RESEARCH ARTICLE

Accuracy of the Pisiform Boost Test for the Diagnosis of Triangular Fibrocartilage Complex Tears in the Wrist - Pisiform Boost Test

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Abstract

Background: A retrospective study was conducted to evaluate the diagnostic accuracy of a novel examination technique, the 'Pisiform Boost Test,' in diagnosing a triangular fibrocartilage complex (TFCC) tear.

Methods: Wrist arthroscopies performed between 2011-2021 were retrospectively reviewed. Patients' clinical records were evaluated to determine the result of the Pisiform Boost Test during clinical examination and TFCC tear within the body of the TFCC as seen at wrist arthroscopy. The Pisiform Boost Test is performed by first assessing for ulna fovea pain on passive ulna deviation of the wrist and then assessing pain while the clinician applies digital pressure over the pisiform and passive ulna deviation.

Results: The pisiform Boost test was found to have a Sensitivity of 91% (95% CI, 81 – 97%) and a Specificity of 33% (95% CI, 14-59%) for the diagnosis of TFCC tears. Positive predictive value of 83%, a negative predictive value of 50%, and an accuracy of 78%. A chi-square test of independence was performed to examine the relation between a Positive Pisiform Boost Test and an arthroscopy-confirmed TFCC tear. The relation between these two variables was statistically significant, x2 (1, N = 82) = 6.4551, *P=.011064*.

Conclusion: The Pisiform Boost Test demonstrates high sensitivity for TFCC tears (0.91). Specificity (0.33) is similar to that in the ulnar grinding test. Therefore, we propose this test be utilized with additional special tests for ulna-side wrist pain to allow clinicians to build a diagnostic picture, aiding decision-making and patient information.

Level of evidence: IV

Keywords: Clinical examination, Triangular fibrocartilage complex, Wrist injury, Wrist pathology

Introduction

The Triangular Fibrocartilage Cartilage (TFCC) is a complex soft tissue structure in the wrist that is vulnerable to injury. It consists of a central articular disc, originating at the sigmoid notch of the radius and insert into the base of the ulnar styloid, with superficial fibers inserted into the ulnar styloid and deep fibers inserted into the ulnar fovea. The function of the disc is to act as a shock absorber in the ulna carpal joint, similar in tissue type and function to the menisci in the knee. Further, it is a load-bearing structure, supporting the carpus at the ulna side of the wrist. The peripheral attachment of the TFCC and the associated ligament structure (dorsal and volar radioulnar ligaments, ulnar collateral ligament, ECU sub sheath) stabilize the distal radioulnar joint.[1–4]

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Injuries to the hand and wrist are common in sports, with 9% to 25% of injuries involving the hand and wrist.[5–8] Damage to the TFCC is a common cause of ulnar-sided pain and disability of the wrist experienced in functional grip and rotation of the wrist, which can mainly affect sports players' use of racquets, bats, or golf clubs. TFCC injuries can be secondary to one specific trauma or chronic degeneration of the TFCC disc. In the acute setting, tears of the TFCC specifically can occur when the wrist is in hyperextension, pronation, and ulnar deviation, with axially loading. Patients complain of deep aching pain, pain with gripping, and sometimes mechanical symptoms of clicking with pronation/supination movement. The injury thus affects many functional tasks, including the need for grip and rotational loading.[4,6,9,10] Further, the ability to weight bear through the wrist, as 18% of the load is transferred across the ulna side, and TFCC will be reduced following a TFCC tear, which will affect daily function tasks such as driving as well as gymnasts and other such athletes.[11] Classification of TFCC injuries uses the Palmar classification, differentiating the two cohorts of Traumatic (Class 1) vs. Degenerative (Class 2).[12] The diagnosis of TFCC injury can present a diagnostic challenge, but early diagnosis is required with reliable healing and expeditious return to sport for the athlete. The gold standard investigation of choice is with Magnetic Resonance Imaging and diagnostic arthroscopy, which also allows for treatment of TFCC tear once confirmed.[13–15] However, accurate examination special tests in the clinic are essential to direct further investigations and appropriate use of resources.[3,5,6]

TFCC tear typically presents with ulnar-sided wrist pain; however, many other pathologies may show similar symptoms.[3,4,6,7,9,16,17] Therefore, the cause of ulna-sided wrist pain can be challenging to diagnose on clinical examination. Many clinical examination techniques have been described in the literature to assess TFCC pathology, specifically through provocation tests with varying diagnostic accuracy reported. The commonly used special tests in the context of TFCC tears include the TFCC stress test, TFCC compression test, press test, ulnar fovea test, TFCC Toggle, and Grind test.[6,13,18–20] When examining for TFCC tear, the 'fovea' sign is often used. This involves an examination of the wrist by palpation of the soft area between the ulnar styloid and FCU tendon, between the ulnar head and the pisiform.[19]

The authors present a novel examination 'special test' which aims to assess specifically for a TFCC tear. No previous test for TFCC has involved the pisiform. The authors describe the Pisiform Boost test with the hypothesis for why this would be a beneficial addition to the clinical examination of the wrist.

Materials and Methods

A retrospective review was conducted using patient details gathered from a single consultant hand and wrist surgeon's secure database of all wrist arthroscopies from 2011 to 2021. These patients were planned for an arthroscopy to diagnose and treat wrist pain for various suspected intra-articular pathologies. MRI (magnetic resonance imaging) scans were performed on the cohort of patients. Those with other extra-articular causes for wrist pain were treated accordingly and did not proceed to wrist arthroscopy.

The patient's pre-operative medical notes were reviewed to include patients whose clinical examination had a pisiform boost test, and whether this was positive or negative was noted. The intra-operative arthroscopy findings of the presence or absence of TFCC pathology were reported. Pathology encompassed central and peripheral TFCC tears. P values were calculated using the chi-square test, with P values < 0.05 considered significant. Confidence intervals were calculated using the Clopper-Pearson test.

Pisiform Boost Test Technique

Before conducting a Pisiform Boost test, pisiform triquetrum pathology, most commonly osteoarthritis, must be excluded as the cause of the patient's ulna-sided wrist pain. Thus, a pisotriquetral grind test is performed and should be negative 21. Pisiform boost test is performed by first assessing for localized ulna fovea pain on passive ulna deviation of the wrist and then assessing pain while the clinician applies digital pressure over the pisiform and passive ulna deviation. Minimal pain on passive deviation alone but acute, localized pain with digital pressure is considered a positive test result. The technique is outlined in [Figure 1]. If an MRI scan is completed, the absence of

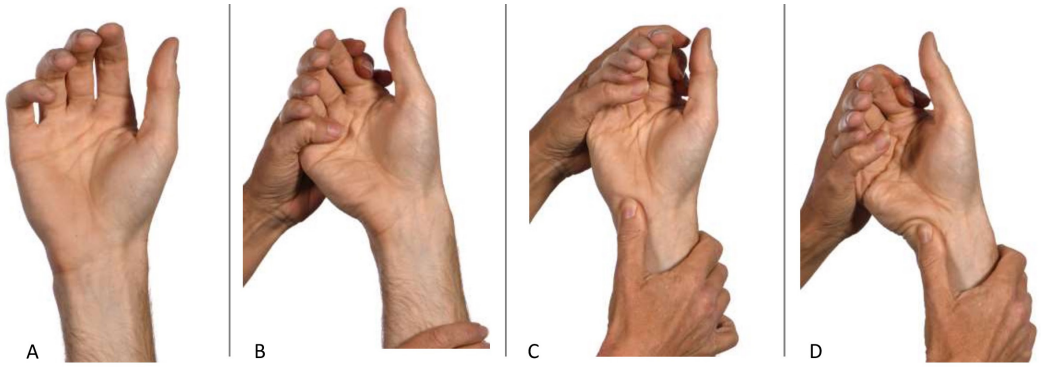

Figure 1. Pisiform Boost Test Technique. A) Patient position. B) Testing for localized ulna fovea pain on passive ulna deviation of the wrist. C) Clinician applying digital pressure over the pisiform. D) Passive ulna deviation while applying digital pressure over the pisiform.

pisiform-triquetral joint OA should further be excluded.

Results

Patient Cohort

A total of 184 patients had wrist arthroscopies performed between 2011 to 2021. 82 out of 184 patients complained of ulna-sided wrist pain and had a Pisiform Boost Test documented in their clinical notes; these were included in the study. An arthroscopy finding of central and peripheral tears of the TFCC was considered positive. Age ranged from 17-72, with a median age of 50. 68% of patients were male, and 32% were female.

Pisiform Boost Test

The number of true positives for the Pisiform Boost test in the presence of arthroscopy-confirmed TFCC tears was 58 out of 82 patients (70%). The rate of false positives was 12 out of 82 patients (15% of cases). 6 out of 82 were true negative (7%), and 6 out of 82 were false negative (7%). [Table 1]

The pisiform Boost test was found to have a sensitivity of 91% (95% CI, 81 – 97%) and a specificity of 33% (95% CI, 14-59%) for the diagnosis of TFCC tears. Positive predictive value of 83% (95% CI 78-87%), negative predictive value of 50% (95% CI 27-74%) and accuracy 78% (95% CI 68-86%), [Table 2]. A chi-square test of independence was performed to examine the relation between a positive Pisiform Boost Test and an arthroscopy-confirmed TFCC tear. This confirmed that the relation between these two variables was statistically significant, x2 (1, N = 82) = 6.4551, *P = .011064*.

Of the 58 patients with positive pisiform boost test and arthroscopy confirmed TFCC pathology, 42 patients were confirmed to have an isolated central TFCC tear and five peripheral TFCC tears.

Concurrent wrist pathology in True Positive cases

In some cases, patients examined with a positive pisiform boost test and found to have a TFCC tear on arthroscopy were found to have concurrent wrist pathology.

One patient was found to have a TFCC central tear in addition to a full-thickness scapholunate ligament tear in one patient who was examined with a positive pisiform boost test. A further 2 cases were found to have associated capsular synovitis and degenerative changes, and an additional 1 case noted associated ulnar recess synovitis.

Concurrent wrist pathology in False Positive cases

A total of 12 cases were false positives, meaning the patient was examined clinically as a positive pisiform boost test but was found to have no TFCC pathology on wrist arthroscopy. 33% of these cases failed to identify any concurrent wrist pathology on arthroscopy. Of the remaining 66% of these cases with normal TFCC on arthroscopy, additional findings were noted, such as dorsal adhesions, dorsal ulnar synovitis, ulnar recess synovitis, and fibrous tissue in the ulnar carpal joint. One case identified damage to the articular cartilage of the distal radius consistent with a previous distal radius

Table 1. Two by Two Table of TFCC tears with the Pisiform Boost Test

	Positive Pisiform Boost Test	Negative Pisiform Boost Test	Total
TFCC tear	58 [0.21]	6 [1.21]	64
TFCC no tear	12 [0.74]	6 [4.3]	18
Total	70	12	82
	Sensitivity	**Specificity**	
	91%	33%	

[the chi-square statistic for each cell] N=82

The chi-square statistic is 6.4551. The p-value is .011064. Statistically significant at p < .05.

Table 2. A four-fold table of the Pisiform Boost Test

	Pisiform Boost Test				
	Positive	**Negative**			
TFCC	Tear	True Positive 58	False Negative 6	Sensitivity	91%
	No Tear	False Positive 12	True Negative 6	Specificity	33%
	Positive Predictive Value	Negative Predictive Value			
	83%	50%			

Table 3. Summary of literature results of TFCC clinical tests

	Test for TFCC Tear	Sensitivity	Specificity
Andersson (2015)	**Clinical Tests**	**NPV 55%**	
Lester (1995)	Press Test	100%	-
Lindau (2000)	DRUJ Ballottement	59%	96%
Schmauss (2016)	Ulna Grinding Test	90%	20%
Tay (2007)	Ulnar Fovea test	95%	87%
Schmauss (2016)	Ulnar Fovea test	73%	44%
This study	Pisiform Boost Test	91%	33%

[13,18–20,26]

fracture. Of note, none of these pathologies would be expected to be seen on an MRI scan.

Concurrent wrist pathology in False Negative cases

Of the 6 cases found to have a TFCC tear on arthroscopy with a negative pisiform boost test, one was found to have an associated scapholunate ligament instability, and the remaining 5 cases were found to have an isolated central TFCC tear.

Discussion

Assessment of ulna-sided wrist pain can be complex and poses diagnostic challenges for clinicians. A variety of clinical examinations have been described in the literature to assess for TFCC pathology with differing diagnostic accuracy reported. The commonly utilized examination special tests have been reported in the literature to hold high sensitivity for TFCC pathology; however, many appear to lack specificity.[13,18–20,22]

Lester et al. described the "press test" creating an axial ulnar load and reported a 100% sensitivity for TFCC tear at the wrist.[20] Nakamura et al. (1997) reported the ulnocarpal stress test as sufficiently sensitive to ulnar-sided wrist pathology.[23] However, Prosser et al. found that the ulnocarpal stress test and ulna grinding test are of poor diagnostic value.[22] The fovea test has demonstrated a 95% sensitivity and 87% specificity for foveal disruption of the TFCC or ulnotriquetrial ligament injuries.[19] Schmauss et al. compared the ulnar fovea sign and the ulna grinding to diagnose a TFCC tear.[18] Ulnar fovea sign was found to have a sensitivity of 0.73, specificity of 0.44, PPV of 0.53, and NPV of 0.66, and the ulna grinding test had similar findings of sensitivity of 0.90, specificity of 0.20, PPV of 0.54 and NPV had 0.65.18

We report the Pisiform Boost Test as a simple examination technique that can aid clinicians in assessing patients with wrist pain. This test is not described in the literature, differing from the alternative special tests currently well recognized. This study has analyzed the use of the Pisiform Boost Test in our unit over several years, demonstrating that it has a high sensitivity for TFCC tears (0.90). Although the specificity result was low (0.33), it is higher than the specificity reported for the ulnar grinding test (0.20), a commonly used test for TFCC pathology.18 Our novel examination test can be used with similar diagnostic accuracy as the widely used tests in the clinical setting.[18] Therefore, we propose this test be utilized in conjunction with the additional special tests and investigations to allow clinicians to build a diagnostic picture, aiding their decision-making and patient information.

The patient cohort in this study was gathered using a single surgeon's database in one unit, yielding limited numbers. The number of results used to calculate negative predictive value and specificity was particularly low in this study and thus should be interpreted cautiously. However, as this study suggests that the clinical test is useful, a larger patient cohort could be gathered by training colleagues in the unit and other centers on using this clinical test and repeating the study. This further work should also assess the inter-observer error of the test. However, the test is simple and easy to perform. Another limitation of this study was the lack of documentation of the result of the pisiform boost test in all the patients' notes. Within the patient cohort, 102 out of 184 did not appear to have documentation of the test being performed in the clinic. This seems to be a multifactorial limitation, including the participation of trainees in the clinical environment, alternative diagnostic suspicion (for example, lack of ulna-sided wrist pain), referrals made from colleagues, or patients reviewed following an investigation with MRI, which confirmed the diagnosis. All of which led to the pisiform boost test either not being performed or not documented.

A future area of research with a larger patient cohort would be to assess the pisiform boost test's ability to distinguish between central and peripheral TFCC pathology. This could aid diagnostic accuracy and allow patients to be managed appropriately. This research has not been successful in determining the accuracy of the test with central vs. peripheral tears due to limited documentation and a small cohort.

Andersson reports clinical provocation wrist tests for TFCC pathology to be of limited diagnostic value, with 55% negative predictive value and low sensitivity and specificity.[13] Prosser et al. found that using provocation tests for TFCC tears was 'not useful'; however, the incremental diagnostic value of adding MRI was statistically significant.[22] Magnetic resonance imaging for the diagnosis of TFCC tears has historically held a sensitivity of 79%. However, this has improved in recent years to MRI providing 94.4% sensitivity and 100% specificity.[14] Our unit has reported the additional benefit of noting the presence or absence of a distal radial joint effusion in diagnosing a TFCC tear on an MRI Scan.[21] Technological advances allow MR Arthrography to diagnose TFCC tears with higher diagnostic accuracy. Nonetheless, clinical examination remains the mainstay of primary assessment of patients with ulnar wrist pain upon presentation to the clinic as it directs the best use of resources in considering radiology imaging.

Several clinical examination techniques and special tests have been described in the literature to aid the diagnosis of a suspected TFCC tear.

Press Test

Lester et al. described the "press test" creating an axial ulnar load and reported a 100% sensitivity for TFCC tear at the wrist.[20] Lester did not comment upon the specificity; we suspect it would be low as several wrist pathologies are likely to cause pain with 'loaded wrist extension' as applied in this test. The press test creates an axial ulnar load by the seated patient pushing their body weight up off a chair using the affected wrist; a positive test provoked focal ulnar wrist pain.[20] Lester et al. have not documented the specifics of this test, and further, these results are from a single surgeon describing and assessing the test and thus may be limited.

Ulnar Fovea Sign

The Ulnar Fovea Sign was described by Tay et al. as ulnar-sided wrist tenderness in the fovea, which is the depression between the ulnar styloid base and flexor carpi ulnaris tendon.19 They demonstrated a 95% sensitivity and 87% specificity for foveal disruption of the TFCC or ulnotriquetrial ligament injuries with this test [Table 3]. The authors state that foveal disruption of the TFCC, as compared to the ulnotriquetrial ligament, can be differentiated depending on the stability of the distal radial ulna joint. However, the ulna fovea sign could not distinguish between them. Thus, the ulnar fovea sign is not specific for diagnosing TFCC pathology, and it should be noted that the two pathologies it diagnoses have different treatments. Schmauss et al. (2016) analyzed the ulnar fovea sign for the diagnosis of TFCC tear and found it to have a sensitivity of 0.73, specificity of 0.44, PPV of 0.53, and NPV of 0.66.18 These results are similar to our test. However, sensitivity (0.90) and PPV (0.83) were higher with the pisiform boost test, and specificity (0.33) and NPV (0.50) were higher with the ulnar fovea test [see Table 3].

Ulnocarpal Stress Test

The ulnocarpal stress test was first described by Hertling and Kessler in their book, with the wrist in ulnar deviation while applying a shear force across the ulnar complex of the wrist.[24] Nakamura et al. reported that the ulnocarpal stress test was sufficiently sensitive to ulnar-sided wrist pathology, with all 45 patients in their study having a positive ulnocarpal stress test having intraarticular pathology.[23] These authors concluded that the ulna carpal stress test is a useful screening test. However, the limitation in studies such as the Nakamura study is that this conclusion has been based on a small patient cohort.

Ulna Grinding Test

The ulnocarpal stress test has been modified with the addition of axial compression and renamed the ulna grind test. Prosser et al. assessed the use of both the ulnocarpal stress test and the ulna grinding test. If either test were positive, they considered it a positive test for TFCC pathology.[22] Their study diagnosed a TFCC tear correctly in 73% of cases. However, the likelihood ratio was less than 2, leading to their conclusion that the provocative test was useless. Schmauss et al. compared the ulnar fovea sign and the ulna grinding to diagnose a TFCC tear. The ulna grinding test also gave the same sensitivity as our pisiform boost test (0.90) but lower specificity (0.20) and PPV (0.54).18 [Table 3].

As described in this study, the pisiform boost test demonstrates high sensitivity and positive predictive value for a TFCC tear, like alternative examinations currently ingrained in clinical practice. Our results found a statistically significant relationship between a positive pisiform boost test and a TFCC tear at arthroscopy test. A larger cohort of patients with assessment using the pisiform boost test would improve the reported rates of specificity and negative predictive value of the test. However, as the results are comparable with the results of other clinical tests for TFCC pathology for both specificity and sensitivity, it is a reliable, simple test for clinicians to include in their repertoire of clinical assessment of patients with suspected wrist pathology and ulna-sided wrist pain. Pisiform Boost Test has been added to our clinical assessment of wrist patients, and further studies are planned to detail this test's diagnostic accuracy.

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