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Original Article

Strain-based elastography assessment of patients with De Quervain tenosynovitis: A preliminary study

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ABSTRACT

Introduction: The development of the condition is occurs by repeated strain of the APL and EPB tendons as they pass under a thickened and swollen extensor retinaculum.

De Quervain tenosynovitis prevalence is about 0.5% in males and 1.3% in females. In the recent years, De Quervain tenosynovitis incidence increases by virtue of modern life conditions such as excessive computer use and increased use of cellular phones.

Materials and methods: The final study population comprised 52 subjects; 30 diseased (patients) (group 1) and 22 healthy subjects (volunteers) (group 2).

All participants were subject to; (1) history taking, (2) clinical examination to prove or eliminate the presence of tenosynovitis, (3) US, and (4) MRI.

Results: Strain-based elastography positive predictive value was 95%, negative predictive value was 90%, sensitivity 92%, and specificity 93%.

Conclusion: In conclusion, we can postulate that strain-based elastography ratio can be used confidently and quantitatively to diagnose De Quervain tenosynovitis.

1. Introduction

In the nineteenth century, Fritz De Quervain, described patients with tender, thickened first dorsal compartment at the wrist. The condition has been termed De Quervain tenosynovitis. It is an entrapment tendinitis of the tendons within the first dorsal compartment of the wrist; patients complained of pain during thumb motion [1]. The tenosynovitis affects the abductor pollicis longus (APL) and the extensor pollicis brevis (EPB) tendons [2].

The development of the condition is occurs by repeated strain of the APL and EPB tendons as they pass under a thickened and swollen extensor retinaculum [3,4].

Patients complain of pain and inflammation in the region of the radial styloid. The pain is exaggerated by motions necessitating ulnar deviation with a flexed first metacarpophalangeal (MP) joint. Actions causing patient complains include using a cloth washing, playing golf, carrying children, or using the hammer [2,5].

De Quervain tenosynovitis prevalence is about 0.5% in males and 1.3% in females [6]. In the recent years, De Quervain tenosynovitis incidence increases by virtue of modern life conditions such as excessive computer use and increased use of cellular phones [7].

Clinical evaluation of De Quervain tenosynovitis may reveal swollen tender region of the first dorsal compartment. Finklestein's test, involving thumb metacarpo phalangeal joint flexion with a closed hand together with wrist ulnar deviation, can lead to a painful response at the styloid process of the radius [2].

Manual palpation is a routine part of clinical examination where the physician gets subjective data from organ of interest. Manual palpation examines tissue elasticity of the diseased structure, and it is a qualitative rather than a quantitative process.

Magnetic resonance imaging (MRI) and ultrasonography (US) are commonly utilized to diagnose the condition of De Quervain tenosynovitis. US has the advantage of no claustrophobia, patients are comfortable, being readily available, real time patient scanning and lower price. However; MRI is the gold standard for diagnosis.

The aim of our work is to evaluate the quantitative assessment of strain-based elastography of affected tissues in De Quervain of tenosynovitis.

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2. Materials and methods

Our research was approved by the Ethics committee of our institute, and informed consent was received from all participants.

The research was conducted from September 2015 to November 2016.

The study population comprised 64 individuals initially; 12 subjects were excluded after the initial recruitment for not undergoing MRI i.e. gold standard. Ten subjects from group 2 and 2 subjects from group 1.

The final study population comprised 52 subjects; 30 diseased (patients) (group 1) and 22 healthy subjects (volunteers) (group 2).

All participants were subject to; (1) history taking, (2) clinical examination to prove or eliminate the presence of tenosynovitis, (3) US, and (4) MRI.

The chief patients' complain was radial wrist pain. Finkelstein test was positive for all patients.

Healthy subjects were asymptomatic giving a negative Finkelstein test.

Group 1 included 8 males and 22 females, with age range from 26 to 57 years and median age was 35.2 years.

Group 2 included 7 males and 15 females, with age range from 25 to 52 years and median age was 32.4 years.

All ultrasound examinations were done by the same radiologist who has a 21-year experience in US. B-mode ultrasonography was done after initial clinical diagnosis with the suspicion of De Quervain tenosynovitis to confirm or exclude findings of the disease.

All ultrasound examinations were done using Philips IU22 xMatrix machine (Philips Ultrasound, Bothhell, WA, USA) and linear transducer (12–5 MHz) using the advanced small parts option and elastography QLAB (Figs. 1 and 2). While the subject is sitting the US examinations were conducted. Longitudinal and transverse images of the retinaculum and tendons were examined.

The strain mean and standard deviation are calculated by the machine.

Three readings of the strain-based elastography final result were taken and the average value was calculated and considered the final value of the strain-based elastography reading.

The strain-based elastography scanning time is around 3 min including three readings, time for machine calculation of the strain ratio value and putting into consideration that some patients are uncooperative in keeping their wrist still for precise readings.

3. Statistical analysis

Statistical calculations were conducted using PASW Statistics 18 software (IBM SPSS, Chicago, IL, USA).

Student *t*-test was used to measure the difference between the two groups (patients and volunteers).

The threshold ratio for diagnosing De Quervain tenosynovitis was calculated using ROC curve analysis.)

4. Results

(There was no significant difference between the two groups regarding age and sex ($p > 0.01$).

All our patients group showed low strain ratio except for three patients, while all our volunteers group except for two volunteers showed high strain ratio. Table 1 shows the different strain ratios in patients and volunteers.

Strain-based elastography positive predictive value was 95%, negative predictive value was 90%, sensitivity 92%, and specificity 93%.

The mean strain-based elastography ratio of group 2 was 6.1 and the mean strain-based elastography ratio of group 1 was 2.3. Statistically significant difference between our patient and healthy subjects groups was received ($p < 0.001$).

De Quervain tenosynovitis diagnostic exclusion threshold ratio was 4.

Among our B-mode ultrasonography findings (Table 2) of De Quervain tenosynovitis patients are; thickened tendons and fluid within their tendon sheaths, thickened retinacula, oedema and cyst formation.

5. Discussion

Pain and abnormal sensations of the arm are common with prevalence rates ranging from 4 to 35% [8–10].

The extensor retinaculum pushes the APL and the EPB muscle tendons tightly against the radial styloid process. Gliding of the tendons is restricted by their thickening from repeated trauma. Thumb movement, especially when combined with deviation of the wrist joint, reproduces pain and inflammatory swelling [2].

The pathology of De Quervain tenosynovitis involves degenerative changes as myxoid degeneration, fibrocartilaginous metaplasia and deposition of mucopolysaccharides [11,12].

In recent years, many of ultrasound machine manufacturers begun to incorporate elastography of tissue stiffness, in their equipment [12]. The two most frequently used elastography techniques are strain-based and shear-wave elastography. Nevertheless, they differ in the forces being measured and in their techniques. In strain-based elastography, manual compression of the transducer is applied, and the amount of deformation of the lesion relative to surrounding normal tissues is

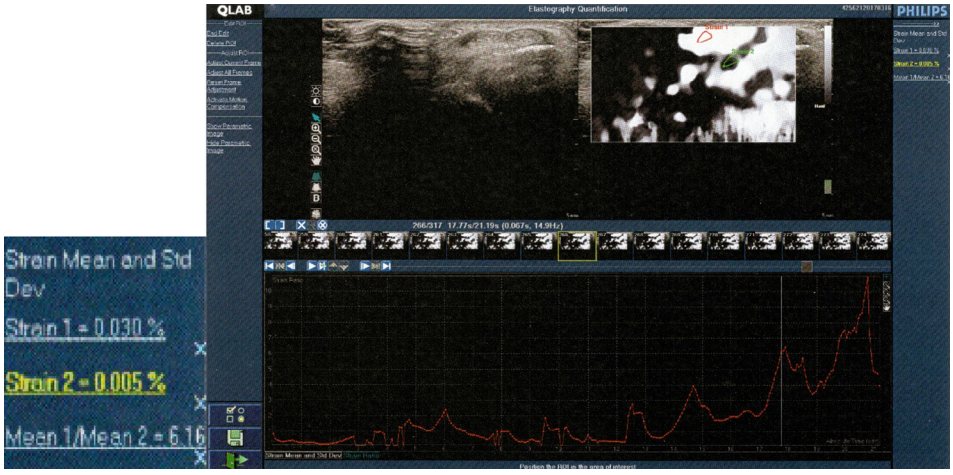

Fig. 1. QLAB calculation of the elastography strain ratio of a normal subject (Right-sided image) and magnified strain mean and standard deviation (Left-sided image) with value of 6.16.