

## Research Article

# Evaluation of TWIST Score in Predicting Testicular Torsion in Children

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### Abstract

**Background:** Torsion of the testis is a surgical emergency because the likelihood of testicular salvage decreases as the duration of the torsion increases. TWIST (Testicular Workup for Ischemia and Suspected Torsion) score had been validated for diagnosis of testicular torsion in children with acute scrotum.

**Objective:** establish the validity and applicability of using TWIST score in the diagnosis of testicular torsion in children.

**Methods:** The study includes 53 patients presented with acute scrotum, TWIST score obtained for all patients and classifies the patients into 3 groups of testicular torsion: Low risk (1-2), Intermediate risk: (3-4) and high risk (5-7).

**Results:** TWIST Score analysis shows that the low-risk score patients are (8, 15.1%), the intermediate risk score patients are (21, 39.6%) and high-risk score patients are (24, 45.3%). Torsion group have significantly high-risk score compared to the non-torsion group. There was a high level of agreement between initial and final diagnosis, but there are 6 patients with false positives among the high-risk patients with no false negative patients among the low and intermediate risk patients. The parameters that show high accuracy in testicular torsion diagnosis are: Hard testis (100.0% vs 11.4%), absent cremasteric reflex (83.3% vs 28.6%), nausea/vomiting (77.8% vs 45.7%) and high riding testis (61.1% vs 20.0%).

**Conclusions:** TWIST score is a useful tool in the diagnosis of testicular torsion especially in the peripheral hospitals with the unavailability of Doppler ultrasound at night. The TWIST score at point 6 provides enough indicator of high suspicion of testicular torsion and need of emergency surgical intervention.

**Keywords:** Testicular torsion; TWIST scores; Risk assessment

### Introduction

The term acute scrotum refers to acute scrotal pain with or without swelling and erythema. This presentation should always be treated as an emergency because of the possibility of testicular torsion and

permanent ischemic damage to the testis [1]. The extent of testicular ischemia depends on the degree of torsion. The testicular salvage rate hinges on the degree of torsion and the duration of ischemia. Almost all testes are salvaged within the first 6 hours after the onset of symptoms, with later treatment; the salvage rates rapidly decrease [2].

Testicular torsion is a surgical emergency that requires prompt intervention. Although clinical diagnosis is recommended, scrotal Doppler ultrasound is frequently ordered which shows decreased blood flow and may detect coiling of the spermatic cord, indicating torsion, even with normal blood flow within the testis [3], ultrasound should only be used when the diagnosis is equivocal because imaging studies will only delay scrotal exploration [1], therefore; Barbosa et al. [4] devised and validated the TWIST (Testicular Workup for Ischemia and Suspected Torsion) score, which assigns a summed score (range 0 to 7 points) to diagnose the testicular torsion in children as shown in Table 1.

Finding	Points
Testicular swelling	2
Hard testicle	2
Absent cremasteric reflex	1
Nausea or vomiting	1
High riding testicle	1

**Table 1:** TWIST (Testicular Workup for Ischemia and Suspected Torsion) score [4].

A score of (1-2) corresponds to a low risk of testicular torsion with no recommendation for Doppler Ultrasound. A score of (3-4) determines the intermediate risk of testicular torsion, for which Doppler Ultrasound would be indicated. A score of (5-7) indicates a high risk of testicular torsion with the recommendation of surgical exploration [4]. We aimed to establish the validity and applicability of using TWIST score in the diagnosis of testicular torsion in children.

### Patients and Methods

#### Study design

A prospective cohort study was conducted in the pediatric surgery department of Children Welfare Teaching Hospital/Medical City; Baghdad-Iraq from June 2015 till October 2016. The study includes 53 patients aged from (1 month-13 years) referred from the pediatric emergency unit or outpatient clinic with acute scrotum. Patients with previous history of scrotal pathology were excluded from the study. All the obtained data were analyzed using (TWIST) score, a summed score (range 0 to 7 points) to diagnose the testicular torsion in children which classifies the patients into 3 groups: Low risk of testicular torsion: Patients with scoring (1-2), Intermediate risk of testicular torsion: Patients with scoring (3-4) and high risk of testicular torsion: Patients with scoring (5-7). All patients of high risk of testicular torsion were admitted to the surgical ward and underwent surgical interventions, while patients of the low and intermediate risk of testicular torsion were admitted to the surgical ward for conservative treatment and followed up (clinical and scrotal Ultrasound) except one patient of intermediate group underwent surgical intervention.

Doppler Ultrasound was done for all patients of the intermediate and low risk of testicular torsion. During operation, the data of each patient was recorded, and the removed testicle was sent for histopathology.

**Statistical analysis**

Anderson darling test was done to assess if continuous variables follow a normal distribution. Chi-square test was used to analyze the discrete variable. To test the agreement level between initial and final diagnosis kappa test was used (more than 0.8 indicate strong agreement). Receiver operator curve was used to see the validity of different parameters in separating patients with torsion from non-torsion and area under the curve (AUC), and its p-value prescribes this validity (if  $AUC \geq 0.9$  means excellent test, 0.8-0.89 means good test, 0.7-0.79 fair test otherwise unacceptable). Trapezoidal method was used to calculate the curve. In a ROC curve, the true positive rate (Sensitivity) is plotted in function of the false positive rate (100-Specificity) for different cut-off points. Reliability tests (Sensitivity, Specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy) were calculated. SPSS 20.0.0 (Chicago, IL), MedCalc Statistical Software version 14.8.1 (MedCalc Software bvba, Ostend, Belgium; 2014) we used for performing the statistical analysis, p-value considered when appropriate to be significant if less than 0.05

**Results**

Patient's distributions according to TWIST score are classified into 3 groups:

**Group I:** A scoring (1-2) includes 8 patients with low risk of testicular torsion who were admitted to the hospital for conservative treatment and followed up accordingly.

**Group II:** A scoring (3-4) includes 21 patients with intermediate risk of testicular torsion who were admitted to the hospital for conservative treatment and followed up accordingly, except one patient who underwent surgical exploration for drainage of the scrotal abscess.

**Group III:** A scoring (5-7) includes 24 patients with high risk of testicular torsion who were admitted to the hospital and treated by surgical exploration accordingly.

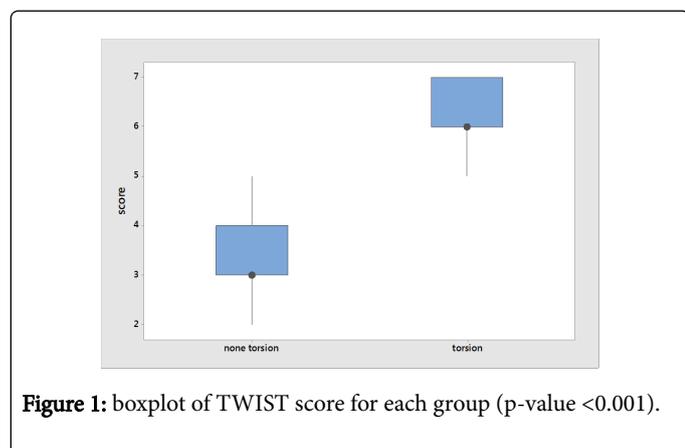
There is a high level of agreement between initial and final diagnosis. In those with with initial diagnosis of testicular torsion, there is some degree of false positive in which 24 patients initially diagnosed as testicular torsion, but only 18 patients of them had testicular torsion, 3 patients had obstructed inguinal hernia, and another 3 patients had hydrocele as illustrated in [Table 2](#).

Professional Diagnosis	Definitive diagnosis					
	Testicular Torsion	Obstructed inguinal hernia	Epididymitis	Idiopathic scrotal edema	Testicular abscess	Hydrocele
Testicular Torsion (24)	18	3	0	0	0	3
Epididymitis (24)	0	0	24	0	0	0
Idiopathic scrotal edema (3)	0	0	0	3	0	0
Testicular abscess (1)	0	0	0	0	1	0
Hydrocele (1)	0	0	0	0	0	1

Kappa = 0.853, p value <0.001.

**Table 2:** Agreement between professional and definitive diagnosis.

The torsion group has significantly high-risk score compared to the non-torsion group as illustrated in [Figure 1](#).

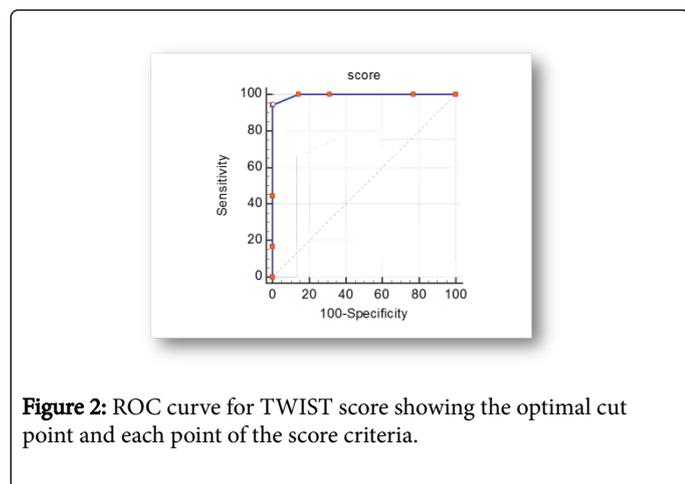


**Figure 1:** boxplot of TWIST score for each group (p-value <0.001).

TWIST score at the cut point 6 had an excellent rule (since  $AUC > 0.9$ ) for predicting testicular torsion (100% specificity, 94.44% sensitivity, PPV 100% and NPV 97.2%), as illustrated in [Table 3](#) and [Figure 2](#).

AUC	95%CI	Cut off	Sensitivity	Specificity	Accuracy	PPV	NPV
0.996	0.925-1.0	>5	94.44%	100%	98.1%	100%	97.2%
AUC: area under the curve, CI: confidence interval, PPV: positive predictive value, NPV: negative predictive value							

**Table 3:** ROC test for predicting the TWIST score point in predicting testicular torsion.



**Figure 2:** ROC curve for TWIST score showing the optimal cut point and each point of the score criteria.

Surgical explorations were done for 25 patients. Testicular torsion was proved in (18/53, 33.96%) patients with acute scrotum after surgical exploration, (9,36%) patients were rescued and underwent bilateral orchiopexy, while another (9,36%) patients underwent orchiectomy (histopathological result shows necrotic infarction of all excised testis) with contralateral orchiopexy. The other 7 patients (3 patients underwent herniotomy, 3 patients underwent hydrocelectomy, and the last patient drainage of a testicular abscess was done). Timeframe to presentation of torsion group, (58.7 ± 55.1) hours the mean time for patients underwent orchiopexy while (74.7 ± 58.1) hours the mean time for patients underwent orchiectomy. The median follow up of patients after discharge 14 days (range 7-90 days), Two patients with salvaged testis have testicular atrophy after one month.

## Discussion

Management of acute scrotum in pediatric age group mainly depended on history and scrotal examination. The immediate surgical intervention was indicated when testicular torsion was suspected, but this type of management policy lead to high rate of false positive diagnosis of testicular torsion in about 2/3 of patients [5].

In this study, the median age was lower in torsion group which was 1.3 year compared to 5 years for the non-torsion group; this result contradicts Feilim Murphy et al. [6] in their studies of 121 children who found that the median age of torsion group was 12 years and 10 years for the non-torsion group. This might be because the last series includes patients with acute scrotum up to 15 years old while the former series with patients' age is up to 13 years old. Knowing that there is a second peak incidence of testicular torsion in adolescent boys aged (13-16) years [7].

In this series, nausea/vomiting are significantly associated with testicular torsion group (77.8% vs 45.7%). This result resembles to Michael Boettcher et al [8], Gregory J et al [9] and Ciftci et al [5] they

found that nausea/vomiting in testicular torsion group versus non-torsion group of about (33.3% vs 2%), (29% vs 2-8%) and (69% vs 26%) respectively.

In this series the high riding testis, absent cremasteric reflex and hard testis are significantly associated with testicular torsion group of (61.1% vs 20.0% , 83.3% vs 28.6% and 100.0% vs 11.4%) respectively. These results resemble Michael Boettcher et al. [8] and Teresa Liang et al. [10] who found that high riding testis was significantly associated with torsion group (41.7% vs 3.3%) and (86% vs 27%) respectively, and absent cremasteric reflex also was significantly associated with torsion group of (50.0% vs 2.2%) and ( 91% vs 19%) respectively.

In this study, there is overall good level of agreement between the initial and final diagnosis (Kappa=0.853, p-value <0.001). In testicular torsion group, 18 out of 24 boys were initially diagnosed as testicular torsion proved to have testicular torsion in final diagnosis, while there are 6 false-positive results (3 boys have obstructed inguinal hernia, and 3 boys have hydrocele). This result in agreement with Mehran Peyvasteh et al. [11] who found good agreement between the initial and final diagnosis of testicular torsion but 3 patients of the false negative result (Initial diagnosis: 69 boys, final diagnosis: 72 boys).

In this study, the testicular torsion group has significantly higher risk score compared to the non-torsion group. In testicular torsion group, the median is 6 while in the non-torsion group the median is 3 which goes with Baker et al. [12] who found that the median was 6 in torsion group and 1 in the non-torsion group.

In this study; none of the patients with low and intermediate risk score had testicular torsion. There are 18 out of 24 patients with higher risk score have testicular torsion. This result contradicts to Barbosa et al. [4] who found that no one of 234 lower risk score patients have testicular torsion, but 12 out of 65 patients of intermediate risk score have testicular torsion and all the 39 patients with high-risk score have testicular torsion, this can be explained by the number and age of patients in the current series comparing to number (338 boys) and age of patients (3 months to 18 years) in Barbosa series [4].

In this study, according to ROC analysis result TWIST score is sensitive and highly specific for the diagnosis of testicular torsion and good for confirmation and exclusion of testicular torsion with very good predicting value for testicular torsion diagnosis at TWIST score point of 6 (specificity 100%, sensitivity 94%, PPV 100% and NPV=97.2%). TWIST score point 5 (PPV=98.4%, NPV=100.0%, sensitivity 100% and specificity 85.7%) this means that the TWIST score at point 5 had excellent for exclusion but increase likelihood of missing positive patients with testicular torsion, so the TWIST score at point 6 provides enough indicator of high suspicion of testicular torsion and need of emergency surgical interventions. This result is consistent with Baker et al [12] who found that the optimal cut point was 6 (AUC=0.90, PPV 93,5% and sensitivity 65.9%), while Barbosa et al [4] found that the optimal cut point was 5 (AUC=0.98, sensitivity 76%, specificity 100%, PPV 100% and NPV 96%) this might be because

the slight difference in inclusion criteria (patients age up to 18 years) and exclusion criteria (age below 3 months and symptoms more than 7 days) with difference in sample size and patients characteristics.

In this series testicular torsion was proved in (18, 33.96%) patients with acute scrotum after surgical exploration, (9, 36%) patients were rescued and underwent bilateral orchiopexy, while another (9, 36%) patients underwent orchiectomy with contralateral orchiopexy. This result is not consistent with Wael Mohammed et al. [13] in their studies of 76 children who found that torsion group was (26, 34.2%) patients, 10 patients of them underwent orchiopexy while 16 patients underwent orchiectomy. This might be because of the late presentation (mean duration=63.3 hours) in the last series while in the former series (median duration=48 hours) in torsion group.

In this series the timeframe to presentation of torsion group, (58.7±55.1 hours) the mean time for patients underwent orchiopexy while (74.7±58.1) hours the mean time for patients underwent orchiectomy. This result is not consistent with Wael Mohammed et al. [13] in their studies who found that (13.9 +- 6.1 hours) the mean time for patients underwent orchiopexy while (94.1 +- 43.9) hours the mean time for patients underwent orchiectomy. This might be because of the late presentation in the last series.

In this series the median follow up of patients after discharge 14 days (range 7-90days), two patients with salvaged testis have testicular atrophy after one month. This result is consistent with Feilim Murphy et al. [6] in their studies who found that one patient with a salvaged testis had testicular atrophy after one month. Our study has some limitations. Evaluation of TWIST score is limited by the low sample number of patients and Patients were poor compliance to complete follow up after discharge.

## Conclusions

TWIST score is a useful tool in the diagnosis of testicular torsion especially in the peripheral hospitals with the unavailability of Doppler ultrasound at night. The TWIST score at point 6 provides enough indicator of high suspicion of testicular torsion and need of emergency surgical intervention.

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