Journal of Hand Surgery (European Volume)
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J Hand Surg Eur Vol published online 22 January 2013
DOI: 10.1177/1753193412475043

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The Journal of Hand Surgery
(European Volume)
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The wrist hyperflexion and abduction of the thumb (WHAT) test: a more specific and sensitive test to diagnose de Quervain tenosynovitis than the Eichhoff's Test

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Abstract
De Quervain's disease has different clinical features. Different tests have been described in the past, the most popular test being the Eichhoff's test, often wrongly named as the Finkelstein's test. Over the years, a misinterpretation has occurred between these two tests, the latter being confused with the first. To compare the Eichhoff's test with a new test, the wrist hyperflexion and abduction of the thumb test, we set up a prospective study over a period of three years for a cohort of 100 patients (88 women, 12 men) presenting spontaneous pain over the radial side of the styloid of the radius (de Quervain tendinopathy). The purpose of the study was to compare the accuracy of the Eichhoff's test and wrist hyperflexion and abduction of the thumb test to diagnose correctly de Quervain's disease by comparing clinical findings using those tests with the results on ultrasound. The wrist hyperflexion and abduction of the thumb test revealed greater sensitivity (0.99) and an improved specificity (0.29) together with a slightly better positive predictive value (0.95) and an improved negative predictive value (0.67). Moreover, the study showed us that the wrist hyperflexion and abduction of the thumb test is very valuable in diagnosing dynamic instability after successful decompression of the first extensor compartment. Our results support that the wrist hyperflexion and abduction of the thumb test is a more precise tool for the diagnosis of de Quervain's disease than the Eichhoff's test and thus could be adopted to guide clinical diagnosis in the early stages of de Quervain's tendinopathy.

Keywords
Tenosynovitis, de Quervain, Eichhoff's test, wrist hyperflexion and abduction of the thumb test, prospective, comparative study

Date received: 19th February 2012; revised: 9th September 2012; accepted: 15th December 2012

Introduction

De Quervain's tenovaginitis (de Quervain, 1895) is a disease that is more common among people who perform manual work, owing to the unique mobility of the human thumb (Leào, 1958). Gender is a predisposing factor with women being more affected (Loomis, 1951).

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Patients with this condition mostly complain of soreness and tenderness on the radial side of the distal radius that is exacerbated by ulnar deviation of the thumb; by a strong grasp combined with flexion and radial deviation of the wrist or by a firm pinching together of the index finger and thumb. Physical examination reveals tenderness and swelling directly over the first dorsal compartment. Within this compartment lie the tendons of extensor pollicis brevis (EPB) and abductor pollicis longus (APL). The bulk of both tendons is very different: the EPB is very small, while the APL has a variable number of tendons in its final portion at insertion (Bahm et al., 1995; Leào, 1958; Minamikawa et al., 1991). A septum can also be present between the EPB and APL (Kutsumi et al., 2005; Minamikawa et al., 1991). The pain in de Quervain's disease is owing to friction of the EPL and APB against the pulley of zone 7 of the first extensor compartment. This friction results in the initial tendinopathy that is subsequently followed by a reactive thickening of the pulley (Brunelli, 2003).

The standard test to confirm the diagnosis of de Quervain's tenovaginitis is said to be Finkelstein's test (Finkelstein, 1939) (Figure 1). However, the majority of clinicians and indeed teaching manuals actually illustrate/describe what is in fact the Eichhoff test (Eichhoff, 1927; Elliott, 1992; Wasseem et al., 2005) (Figure 2).

To perform the Finkelstein test, the examiner grasps the thumb firmly with one hand, while the other holds the forearm on the ulnar side in a resting position in neutral pro-supination. A firm traction is than applied on the patient's thumb, pulling

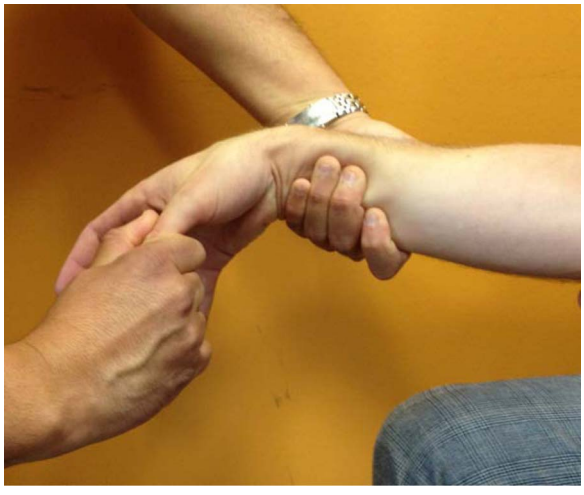

Figure 1. Finkelstein's manoeuvre as described in 1930: the examiner pulls the thumb in ulnar deviation and longitudinal traction to exacerbate the symptoms of de Quervain's disease.

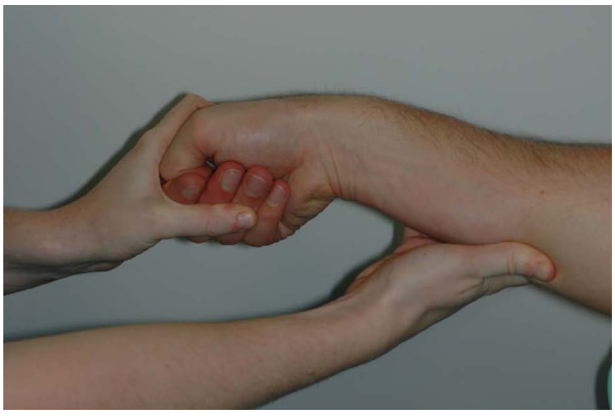

Figure 2. Eichhoff's manoeuvre described in 1927, commonly confused with Finkelstein's test described in 1930.

it longitudinally and in the direction of slight ulnar deviation to the wrist. When performing the Eichhoff test, the patient is asked to oppose the thumb into the palm and then clench the fingers over the thumb. Ulnar deviation is applied passively to the wrist with one hand while the examiner's other hand holds the forearm in the same way as for the Finkelstein test. Both of these manoeuvres will exacerbate painful symptoms (Figure 1 and 2). There are also a number of other tests that can be used to assess for de Quervain's disease, such as Brunelli's test (Brunelli, 2003), the EPB entrapment test (Alexander et al., 2002) and ulnar deviation of the wrist, but these tests, in the author's clinical experience, do not appear to be as frequently used in the diagnosis of de Quervain's in practice.

While there is an obvious confusion between the two tests in that many name the Eichhoff the Finkelstein, there are also differences between them. The problem with the Finkelstein test is that it is a passive test, relying on the skill of the examiner. It also involves stressing other unrelated joints, such as the radio-scaphoidal, the scapho-trapezial, the trapezio-metacarpal and the metacarpo-phalangeal joint. Furthermore, it appears to lack precision in that the tendons of interest cannot be specifically isolated during the test. However, while the Eichhoff involves an element of active contribution by the patient in that the patient is instructed to hold their thumb in their palm with a clenched fist, it remains primarily a passive test and has been criticized for producing positive results within normal individuals (Brunelli, 2003; Eichhoff, 1927; Elliott, 1992; Loomis, 1951; Wasseem et al., 2005). Passive tests such as these have the disadvantage of stressing different structures that are not directly involved in the pathology of de Quervain.

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We wanted to develop a test that would allow the patient to have more control over the pain elicited by the test, rather than the tester having to cause pain to produce a positive result. If such a test could be developed, it would enable the patient to decide for themselves when to stop the test. Effectively such a test would use the patient's natural pain threshold to signify the end of a test with a positive result.

With these criteria in mind we developed the wrist hyperflexion and abduction of the thumb (WHAT) test because we wanted a test with a greater focus on the tendons of the first dorsal compartment (APL and EPB) and which was an active test that allowed the patient to have maximal control over the test process. The WHAT test is designed to solely target the tendons of the first compartment in that it is performed by asking the patient to fully flex their wrist (within their pain margins) and keep their thumb fully extended and abducted while the examiner applies a gradually increasing abduction resistance to the thumb. When the patient is unable to maintain the force against the examiner, the patient is free to release the pressure and the test is complete. Pain on resisted pressure against the examiner signifies a positive result.

We present the results of a comparison between the Eichhoff test and our new WHAT test (Figure 3) and compare both with the results obtained with ultrasonography (Luchetti et al., 2004). Our aim was to examine the relative abilities of these two tests to diagnose APL and EPB tendinitis of the first extensor compartment at the radial styloid.

Methods

Between June 2007–2010, we prospectively evaluated 104 patients who presented clinically with the symptoms of de Quervain's disease. Previous surgery for de Quervain's was not an exclusion criterion. The average age was 52 years and 11 months (range 17–88 years). Fifty-seven patients presented with the affection on the dominant side and 43 on the non-dominant side. Four patients were excluded from the study owing to problems with data recording, thus leaving 100 patients (88 women, 12 men) in the data analysis.

On clinical suspicion of de Quervain's (a positive local tenderness on the radial styloid), patients underwent the Eichhoff test and the new WHAT test, which were both carried out by two experienced hand surgeons.

Performed in random order, Eichhoffs test was carried out in the following sequence: ulnar deviation of the clenched wrist holding the opposed thumb (Figure 2). The WHAT test was performed as follows: the wrist was hyperflexed and the thumb abducted in full metacarpo-phalangeal (MP) and inter-phalangeal (IP) extension, resisted against the examiner's index finger (Figure 3). Exacerbation of the symptomogy was considered as a positive test result. Those subjects who had a positive test result, for either or for both of the two tests, were subsequently sent for X-ray and ultrasonography to confirm the diagnosis of de Quervains. These blinded radiological data were then used to compare the WHAT test with the Eichhoff test.

Figure 3. WHAT test: active testing by shearing the tendons of the first extensor compartment against the palmar distal edge of the pulley.

Data were analysed by examining the specificity and sensitivity of the two tests, along with a number of other dimensions of diagnostic performance. Specificity was calculated as: True –ve/True –ve + False +ve and Sensitivity as: True +ve/True +ve + False –ve. The results of which, including confidence intervals, are presented in Table 1. Statistical significance is reported as $p \leq 0.05$ where appropriate.

Results

The results of the discriminatory abilities of the two tests to diagnose de Quervain's can be viewed in Table 1. All X-rays revealed no abnormalities on the distal radius, the radiocarpal, midcarpal or at the trapeziometacarpal level. Ninety-three ultrasounds were positive and seven were negative.

The accuracy of Eichhoff's test was 0.84, while that of the WHAT test was 0.94, suggesting that the latter performs better overall in establishing the correct diagnosis.

The sensitivity of a test describes how good a test is at picking up all patients who have the condition

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Table 1. Results for the two diagnostic *tests.

Name of test	Eichhoff test		WHAT test	
	Test result	95% CI of test result	Test result	95% CI of test result
Accuracy	0.84	0.75 – 0.93	0.94	0.88 – 1.0
Sensitivity	0.89	0.81 – 0.97	0.99	0.96 – 1.02
Specificity	0.14	–0.19 – 0.47	0.29	–0.14 – 0.71
Positive likelihood ratio	1.04	0.70 – 1.55	1.39	0.76 – 2.52
Negative likelihood ratio	0.75	0.07 – 8.57	0.04	0.002 – 0.69
Diagnostic odds	1.38	–2.53 – 5.29	36.80	–522.10 – 982.10
Positive predictive accuracy (value)	0.93	0.87 – 1.00	0.95	0.892 – 1.01
Negative predictive accuracy (value)	0.09	–0.13 – 0.31	0.67	–0.01 – 1.35
False positive rate (α)	0.86	0.53 – 1.19	0.71	0.29 – 1.14
False negative rate (β)	0.11	0.03 – 0.19	0.01	–0.02 – 0.04

*For further information on these parameters please refer to Table 2.

under test. Specificity on the other hand, defines how good the test is at correctly excluding patients who do not have the condition under test (Loong, 2003). A summary description of all the aspects of diagnostic performance of the two tests, together with their calculation and interpretation, can be viewed in Table 2 (constructed using Glas et al., 2003; Harper and Reeves, 1999; Loong, 2003).

The results obtained from the Eichhoff test, produced a sensitivity of 0.89 and a specificity of 0.14; a positive predictive value of 0.93 and a negative predictive value of 0.09. The positive likelihood ratio for the Eichhoff's test was 1.04 and 0.75 for a negative test. The WHAT test revealed greater sensitivity of 0.99 and an improved specificity of 0.29, together with a slightly better positive predictive value of 0.95 and with an improved negative predictive value of 0.67. The likelihood ratio for a positive test was better than that of the Eichhoff test at 1.39 and the negative likelihood ratio was also improved (lower) at 0.04. These results support the improved performance of the WHAT test over the Eichhoff test in diagnosing de Quervain's disease.

Discussion

The classic test confirming the diagnosis of de Quervain's syndrome is the Eichhoff test, commonly confused with Finkelstein's test (Eichhoff, 1927; Elliott, 1992; Finkelstein, 1939; Leào, 1958; Wasseem et al., 2005). Our aim was to assess the performance of a new test that we have developed, known as the WHAT test, because of the controversy associated with the accuracy of Eichhoff's test (Brunelli, 2003; Eichhoff, 1927; Elliott, 1992; Loomis, 1951; Wasseem et al., 2005) and also the need for an improved patient-friendly test for use in daily medical practice.

The mechanism of the Eichhoff test generates a passive distension and shear stress between tendon and radius on its blunt styloid edge. It thus creates a (passive) conflict between the bulk of the APL and EPB tendons into the thickened first extensor compartment pulley at its proximal end, rather than testing the conflict between the tendons and the pulley at the distal end (Figure 4). The passive distention of the joints in the Eichhoff test is possibly the mechanism that leads to the higher number of true false positives reported in this test. The distension itself can create pain in other articular areas that is unrelated to true de Quervain's disease owing to tensioning of the radial collateral carpal ligament (LCCR), the scapho trapezial ligament (LST) and the carpo metacarpal ligament (LCM) as was pointed out by Brunelli (2003).

The WHAT test is an active test where the patient themselves is asked to hyperflex the wrist actively and to put their thumb actively into abduction. While this is being done, the examiner uses his index finger to counter the manoeuvre, which will cause pain if there are true de Quervain's problems with the APL and EPB. The mechanism of the WHAT test minimizes the shear (and excursion of the tendons in the sheath) between APL/EPB and the bony floor of the first extensor compartment. Since the patient is performing this test, they are effectively controlling the tensioning of the LCCR, the LST and LCM.

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Table 2. Summary of statistical measures.

Name of test	Statistic (test result)	Interpretation	How calculated
Accuracy	Closer to one is better	Answers the question: What proportion of all tests have given the correct result?	Accuracy = true N + true P as a proportion of all results = (TP + TN)/(TP + TN + FP + FN)
Sensitivity	Closer to one is better	How good is the test at picking up all patients who have the condition?	Number of detected +ve divided by the number of actual positives = TP/(TP + FN)
Specificity	Closer to one is better	How good is the test at correctly excluding patients who do not have the condition?	Number of detected –ve divided by the number of actual negatives = TN/(TN + FP)
Positive likelihood ratio	Larger is better	How much more likely is a +ve test to be found in a patient with the condition than in a person without the condition	LR^+ = Sensitivity/1 – specificity
Negative likelihood ratio	Smaller is better	How much more likely is a –ve test to be found in a patient without the condition than in a person with the condition	LR^- = 1 – Sensitivity/specificity
Diagnostic odds	Larger is better	The ratio of the odds of disease in test positives relative to the odds of disease in test negatives. Ranges from 0 to infinity with the higher the number, the better	DOR = (TP/FN)/(FP/TN)
Positive predictive accuracy (value)	Closer to 1 is better	If a patient tests +ve what is the probability that he/she will have the condition?	PPV = TP/(TP + FN)
Negative predictive accuracy (value)	Closer to 1 is better	If a patient tests –ve, what is the probability that he/she doesn't have the condition?	NPV = TN/(TN + FN)
False positive rate (α)	Smaller is better	Rejecting the H^0 (Null hypothesis) when it is actually true constitutes making a Type 1 error (i.e. false positive error). A low Type 1 error rate indicates a test of high specificity.	α where (1 – α) = specificity
False negative rate (β)	Smaller is better	Failure to reject a H^0 when it should be rejected. A low Type 2 error rate indicates a test of high sensitivity	β where (1 – β) = sensitivity

N, negative; P, positive; T, true; F, false; PPV, positive predictive value; NPV, negative predictive value.

The results of our study suggest that the WHAT test compares favourably with the Eichhoff test in that it provides greater accuracy in the diagnosis of de Quervain's disease. The tendency of the Eichhoff to generate more false positives is reflected in the low negative predictive accuracy of the Eichhoff (0.09) compared with the WHAT (0.67). This suggests that the latter has an improved ability to correctly diagnose the absence of de Quervain's. This finding may be attributed to the WHAT test being an active test that will force, in particular, the volar and bulkiest tendon, the APL (Bahm et al., 1995; Leào, 1958; Minamikawa et al., 1991) to generate an additional fulcrum at the distal edge of the pulley of the first extensor compartment, hence causing, even in the early stages of de Quervain's, exacerbation of pain and result in a correct positive diagnosis (Figures 5 and 6). This mechanism is perhaps responsible for a faster and more specific positive response in the initial stage of symptom onset. The WHAT test could also be sensitive to early problems with EPB, even if in a separate tendon sheath (which has also been shown to be associated with a higher prevalence of de Quervain's (Yuasa and Kiyoshige, 1998)

Moreover it appears that the WHAT test can reveal a possible palmar subluxation of the tendons (White and Weiland, 1981) in people who have persistent pain over the first extensor compartment following previous surgery; a feature that the other tests (e.g. Finkelstein, Brunelli, EPB entrapment test, ulnar

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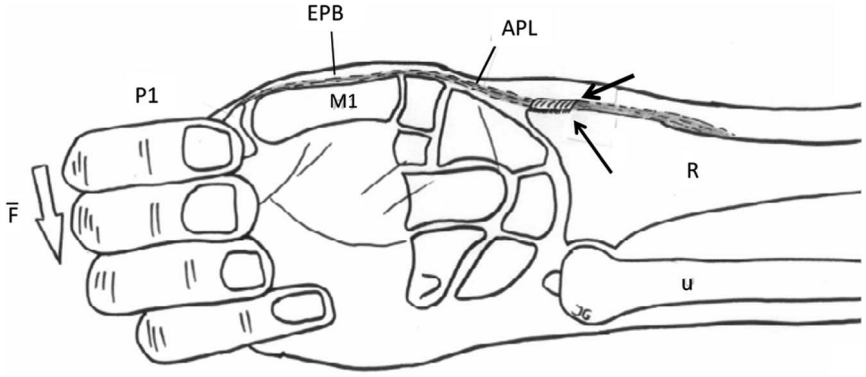

Figure 4. The test described by Eichhoff (1927). This manoeuvre is often confused with the Finkelstein's test. The principle of both tests is to cause a shear between the (thickened) APL and EPB and the pulley/bony floor of the first compartment (arrows).
EPB, extensor pollicis brevis, APL, abductor pollicis longus.

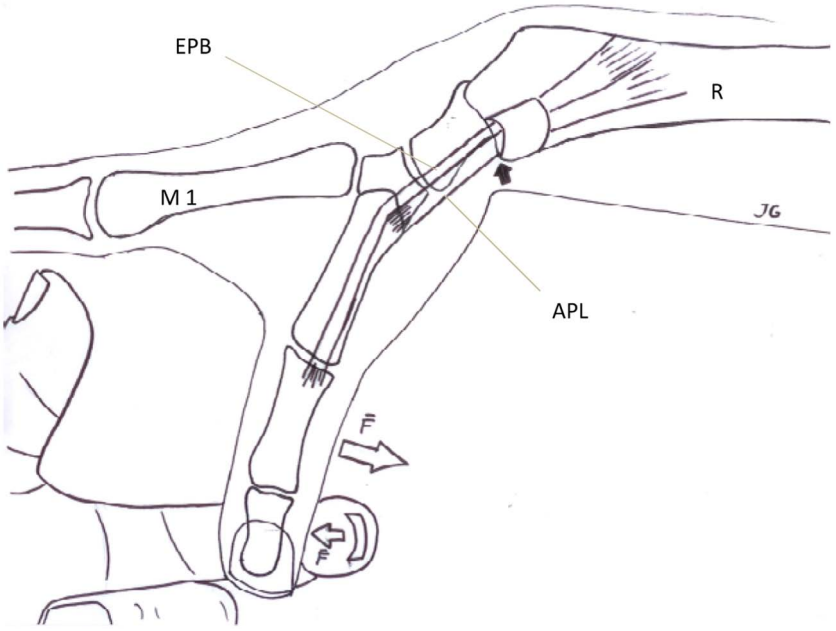

Figure 5. Illustration of the mechanism of the WHAT test. APL and EPB actively contracted cause shear stress on the inferior palmar border of the pulley (arrow) of the first extensor compartment giving a painful exacerbation in the initial stage of de Quervain tenosynovitis.
EPB, extensor pollicis brevis, APL, abductor pollicis longus.

deviation test) do not reveal (Figure 7). This was seen in four patients with persistent pain who had previously been operated on elsewhere, who had a normal Eichhoff's test result with no tendinitis, but during the WHAT test all revealed a clear subluxation of the tendons of the first extensor compartment. Comparative ultrasound in the WHAT test position confirmed this diagnosis, which was missed during ultrasonography in a functional position.

While this result on a small number of patients should be viewed with caution, with further research on a greater number of subjects the WHAT test may have the potential to become the preferred choice when needing to identify the presence of persistent pain around the first compartment owing to a subluxation of the APL and EPB following surgical release of the sheath of the first compartment in de Quervain tenosynovitis.

While we acknowledge that our study is limited in that it is a single centre involving only two experienced consultant hand surgeons, we believe that our results begin to suggest that the WHAT test may offer a more

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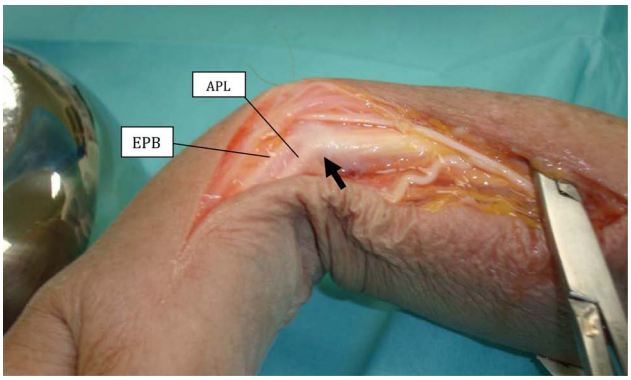

Figure 6. Cadaveric dissection: tensioning of the APL and EPB resulting in a clear shear (arrow) of the tendons at the palmar border of the first extensor compartment.
EPB, extensor pollicis brevis, APL, abductor pollicis longus.

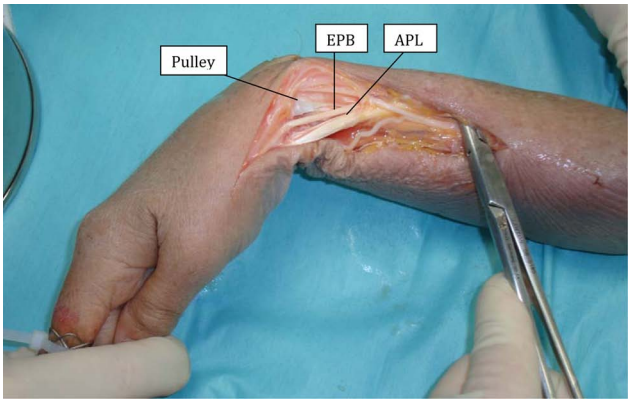

Figure 7. Cadaveric dissection: after opening of the first extensor compartment (pulley) and performing the WHAT test (see text) clear dislocation of the tendons of the first extensor compartment (compared with the situation in Figure 6).
EPB, extensor pollicis brevis, APL, abductor pollicis longus.

precise tool for the diagnosis of de Quervain's tenovaginitis and thus add a new approach to further advance clinical diagnosis in the early stages of de Quervain syndrome.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interests

None declared.

Acknowledgements

The Authors would like to thank Kim Jones PhD and Malcolm Forward Ir. PhD for their help in the preparation of this article and review work. Thanks to Sofia Pensaert for the corrections and verifications of the text.

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