

## Validity of tap test in diagnosis of syndesmotic injury

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### Abstract

**Background:** Management of the distal tibiofibular syndesmosis remain controversial area in the treatment of ankle fractures. The distal tibiofibular syndesmosis consists of a complex ring of ligaments and the interosseous membrane that maintain the relationship of the tibia and fibula at the ankle mortise. Disruption of these ligaments can lead to late instability, pain, and arthrosis.

**Aim of the work:** to evaluate the efficacy of intraoperative test for syndesmotic disruption including hook test and tap test and compare it with preoperative MRI diagnosis.

**Patients and Methods:** We conducted a comparative study on patient with ankle fractures treated with open reduction and internal fixation and evaluated for syndesmotic disruption intraoperative with both hook test and tap test after fracture fixation. The study was carried out on 20 patients attending to orthopedic department in Benha university hospital and Al Helal Hospital from November 2022 to May 2023 after approved by the ethical committee of faculty of medicine, Benha University.

**Results:** The study include 20 patients, the mean age of the studied patients was 36 years. Regarding gender, there was a male predominance; about two-thirds of the studied patients were males (60.0%). More than one-third of the studied patients were from rural areas (40.0%). Also, more than one-third (40.0%) were smokers. Syndesmotic disruption was detected in twelve patients by pre-operative MRI. Hook test was positive in (83.0%) of patients diagnosed for syndesmotic disruption by preoperative MRI, while tap test was positive in all patients diagnosed for syndesmotic disruption by preoperative MRI (100.0%).

**Conclusion:** Obtaining an accurate syndesmotic reduction is critical to avoiding the significant morbidity that can be associated with malreduction. Anatomic reduction of the fibula and syndesmosis has been associated with improved short musculoskeletal function assessment functional outcome scores, whereas malreduction leads to instability and arthritis. This study provide detection of sensitivity of the Hook and Tap tests for detection of syndesmotic instability in relation with preoperative MRI.

**Keywords:** Validity, Tap test, syndesmotic injury.

### INTRODUCTION

Management of the distal tibiofibular syndesmosis remain controversial area in the treatment of ankle fractures<sup>(1)</sup>.

The distal tibiofibular syndesmosis consists of a complex ring of ligaments and the interosseous membrane that maintain the relationship of the tibia and fibula at the ankle mortise. Disruption of these ligaments can lead to late instability, pain, and arthrosis<sup>(2,3)</sup>.

Anatomic reduction is required to obtain satisfactory results; however, the amount of diastasis that can be tolerated is not universally accepted. Studies have shown as little as 1 mm of talar displacement can increase joint contact loads by as much as 42%<sup>(4)</sup>.

Precise diagnosis of distal tibiofibular syndesmotic injury is challenging, and preoperative radiographs rarely reveal subtle injuries as they provide only a static image<sup>(5,6)</sup>.

Although ultrasonography (US), computed tomography (CT), magnetic resonance imaging (MRI), and arthroscopy have been described as possible alternative means of making this diagnosis, the most common and accessible approach remains a dynamic test intra operatively at the time of treating these injuries. That being said, a gold standard diagnostic test has still not been established<sup>(7)</sup>.

The intra-operative tests commonly in use when assessing for the presence of syndesmotic instability are the hook test and the external rotation stress test which have high inter-observer variance<sup>(8)</sup>.

An alternative technique called tab test using a 3.5 mm blunt cortical tap has been described by *Rajagopalan et al.*<sup>(9)</sup>.

This study was designed to detect the efficacy of intraoperative test for syndesmotic disruption including hook test versus tap test and compare it with preoperative MRI diagnosis.

### AIM OF THE WORK

To evaluate the efficacy of intraoperative test for syndesmotic disruption including hook test and tap test and compare it with preoperative MRI diagnosis.

### Patients & METHODS

**All patients were evaluated preoperatively using:** 1. ATLS protocol. 2. **History taking included:** Name, age, sex, address, occupation, special habits, cause and the time of the injury, and whether it is due to fall, direct trauma, motor vehicle accident or pedestrians by motor vehicle and asking for any previous injuries and surgical interventions, any medical co-morbidity and medication. 3. **Clinical Examination:** All patients were examined clinically for evaluation of the type the fracture, whether it is closed or open, whether patient mono or poly traumatized and whether accompanied by

any neurological or vascular injury.

**4. Radiological examination:** X ray AP, lateral and mortise views of the affected ankle were carried to demonstrate fracture pattern.

**These films were evaluated for radiological signs of syndesmotic disruption:** decreased tibiofibular overlap <6 mm in AP view and <1 mm in mortise view, increased medial clear space >4 mm on mortise view and increased tibiofibular clear space >6mm on both AP and mortise views.

**MRI ankle:** all patients

**5. Routine preoperative labs;** including blood grouping and cross matching, liver, kidney functions, CBC, coagulation profile and Fasting Blood Sugar.

**Preoperative management protocol: Initial management:** trauma sheet and general management. **Definitive management:** timing of surgery, surgical technique, postoperative management and follow-up assessment.

**A) Trauma Sheet: History: Personal history:** name, age, gender and occupation and activity. **Present history: Mechanism of injury:** Place of trauma (home, work, road..., etc.), time and date of trauma, time and date of admission to hospital and initial management in other hospitals in referred patients. **Past history:** history of operations, medical disease of orthopedic importance: Diabetes, bronchial asthma, rheumatoid and drug therapy (cortisone). **Examination: General:** vital signs: blood pressure, pulse, temperature and respiratory rate and careful evaluation of the whole patient as well as the involved lower extremity is mandatory. Assessment must include careful examination of the ankle joint, the knee and leg. **Local:** fracture side (RT or Lt), fracture type (open or closed) and look tenderness, and limb deformity. Other injuries to the same extremity should be suspected when there is pain or swelling in the limb above or below the fracture site. **Radiological:** fracture pattern and

associated fractures. **Laboratory:** Including blood grouping and cross matching, liver, kidney functions, Complete Blood Count, coagulation profile and Fasting Blood Sugar.

**Management: Preoperative measures:** describe the consent obtained from all patients, MRI diagnosis was obtained by the radiologist as positive or negative for syndesmotic injury and 1st generation cephalosporin antibiotic was given one hour preoperatively. **Operative details:** operation was done under spinal anaesthesia with the patient in the supine position, medial and lateral approaches were used for medial and lateral malleolus, lateral fixation with a lag screw and neutralizing plate, medial fixation with lag screws or by tension band wiring, completed osteosynthesis was checked by image intensification, after the malleolar fixation hook test and tap test were done under fluoroscopy, each ankle was held in internal rotation with zero plantar flexion to obtain a clear mortise view by fluoroscopy, this view was then saved to a digital imaging system, next, each of the two examinations was performed tap test and hook test, the hook test was performed by using a surgical clamp to grasp the distal fibula 1-2 cm proximal to the tibiotalar joint, the distal fibula was then manually pulled directly lateral, an image was taken and saved, the tap test was performed using the screw hole at an appropriate level, a drill hole is made through the near and far cortex of the fibula using 2.5 mm drill. A 3.5 mm tap or 3.5 mm cortical screw is introduced to meet and push the near cortex of the tibia. An image was taken and saved, both the hook and the tap test then were compared with the values of the unstressed mortise view, the test will be positive if there is changes in the tibiofibular overlap, tibiofibular clear space and the medial clear space and the collected data will be tabled, analyzed.

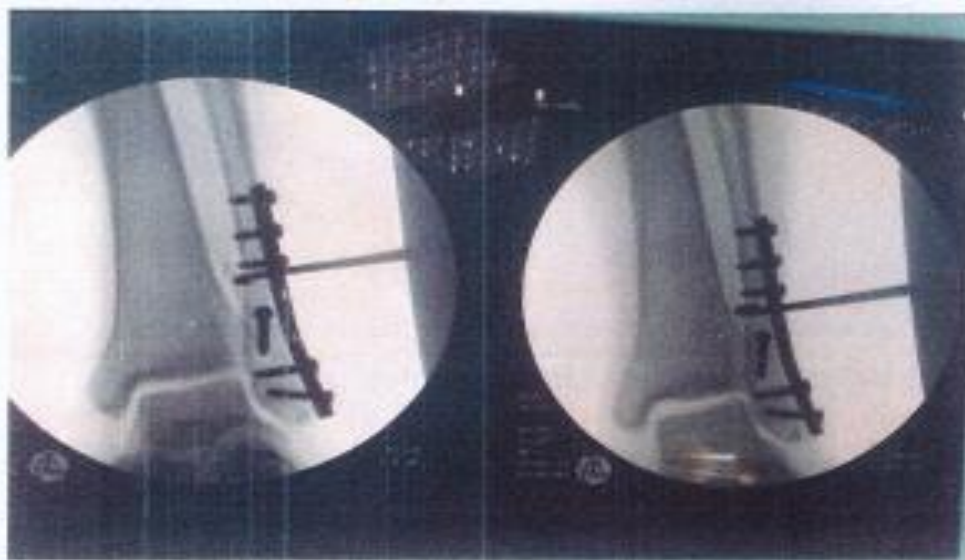
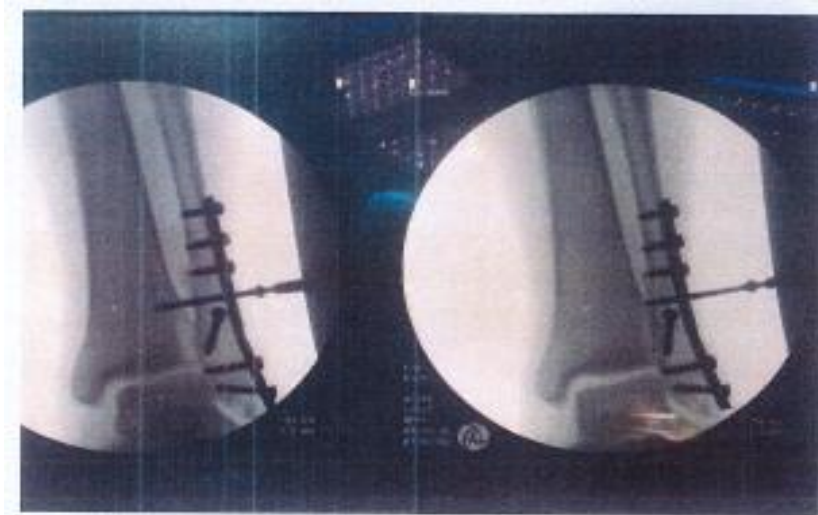


Fig. (1) Hook test



**Fig. (2)** Tap test



**Fig. (3)** Tap test.



**Fig. (4)** Hook test.

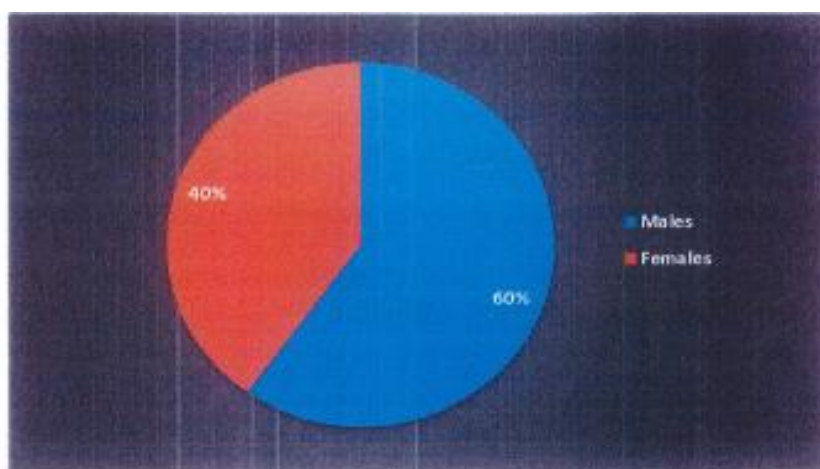
## RESULTS

This study was conducted at Benha University Hospitals and Al Helal Hospital and included 20 cases with ankle fractures treated with open reduction and internal fixation. Patients were evaluated for syndesmotomic disruption intraoperative with both hook test and tap test after fracture fixation.

**General characteristics of the studied patients:** The mean age of the studied patients was 36 years. Regarding gender, there was a male predominance; about two-thirds of the studied patients were males (60.0%). More than one-third of the studied patients were from rural areas (40.0%). Also, more than one-third (40.0%) were smokers. (Table 1 & figure 5)

**Table (1)** General characteristics of the studied patients

General characteristics		
Age (years)	Mean±SD	36±8
Sex	Males n(%)	12 (60.0)
	Females n(%)	8 (40.0)
Residence	Rural n(%)	8 (40.0)
	Urban n(%)	12 (60.0)
Smoking	N (%)	8 (40.0)



**Fig. (5)** Gender distribution of the studied patients.

**Detection of syndesmotomic disruption by MRI, hook test, and tap test:** Syndesmotomic injury was detected in 12 cases by preoperative MRI diagnosis. Hook test intraoperative diagnosis was detected in 10 cases while intraoperative diagnosis by tape test was positive in 12 cases.

**Table (2)** Detection of syndesmotomic disruption by preoperative MRI, hook test, and tap test.

	N (%)
Preoperative MRI	12 (60.0)
Hook test	10 (50.0)
Tap test	12 (60.0)

**Matching of tap test results with pre-operative MRI:** Pre-operative MRI detected syndesmotomic disruption in 12 patients. Tap test results showed matching with positive pre-operative MRI in all twelve patients with syndesmotomic injury (Table 3).

**Table (3)** Matching of tap test results with pre-operative MRI diagnosis:

	Total	Tap test	
		Match	Mismatch
Syndesmotomic disruption in preoperative MRI	12	12	0

**Sensitivity of intraoperative tap test in comparison with preoperative MRI diagnosis and intraoperative hook test:** Tap test sensitivity was 100% regarding preoperative MRI diagnosis and 121% regarding intraoperative hook test.

**Statistical Methods:** Data management and statistical analysis were done using SPSS version 25 (IBM, Armonk, New York, United States). Quantitative data summarized as means and standard deviations. Categorical data were summarized as numbers and percentages. Diagnostic indices, including sensitivity, specificity, PPV, NPV, and overall accuracy, were calculated for hook and tap tests using pre-operative radiograph findings as a reference.

## DISCUSSION

The absence of diastasis between the distal parts of the tibia and fibula on static radiographs is not sufficient to exclude syndesmotom disruption in patients with ankle injuries<sup>(10)</sup>. While both magnetic resonance imaging and ankle arthroscopy are accurate tools for the diagnosis of mortise instability<sup>(11)</sup> they are expensive and often are not readily available, leaving the surgeon to rely on intraoperative stress radiographs.

Pre-operative radiographic measurements such as tibiofibular overlap, tibiofibular clear space, medial and superior clear space are of little value in detecting syndesmotom injury because these depend on ankle rotation during radiography<sup>(10)</sup>. *Jenkinson et al* concluded that intraoperative fluoroscopic stress examination increases the rate of detection of syndesmotom injury<sup>(12)</sup>. A biomechanical cadaveric study concluded that intraoperative hook test is more reliable, because of the greater displacement when performing this test, than the external rotation stress test<sup>(13)</sup>.

*Frederic J. Cotton* first described the hook test to test the integrity of ankle syndesmosis intraoperatively<sup>(14)</sup>. After appropriate fixation of fibula, to perform this test a bone hook is used to distract the fibula in sagittal plane by applying manual force. A counter force is applied to tibia to prevent tibial motion. Syndesmosis is observed for tibiofibular clear space under fluoroscope in anteroposterior mortise view. Tibiofibular clear space exceeding the 5 mm indicates an unstable syndesmosis<sup>(13)</sup>.

Precise diagnosis of distal tibiofibular syndesmotom injury is challenging, and a gold standard diagnostic test has still not been established. Tibiofibular clear space identified on radiographic imaging is considered the most reliable indicator of the injury. The Cotton test is the most widely used intraoperative technique to evaluate the syndesmotom integrity although it has its limitations. Tap test is an intra operative test using a 3.5 mm blunt cortical tap is a simple, accurate and reliable technique able to demonstrate significant differences in the tibiofibular clear space. It could represent a more controlled and stable alternative to Cotton test<sup>(15)</sup>.

The main goal of this study was to evaluate sensitivity of intraoperative test for syndesmotom disruption including hook test and tap test and compare it with preoperative MRI.

We conducted a comparative study on patient with ankle fractures treated with open reduction and internal fixation and evaluated for syndesmotom disruption intraoperative with both hook test and tap test after fracture fixation. The study was carried out on 20 patients attending to orthopedic department in Benha university hospital and Al Helal Hospital from November 2022 to May 2023

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Our study include 20 patients, the mean age of the studied patients was 36 years. Regarding gender, there was a male predominance; about two-thirds of the studied patients were males (60.0%). More than one-third of the studied patients were from rural areas (40.0%). Also, more than one-third (40.0%) were smokers.

Syndesmotom disruption was detected in twelve patients (60%) by pre-operative MRI. Hook test was positive in ten patients (50.0%), while tap test was positive in twelve patients (60.0%).

Matching of hook test results with Pre-operative MRI detected syndesmotom disruption in 10 patients. Hook test results showed mismatching with positive pre-operative MRI in two patients.

Matching of tap test results with Pre-operative MRI detected syndesmotom disruption in twelve patients. Tap test results showed no mismatching with positive pre-operative MRI.

When comparing results of hook and tap tests to the reference pre-operative MRI findings, tap test demonstrated 100% sensitivity while hook test demonstrated 83% sensitivity.

In the study done by *Vivtcharenko et al.*<sup>(16)</sup> compared the Cotton and Tap tests for detection of coronal plane syndesmotom instability. Both tests demonstrated similar increases in the TFCS measurements in stressed injured conditions when compared to intact non-stressed and stressed conditions, as well as injured non-stressed conditions. The study results showed that the intraclass correlation coefficient for interobserver and interobserver reliability was respectively 0.96 and 0.79. TFCS measurements were similar in intact non-stressed, intact stressed (both Cotton and Tap tests) and injured non-stressed conditions, with mean values and 95% Confidence Intervals of: intact non-stressed, 3.5 mm; intact stressed, 3.6 mm (Cotton test) and 4.0 mm (Tap test); injured non-stressed, 3.8 mm. The Cotton test and Tap test had, respectively, 73.3% and 70% sensitivity, 100% and 90% specificity, 86.7% and 80% diagnostic accuracy.

In the study done by *Cesar Netto et al.*<sup>(15)</sup> demonstrated that this novel coronal syndesmotom instability test using a 3.5 mm blunt cortical tap is a simple, accurate and reliable technique able to demonstrate significant differences in the tibiofibular clear space when injury was present. It could represent a more controlled and stable alternative to the most used Cotton test.

In the study done by *Pakarinen et al.*<sup>(17)</sup> showed that Interobserver agreement for the hook test and the clinical stress test was excellent, but the sensitivity of these tests was insufficient to adequately detect instability of the syndesmosis intraoperatively.

In the study done by *Stoffel et al.* <sup>(13)</sup> showed that for the detection of syndesmotic instability at the site of ankle fractures on stress radiographs, the lateral stress test appeared to be superior to the external rotation stress test in this cadaver model.

## CONCLUSION

Obtaining an accurate syndesmotic reduction is critical to avoiding the significant morbidity that can be associated with malreduction. Anatomic reduction of the fibula and syndesmosis has been associated with improved short musculoskeletal function assessment functional outcome scores, whereas malreduction leads to instability and arthritis. This study provide detection of sensitivity of the Hook and Tap tests for detection of syndesmotic instability in relation with preoperative MRI. Tap test is better than hook test in detection of Syndesmotic disruption and matching with preoperative MRI. Tap test is a simple, accurate and reliable technique for detection of syndesmotic instability.

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