

The Twist X-Ray: A Novel Test for Dynamic Scapholunate Instability

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Abstract

Background Scapholunate instability (SLI) is the most common form of carpal instability. Early detection of SLI is imperative as early reconstructive procedures can potentially prevent the natural history of progressive degenerative arthritis. After wrist arthroscopy, magnetic resonance imaging (MRI) remains the next best noninvasive diagnostic option; however, access still remains costly and is often limited in many health care systems worldwide. In this article, we describe a novel device that allows for dynamic X-rays to be taken, accentuating the scapholunate (SL) widening.

Description of Technique Twist X-ray views are generated by the patient clenching a device that combines the standard clenched fist views with ulnar deviation and supination. The test is easy to perform and functions by combining a higher grip force with the ulnar deviation and pronation effects of the extensor carpi ulnaris tendon, thus accentuating the SL gap in dynamic instability.

Patients and Methods We present a series of four patients with dynamic SLI and compare the findings of the Twist X-rays with conventional wrist X-rays series, including standard anteroposterior, lateral, radial, and ulna deviation, clenched fist, and pencil grip views.

Results In all the four patients, there was substantial dynamic SL widening. The SL interval increased from a mean of 1.8 mm (range: 1.5–2.8) on posteroanterior X-rays to 6.3 mm (range: 4.6–8.2) with the Twist views. Interestingly, on the pencil grip view, the mean widening was only 1.5 mm (range: 1–2.8 mm).

Conclusion The authors describe a novel device that allows for improved detection of dynamic SL ligament instability when performing stress X-ray views of the wrist.

Level of Evidence This is a Level IV study.

Keywords

- ▶ scapholunate instability
- ▶ X-ray
- ▶ wrist
- ▶ scapholunate ligament
- ▶ scapholunate advanced collapse
- ▶ arthritis

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Scapholunate instability (SLI) is the most common form of carpal instability.¹ Early detection of SLI can direct patients toward a scapholunate stabilizing procedure and potentially prevent the development of scapholunate advanced collapse. After wrist arthroscopy, the gold standard non-invasive test is a 3T magnetic resonance imaging (MRI) scan, which has a sensitivity in the order of 80 to 90% and a specificity of 100%.^{2,3} However, to date, MRI still remains costly and access is often limited in many public health care systems.

Early scapholunate ligament instability is often occult on static wrist X-rays unless there is more severe pathology and the secondary stabilizers have been disrupted.¹ Dynamic stress views are frequently used to increase the sensitivity of detection of this condition.⁴ The current standard X-ray series for assessing SLI is the posteroanterior (PA), oblique, lateral, and the dynamic clenched fist views. Radial and ulnar deviations in a static position can also be performed, but they have not shown to be of specific value.⁴

Here we describe a novel device that aims to accentuate the scapholunate interval by combining the clenched fist position with ulna deviation, increased grip force, and supination. We demonstrate its use in a small series of patients with dynamic SLI and compare the results with standard stress wrist views. Our hypothesis is that this device will be able to provide a series of X-rays, which we have called the “Twist views,” which will increase the detection of dynamic scapholunate ligament instability of the wrist.

Patients and Methods

The Device and the Twist Views

The Twist device prototype was designed by two of the coauthors (T. G. and A. H. R.). It consists of a circular disc that is approximately 10 cm wide and 3 cm thick, akin to a Vegemite or peanut butter jar sized lid. This is mounted to a bar, which is stabilized by the patient’s other hand, to allow sufficient twisting force to be applied without the device moving (►Fig. 1A, B). The radiographer positions the patient’s wrist and then instructs the patient to twist the disc, similar to opening a jar. X-rays are routinely taken with the wrist position in a neutral position.

As the disc is larger than a pencil and sits comfortably within the palm, this allows the patient to increase the force they apply to the device, thus increasing the force that drives the capitate into the disrupted scapholunate interval.⁵ Ulnar deviation accentuates the scapholunate gap by driving the scaphoid along the scaphoid fossa radially, away from the lunate. The wrist is positioned in supination to harness the force of extensor carpi ulnaris as a distal carpal pronator and further accentuate the scapholunate gap.⁶

The Twist views, which we have developed, are stress X-ray views that combine the clenched fist view with ulnar deviation, increased grip force, and supination. This device was designed to reproduce the common patient complaint of pain when trying to open a jar or turning a doorknob. The test is easy to perform and appears to accentuate dynamic SLI.

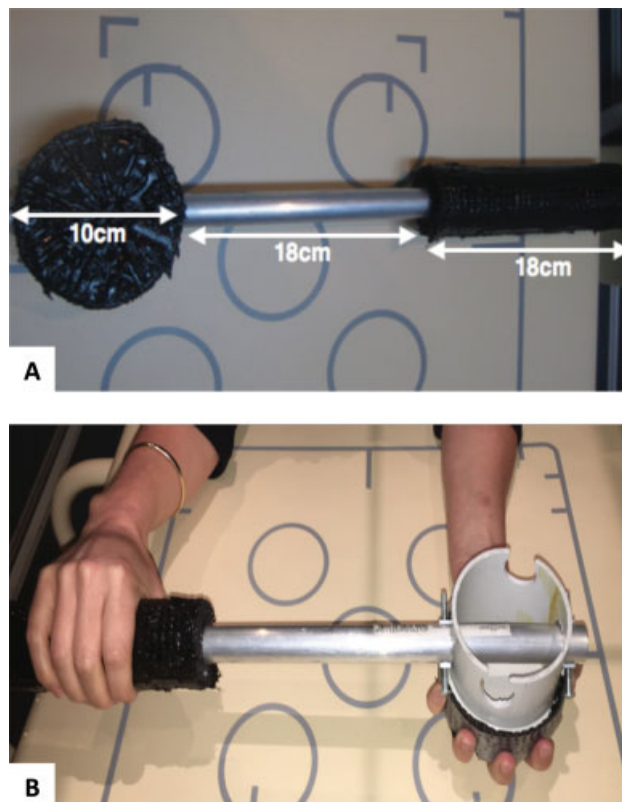


Fig. 1 (A) Dimensions of the Twist device. (B) The patient clenches the circular disc with the affected wrist in the supinated position and uses the contralateral hand to provide a counterforce when performing either radial or ulna deviation.

Patients

A series of four patients who presented to our institution with clinical features consistent with an injury to the scapholunate ligament and dynamic SLI is presented. The mean age of the patients was 36 years (range: 29–40) and all were male. Each patient had a history of prior trauma to the affected wrist, with pain over the dorsal side on palpation and on provocative maneuvers. The mean time from index injury was 6.5 months (range: 1.5–15). All the four patients demonstrated a positive Watson’s shift test consistent with dynamic SLI.

All the four patients underwent a standard wrist X-ray series in addition to the Twist X-ray views. These included PA, lateral, radial, and ulna deviation wrist X-rays and the pencil grip view.

The X-rays were digitized, and measurements of the scapholunate interval were analyzed on PACS (Picture Archiving and Communications System). The scapholunate interval was assessed by a musculoskeletal radiologist (A. H. R.) in a standard fashion by measuring the distance between the scaphoid and lunate at the midpoint of the joint.⁴

Results

The mean scapholunate interval distance on the PA X-rays was 1.8 mm (range: 1.5–2.8). With the Twist X-rays, the scapholunate gap increased substantially to 6.3 mm (range: 4.6–8.2). (►Figs. 2–5). Interestingly, on the pencil grip view, the mean

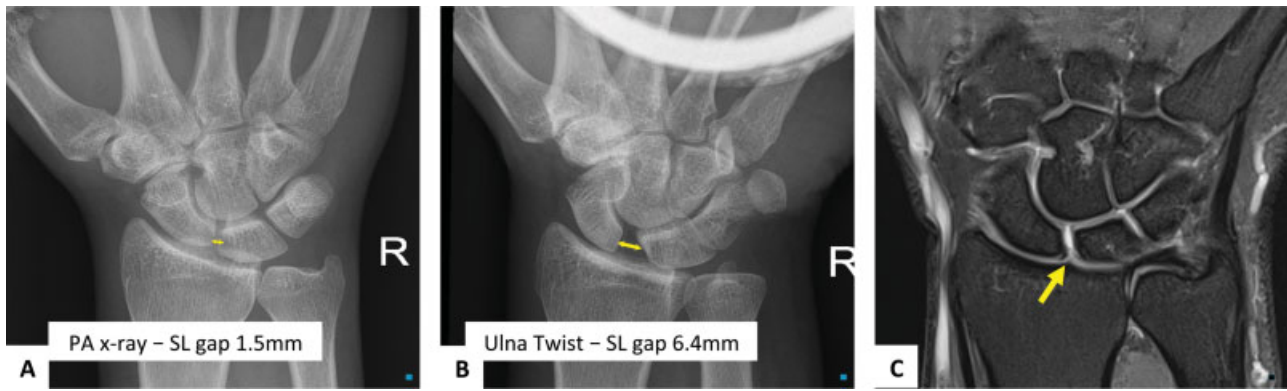


Fig. 2 Patient 1: a 39-year-old male who presented with right dorsal wrist pain over the scapholunate interval and episodic wrist clunking sensations after a hyperextension injury to the wrist. Watson’s test was positive. (A) Posteroanterior neutral wrist X-ray. (B) Ulna Twist X-rays. (C) magnetic resonance imaging (MRI) scan confirming complete scapholunate ligament tear.

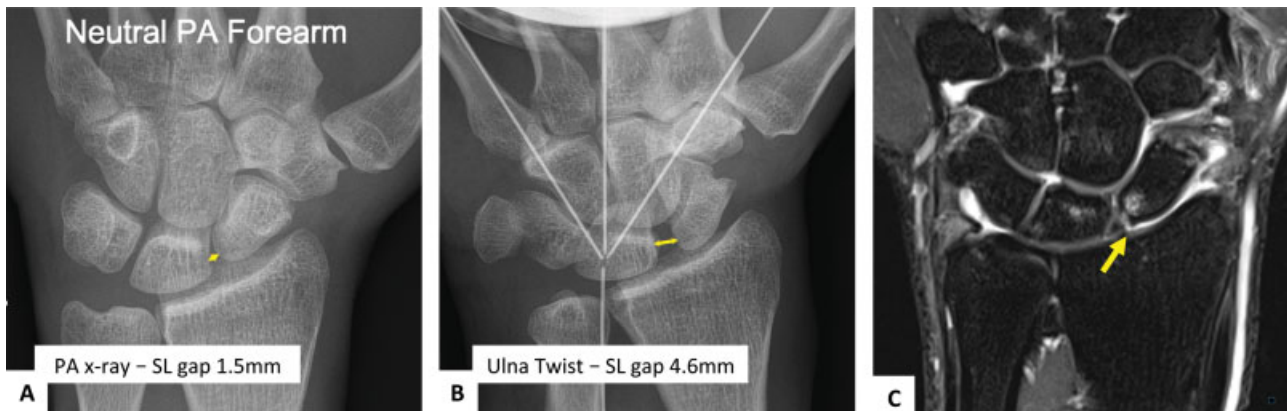


Fig. 3 Patient 2: a 36-year-old male who presented with 3 months of left wrist pain after a fall from a motorbike. The patient had tenderness over the scapholunate (SL) interval with a positive Watson’s test. (A) Posteroanterior neutral X-ray demonstrating normal SL alignment (1.5 mm). (B) Ulna Twist X-ray demonstrating an abnormal SL interval of 4.6 mm. (C) Coronal proton-density fat-saturated image demonstrating a full-thickness tear of the membranous SL ligament at the scaphoid attachment (arrow).



Fig. 4 Patient 3: a 29-year-old male fencer who presented with 15 months of right wrist pain after a lunge with the wrist hyperflexed. The patient had tenderness over the scapholunate (SL) interval and a positive Watson’s test with an associated clunking/cracking sensation. (A) Posteroanterior neutral X-ray and (B) clenched fist X-ray showing normal SL gap. (C) Ulna Twist X-ray demonstrated a markedly widened SL interval of 8.2 mm.

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Fig. 5 Patient 4: a 39-year-old male who presented 6 weeks after a fall onto an outstretched right hand with pain over the dorsal side of the wrist and a positive Watson's test. (A) Neutral X-ray demonstrating a scapholunate (SL) interval of 2.8 mm. (B) Clenched fist X-ray showed a widened SL interval of 4.1 mm. (C) Ulna Twist X-rays demonstrated marked widening of SL interval of 6 mm.

widening was only 1.5 mm (range: 1–2.8 mm). Only two of the four patients had a clenched fist view taken, which measured 2 and 4.1 mm, respectively. This compared with 8.2 and 6 mm, respectively, in their Twist X-rays (► **Table 1**).

Three of the four patients had subsequent MRI scans, all of which confirmed a complete tear of their scapholunate ligament. The one patient who did not undergo MRI underwent an ultrasound scan, which also confirmed a complete scapholunate ligament tear.

Discussion

Various dynamic tests have been described to improve the detection of scapholunate ligament injuries.^{4,7,8} The clenched fist view has been an important addition to the armamentarium of X-ray views used to diagnose dynamic SLI.⁸ The view accentuates the scapholunate gap secondary to the scapholunate ligament incompetence by driving the capitate proximally into the disrupted interval. Unfortunately, it can be challenging to standardize the view due to variability in wrist position and difficulty in controlling the degree of grip strength.⁸

Moneim described a modification of the clenched fist view.⁹ By elevating the hypothenar eminence 20 degrees on a foam block, the bone overlap is limited, allowing more

accurate evaluation of the scapholunate interval. Following on from that concept, Lawand and Foulkes reported their use of the “clenched pencil” view that combined the mechanism of the clenched fist view with the optimal pronation angle advocated by Moneim.^{8,9} Additionally, the view imaged both wrists for comparison, helping to rule out congenital laxity. In a study by Lee et al, of all the various dynamic tests, they showed that the PA clenched pencil view consistently demonstrated the widest scapholunate gapping in the setting of dynamic SLI, especially at 30 degrees of ulna deviation.⁴ In a further study by Patel et al, they compared multiple views including PA neutral, PA ulnar deviation, and PA clenched fist and showed that PA ulnar deviation and clenched fist were equal in detecting dynamic SLI.⁷ Unfortunately, in that study, the method to perform the clenched fist view was not described.

The sensitivity and specificity of high-resolution noncontrast MRI scan for the detection of scapholunate ligament tears have been reported to be in the order of up to 88% and 100%, respectively.^{2,3,10} Unfortunately, MRI scans are an anatomical static evaluation giving limited information about dynamic function, therefore giving rise to potential false-negative results.¹⁰ While wrist arthroscopy allows for both anatomical and functional evaluation and is, to date, the gold standard for evaluation of dynamic SLI, it is an invasive procedure that invariably carries some degree of risk.¹¹ But,

Table 1 Scapholunate interval measurements

Patient	Side	PA	Radial deviation	Ulnar deviation	Pencil grip	Clenched fist	Radial twist	Ulnar twist	MRI
1	Right	1.5	1	2.4	2.8	NP	4.2	6.4	Complete SL tear
2	Left	1.5	2.5	1	1	NP	3.4	4.6	Complete SL tear
3	Right	1.5	1	1	1.3	2	1.3	8.2	NP (U/S confirmed)
4	Right	2.8	1.5	1.5	1	4.1	2	6	Complete SL tear
Mean		1.8	1.5	1.5	1.5	3.1	2.7	6.3	

Abbreviations: DEV, deviation; MRI, magnetic resonance imaging; NP, not performed; PA, posteroanterior; SL, scapholunate; U/S, ultrasound. Note: All measurements are in millimeters.

on the other hand, less invasive tests such as MRI scan, which are highly specific, are costly and only reveal static anatomical abnormalities without functional evaluation.

As such, the development of this simple and novel device has great potential in augmenting the current diagnostic armamentarium, especially in resource poor communities. We believe that the Twist device reproduces the mechanics of the clenched fist and dynamic ulna deviation views, which is most often the position in which patients with scapholunate pathology complain of their symptoms. Although not proven biomechanically, we hypothesize that the Twist device works by increases the proximally directed forces that drive the capitate into the disrupted scapholunate interval. With ulnar deviation, this increases the scapholunate gap by pushing the scaphoid radially, thus distracting it away from the lunate.⁵ In addition, as previously described, with wrist positioned in supination, the extensor carpi ulnaris acts as a distal carpal pronator, further accentuating the scapholunate gap.⁶

In this study, we found that the Twist X-rays demonstrated substantially greater gapping of the scapholunate interval when compared with the clenched fist and pencil grip views. Furthermore, the majority of the pencil grip measurements were within normal limits (less than 2 mm) despite there being clear disruption of the scapholunate ligament. We do appreciate that one of the major limitations of this study is the small number of patients in the series. Hence, it would, therefore, be of interest to conduct a larger prospective comparative study comparing the Twist X-ray to other dynamic tests and ultimately MRI scan and wrist arthroscopy to determine its sensitivity and specificity, as well as its positive and negative predictive values.

Conclusion

The Twist X-ray series is an easy and relatively inexpensive study to perform, which accentuates dynamic scapholunate. From our experience, the increased scapholunate widening seen on the Twist views has correlated positively, both clinically and with MRI results. However, further prospective studies are necessary to further evaluate the Twist X-ray

series in comparison to standard static and dynamic views, as well as MRI and ultimately wrist arthroscopy.

Ethical Approval

The ethical approval was granted by Avenue Hospital Human Ethics Approval, Trial No. 199 (29/4/16).

Conflict of Interest

None.

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