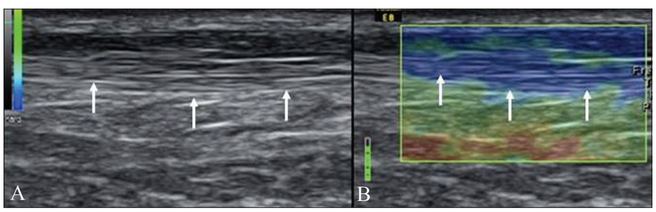

Figure 1 (A, B): Normal Achilles tendon. Longitudinal B-mode image (A) and real-time sonoelastography (B) show the distal Achilles tendon (arrows) in an asymptomatic healthy volunteer, with predominant blue areas indicating hardness

Findings

Normal Achilles tendons with a normal B-mode appearance (i.e., uniform fibrillar appearance, with normal bulk and echotexture) show predominant blue color on the SE, indicating the hard nature/consistency of normal young tendons [Figure 1]. Small variable patches of green color may also be seen in normal tendons. Achilles tendons in the asymptomatic geriatric population appear mildly bulky on the B-mode (an age-related change) and may show early changes of tendinosis. On the SE these tendons reveal a predominantly green color, with small variable patches of either blue or red; this indicates a predominantly firm consistency [Figures 2 and 3]. Patients with frank clinical and B-mode ultrasound features of Achilles tendinitis (i.e., bulky tendon, with hypoechoic texture and loss of the fibrillary

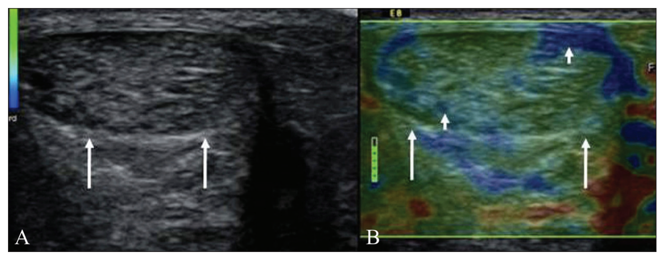

Figure 2 (A, B): Early asymptomatic tendinosis. Transverse real-time B-mode image (A) and sonoelastography image (B) show the distal Achilles tendon (long arrows) in an asymptomatic geriatric patient with tendinosis; there is predominant green color, with small patches of blue (small arrows)

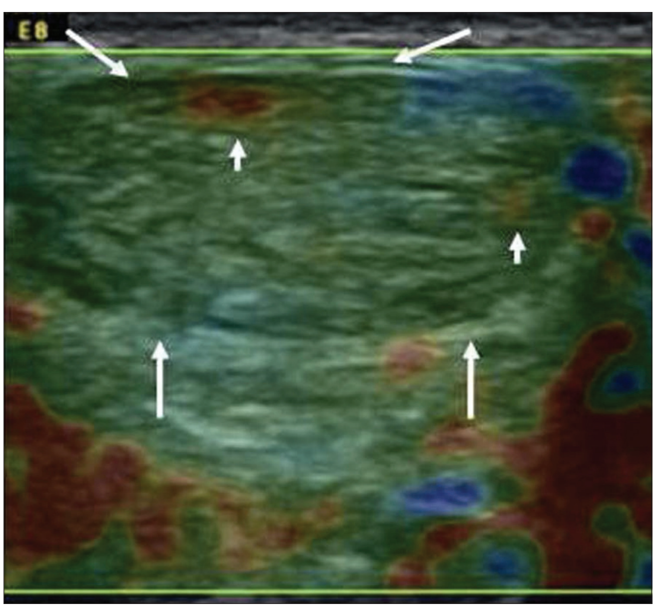

Figure 3: Early asymptomatic tendinosis. Transverse real-time sonoelastography shows the distal Achilles tendon (long arrows) in an asymptomatic geriatric patient; there are predominant green areas with small patches of red (small arrows)

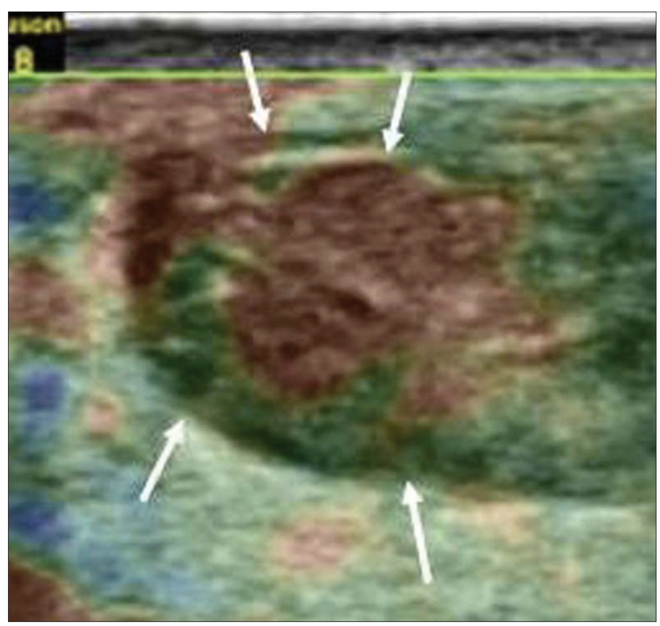

Figure 4: Symptomatic chronic Achilles tendinitis. Transverse real-time sonoelastography shows the distal Achilles tendon in a symptomatic geriatric patient; red areas (arrows) are predominant, indicating softness

pattern on B-mode ultrasound) reveal predominantly red color on the SE; this indicates a soft tendon, with loss of the normal hard/firm consistency [Figure 4].

De Zordo *et al.*, evaluated 80 asymptomatic Achilles tendons in volunteers and reported that 86.7% of the tendons had a hard structured pattern, with predominant blue color on SE.[6] Our findings are consistent with the findings of De Zordo *et al*.

Conclusion

Real-time SE provides useful information regarding the consistency of the tendons and can supplement the information obtained on B-mode ultrasound. Given the fact that SE can differentiate between normal and abnormal tendons, further work is required to assess its efficacy and usefulness in the management of such patients, using randomized control trials.

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