European Journal of Radiology 95 (2017) 192–196

Contents lists available at ScienceDirect

European Journal of Radiology

journal homepage: www.elsevier.com/locate/ejrad

Research article

Shear wave elastography findings of de Quervain tenosynovitis

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ARTICLE INFO

Keywords:
Elastography
Shear wave
Tendons
De quarvain tenosinovitis
First extensor compartment

ABSTRACT

Objective: Our aim was to evaluate the feasibility of using shear wave elastography (SWE) to assess first extensor compartment tendons rigidity and its alterations with tenosynovitis.
Materials and methods: We performed B-mode ultrasound and SWE to total number of 80 participants. All participants were evaluated clinically to call the diagnosis of de Quervain tenosynovitis or to rule out the diagnosis. We composed 2 groups. Group 1 included 40 healthy volunteers (33 females and 7 male participants with ages ranging from 24 to 60 years, median age was 37.5 years) and group 2 had 40 de Quervain patients (32 females and 8 male patients with ages ranging from 25 to 51 years, median age was 34 years). SWE measurements were repeated 3 times and arithmetic average was used for the final SWE value.
Results: The median SWE value of healthy group (group 1) was 72 kPa and the de Quervain patient group (group 2) was 29 kPa. Two groups demonstrated statistically significant difference ($p < 0.001$). The ROC curve analysis was performed and the SWE value of 40.5kPA was calculated as a cut-off value for the diagnosis of de Quervain tenosynovitis with 95% specificity and 85% sensitivity.
Conclusion: SWE modality can provide useful data regarding de Quervain tenosynovitis.

1. Introduction

De Quervain tenosynovitis is a painful stenosing inflammatory pathology of the first extensor compartment of the wrist. The compartment houses abductor pollicis longus (APL) and extensor pollicis brevis (EPB) tendons. The prevalence of de Quervain tenosynovitis was reported as 0.5% in males and 1.3% in females in the literature [1]. The effects of musculoskeletal conditions are pervasive in terms of treatment and care, as well as the impact upon quality of life, mobility, and productivity, and in fewer days at work and in school. Nowadays, the incidence of de Quervain tenosynovitis just like other musculoskeletal conditions, is increasing due to modern life conditions such as excessive computer use at work and growing use of cellular phones [2]. In most of the cases, the diagnosis of de Quervain tenosynovitis is clinical but imaging modalities are implemented for supporting the diagnosis and ruling out the differential diagnosis such as intersection syndrome and Wartenberg syndrome. Magnetic resonance imaging (MRI) and ultrasonography (US) are the most used techniques. US has some advantages over MRI such as wide availability, inexpensiveness and patient conformity [3]. Besides US has a high resolution than MR in structures near the surface, it allows dynamic examination and shows increased vascular supply without the need for contrast agent injection.

From past to present, manual palpation has been a routine part of clinical examination that physicians practice to get subjective data regarding the condition of interested organ. The basic physical principle of this method is the strong correlation between tissue elasticity and the pathologic conditions [4]. On the other hand, elastosonography offers more objective and advanced alternative for manual palpation. An external force is applied to the tissue and causes a local tissue displacement which can be detected by elastosonography. There are different types of elastosonography depending on both the kind of the implemented force and the kind of method that can measure the alteration in the tissue such as strain and shear wave elastographies [5]. In strain elastography, a manually applied external force is used, displacement of tissue is analyzed, and the stiffness of the interested area is depicted within a color box [5]. Only semi-quantitative data can be obtained by strain ratio calculation [5]. There are handicaps with this method such as its operator dependence and lack of providing quantitative data regarding tissue stiffness. On the other hand, shear wave elastography (SWE) offers quantitative data and it is not operator dependent. In SWE,

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http://dx.doi.org/10.1016/j.ejrad.2017.08.011
Received 13 May 2017; Received in revised form 9 August 2017; Accepted 11 August 2017

ultrasonographic waves that generated by the transducer is sent to the region of interest and they create shear waves in the tissue. These waves are detected by the transducer and their speed is used to calculate the Young modulus of the tissue which is directly related to the stiffness of the tissue [6,7].

To our knowledge there is no study in the literature that assesses the shear wave elastography changes to the first extensor compartment in patients diagnosed with de Quervain tenosynovitis. The aim of our study is to evaluate the shear wave elastography alterations of tenosynovitis in the first extensor compartment.

2. Material and methods

This study was approved by the Institutional Review Board, and informed consent was obtained from all participants. From January 2016 to December 2016, we examined 40 healthy volunteers (group 1) and 40 patients (group 2). All participants were examined clinically to detect the presence or absence of tenosynovitis. The patients complained of radial wrist pain and their Finkelstein test were positive. Volunteer group were asymptomatic with a (–) Finkelstein test. Group 1 included 33 females and 7 male volunteers with ages ranging from 24 to 60 years (median age was 37.5 years). Group 2 included 32 females and 8 male patients with ages ranging from 25 to 51 years (median age was 34 years).

All ultrasound examinations were performed by the same radiologist who has a 10-year experience in sonography. All examinations were done with Toshiba Aplio 500 (Tokyo, Japan) and linear transducer (12 MHz) was implemented. The US examination was performed while patients were seated. Images of the first extensor compartment were acquired transversely (short axis of the tendon) (Fig. 1). All SWE measurements were done in the same axis. A gel-pad was used to deepen the region of interest. SWE was activated and region of interest (ROI) is placed in the first extensor compartment of the wrist where tendons (both APL and EPB tendons) and the sheath was depicted best (Figs. 1 and 2). ROI covered both tendons. Three consequent measurements were done and their average was calculated as the final SWE value.

All SWE values and demographic data of participants were recorded and analyzed statistically.

3. Statistical analysis

The statistical analysis was performed using SPSS 15.0 (Statistical Package for Social sciences). Mann-Whitney *U* test was used to analyze the difference between SWE values of both groups. ROC curve analysis was used to calculate the cut-off value in the diagnosis of de Quervain disease.

4. Results

There was no significant difference between two groups regarding gender and age ($p > 0.05$). The median SWE value of group 1 was 72 kPa (mean value 69.17 ± 22.45 kPa minimum and maximum values were 30 kPa and 128 kPa respectively) and the median SWE value of group 2 was 29 kPa (mean value 29.75 ± 8.02 kPa minimum and maximum values were 18 kPa and 47 kPa respectively). There was a statistically significant difference between 2 groups ($p < 0.001$). Fig. 3 depicts the differences of SWE values between two groups. The cut-off value for the diagnosis of de Quervain tenosynovitis was found to be 40.5 kPa. The area under the ROC curve was 0.955. The specificity and the sensitivity were calculated as 95% and 85%, respectively.

We depicted several B-mode sonographic findings in group 2 (Fig. 4). Table 1 summarizes the sonographic findings of two groups.

5. Discussion

Shear wave elastography is a new imaging modality that can display and compute tissue stiffness [4]. There are several studies on different organs [8] that examine the feasibility of SWE in chronic liver disease [9], liver masses [10], thyroid [11], breast [12] and prostate [13] pathologies. Besides, musculoskeletal system was also evaluated in several studies [8,14–16].

In B-mode evaluation, there was only one volunteer who demonstrated mild extensor retinaculum thickening (0.8 mm). The SWE value of this case was 75 kPa which is above our cut-off value (40.5 kPa). We think that this may be a variative appearance. All other volunteers demonstrated normal tendon sizes and no fluid within the compartment. On the other hand, group 2 patients mostly showed tendon thickening and fluid within the compartment, retinaculum thickening, peritendinous oedema and hyperemia in peritendinous region. These

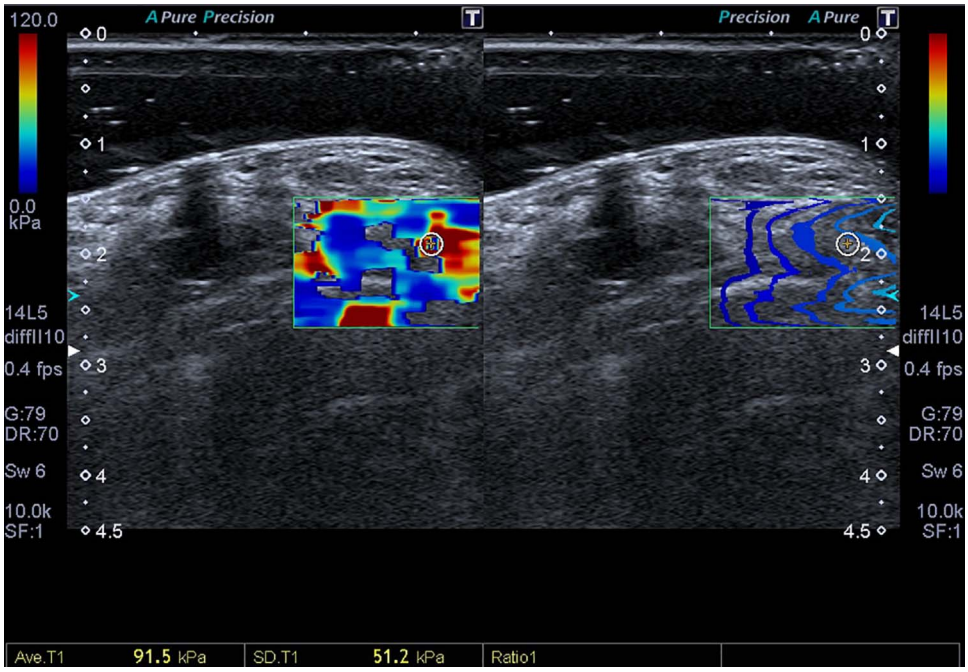

Fig 1. A 34-year old healthy female volunteer, axial sonographic image of the first extensor compartment of the wrist. Circle ROI depicts the area where SWE measurements were performed.