

## The Role of Cremaster Muscle as a Cause of Ascending Testis after Inguinal Hernia/Hydrocele Repair

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### Abstract

#### Background

Ascending testis (AT) is one of the rare but serious complication that may occurs following inguinal hernia/hydrocele repair. We aimed to review our more than 7 years' experience and discuss the possible mechanism through which the AT possibly occurs following inguinal hernia/hydrocele repair.

#### Materials and Methods

A retrospective analysis of 7,212 boys who had undergone inguinal hernia/hydrocele repair between March 2009 and April 2016 was conducted. Exclusion criteria were: undescended testis, misdiagnosed AT, and retractile testis. Two types of surgical procedures were performed based on the medical records: (1) transection of the hernia sac and processus vaginalis alone and (2) isolation of the vas deferens and testicular vessels and a global transection of the remaining structures. Subsequently, post-operative incidence of AT was compared across variables extracted from the medical records.

#### Results

Sixteen (0.22%) patients were diagnosed with AT post operatively. AT incidence after inguinal hernia/hydrocele repair was reported in approximately 0.19% of the entire patient sample (in the 8491 hernia/hydrocele repairs). Comparison of AT incidence with the age at initial operation showed significant increase at the age of one year or less ( $P = 0.017$ ). In addition, AT incidence was significantly higher in the patients for whom only the sac/processus vaginalis was transected rather than the patients who underwent hernia/hydrocele repair with isolation of the vas deferens and testicular vessels (0.06% vs. 0.27%, respectively,  $P = 0.023$ ). Other subgroup analyses remained non-significant.

#### Conclusion

We conclude that transection of the cremaster muscle might decrease the incidence of ascending testis following inguinal hernia/ hydrocele repair.

**Key Words:** Ascending testis, Cremaster muscle, Inguinal hernia.

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## 1- INTRODUCTION

Ascending testis (AT) is defined as a testis secondarily ascended into a cryptorchid position such as a high scrotum and low inguinal region which had initially descended into the correct position in the early infancy (1, 2). This situation is different from the congenital undescended testis, in which testes fail to migrate into the scrotum, and iatrogenic cryptorchidism. The incidence of AT is estimated to be approximately 1-2% among a normal male population (3).

Inguinal hernia repair is one of the most common pediatric operations performed by pediatric surgeons (4). Post-operative AT is a rare, but serious, complication occurring in children following this kind of surgery, with an estimated incidence rate of less than 1% following open approach (5, 6).

Various explanations for this complication have been proposed; while some authors believe that AT occurs due to failure to retain the testes in place, which should spontaneously descend back into the scrotum after the open inguinal herniorrhaphy approach (6), others assume that inguinal herniorrhaphy makes the spermatic cord prone to adherence to the inguinal canal, and consequently, AT, occurs (7, 8). The consensus is that the incidence of AT is actually less following laparoscopic inguinal hernia repair, because of less manipulation of inguinal canal through this technique compared with open surgery (9), albeit there are some contradictory reports of higher incidence of AT following laparoscopic repair (10-12).

Hence, the precise etiology of this complication remains somewhat vague and no definitive conclusion has been reached that explains its association with hernia repair. In this paper we retrospectively review the medical records over the past seven years of pediatric inguinal

herniorrhaphy to reevaluate the possible mechanism by which ascending testis (AT) occurs due to inguinal hernia or hydrocele-repairing surgery.

## 2- MATERIALS AND METHODS

### 2-1. Design and setting

The medical records of 7,212 male children who had undergone surgery for inguinal hernia or hydrocele between March 2009 and April 2016 in the Department of Pediatric Surgery of Hazrat-e-Masumeh Pediatrics Hospital in Qom, Iran were analyzed. Patients who met any of the following exclusion criteria: (1) undescended testes (UDT); (2) misdiagnosed AT; and (3) retractile testes (4) incomplete medical records. Pre-operative examination was performed for detection of UDT, were excluded from the study. A misdiagnosed AT was defined as an undescended testis, which was not clearly diagnosed before and during surgery, but was found post-operatively and leading to orchiopexy. Retractable testes were described as a non-traumatic, non-tender inguinal mass, along with "empty" hemiscrotum, resulting from an exaggerated cremasteric reflex, if they can be brought back into the scrotum.

### 2-2. Data collection and surgical method

Variables extracted from the medical records and measured included gestational age (preterm, full-term), birth weight, age at initial repair, type of surgical approach, type of diseases (inguinal hernia, hydrocele), the site of gubernacular attachment (classified as scrotal bottoms, lateral or upper scrotal, around the inguinal ring), and side of repair by experienced medical staff. Two types of surgical procedures were performed based on the medical records: (1) transection of the hernia sac/processus vaginalis (a protruding pouch of peritoneum that contains a herniated organ or tissue) alone, and (2) isolation of the vas deferens and

testicular vessels and a global transection of the remaining structures of the spermatic cord, including some degree of transection of the cremaster muscle which was represented the transection of the sac and cremaster muscle in this study.

According to the medical records, the open approach of inguinal hernia repair was performed under general anesthesia by using the Mitchell-banks method (4). A deep, 1-cm inguinal skin incision was performed to expose the external ring. The spermatic cord was then exposed, through the external ring, up to the level of the internal ring. Then, at the discretion of the surgeon, one of two surgical methods was used. In one method, the hernia sac/processus vaginalis, which was isolated after sharp dissection of the cord, was highly ligated and the distal part was transected alone.

In an alternative surgical method, the vas deferens and the vessels were isolated, and the remaining structures of spermatic cord were globally transected, and inevitably the cremaster muscle was transected in addition to the hernia sac/processus vaginalis. In cases of hydroceles, thereafter, wide opening of tunica vaginalis around the testis was performed. The wound was then closed by sutures.

### 2-3. Ethical consideration

The study research proposal was approved and supported financially by research council affiliated with the Qom University of Medical Sciences. Also, this university's ethics committee supervised and corroborated the study in terms of ethical considerations. To comply with the principle of anonymity, the samples' identities were kept confidential.

### 2-4. Statistical Analysis

All statistical analyses were performed using SPSS version 24.0. P-value of <0.05 were considered to be significant.

## 3-RESULTS

The review of medical records indicated that 7,212 boys underwent surgery for either inguinal hernias or hydroceles over the past 7 years at our university institution. A total number of 8,491 cases, including 6,917 inguinal hernias and 1,574 hydroceles were reviewed. Of these, 796 cases of hydroceles were categorized as hydrocele alone and 432 as hydrocele + hernia (**Table 1**).

Five hundred and sixty-one (7.8%) boys were premature. The total number of the hernia/hydrocele cases were categorized on the age groups of one-year-old and less, one to two, two to five, five to ten, and over 10 years old with 4,860 (57.24%), 1,452 (17.10%), 1,089 (12.83%), 697(8.21%), and 393(4.62%) patients, respectively (**Figure.1**).

The mean age of patients at the time of initial repair was 2.54 years old, with a range of 3 days- 13 years. The mean birth weight of patients was 3.2 kg, with a range of 1.1-5.2 kg. The clinical presentation of left-sided, right-sided, and bilateral inguinal hernia were 1728(24%), 4205 (58.3%), and 1279 (17.7%) patients, respectively (**Figure.2**).

An open approach with only transection of sac/processus vaginalis was performed in 5,204 (61.3%) patients, and another 3,287 (38.7%) underwent an open approach with transection of both sac and cremaster muscle (**Table.1**).

The mean follow-up time was 1.4 years, with a range of 6 months to- 5.4 years, and 87.2% attendance. Seventeen (0.24%) patients were diagnosed with cryptorchidism, or AT, after the operation, and of these, one patient was excluded from the analysis because of a retractile testis. The remaining 16 patients with 16 ATs who had unilateral hernia/hydrocele, approximately 0.19% of all the hernias/hydroceles undergoing the surgery were enrolled to be further analyzed in our study. The age spectrum of them at initial

repair was 9 months to 3 years with a mean age of  $1.3 \pm 0.7$  years. The mean birth weight of them was  $3.4 \pm 1.2$  kg with the range of 1.4 -4.1 kg. One patient was preterm and the others were full-term (**Figure.3**).

AT developed after inguinal hernia repair and hydrocelectomy in 14 and 2 patients, respectively. The gubernaculum was attached to the scrotal bottom, around the inguinal ring in 15(93.75%) and 1(6.25%) of ascending testes (**Figure.4**).

Fourteen patients developed AT following open surgery with transection of only the hernia sac/processus vaginalis, and two patients developed AT following open surgery with transection of both the sac/processus vaginalis and the cremaster muscle. Seven testes were left-sided and nine testes were right-sided and there were no bilateral cases. Five testes were located high in the scrotal position and others were

located in the low inguinal region. The time of orchiopexy from initial operation was ranged from 7- 24 months. Comparison of AT incidence with the age at initial operation was significantly increased at the cut off age of one year ( $P=0.017$ ).

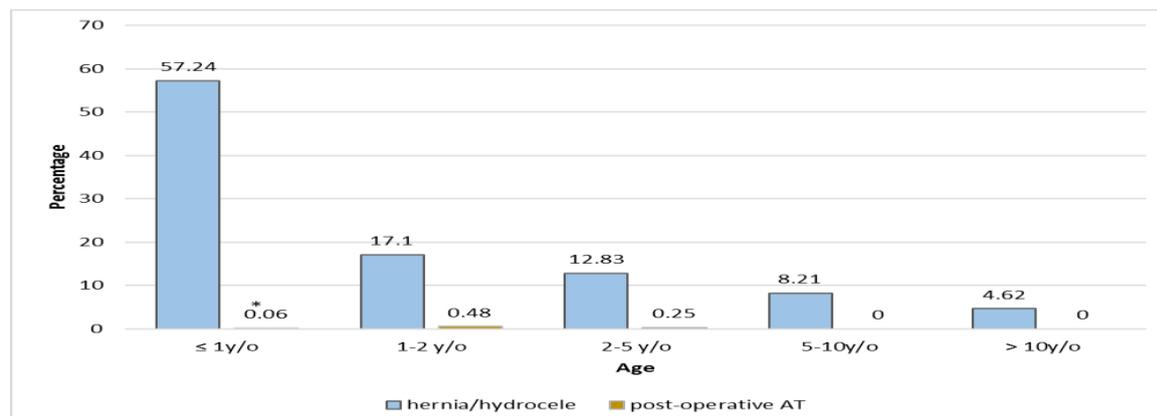
Furthermore, AT incidence was significantly higher in the group who underwent open surgery with transection of only the sac/processus vaginalis ( $P=0.023$ ). However, other subgroup analyses remained non-significant ( $P >0.05$ ) (**Table.2**).

Observationally, throughout the orchiopexies, it was witnessed in thirteen patients that the spermatic cord was extensively adhered to the inguinal canal. However, the spermatic cord was not shortened in any of the cases, hence, no problem was encountered in returning the testes into the scrotum.

**Table-1:** General characteristics of the patients who underwent inguinal hernia/hydrocele repair.

Variables	Total patients/cases with hernia/hydrocele	Patients/cases with post-operative AT
Total patients	7212	16
Age, mean (range)	2.54 years (3days- 13 years)	1.3 years (9 months- 3 years)
Birth weight, mean (range)	3.2 kg (1.1- 5.2 kg)	3.4 kg (1.4- 4.1 kg)
Total cases of hernia or hydrocele	8491	16
Right/ Left/ Bilateral	4205/1728/1279	9/7/0
Sac transection/Sac +CM transection	5204/3287	14/2
Inguinal hernia/ hydrocele	6917/1574	14/2
Full-term/Preterm	6651/561	15/1

AT: Ascending testis; CM: Cremaster muscle.

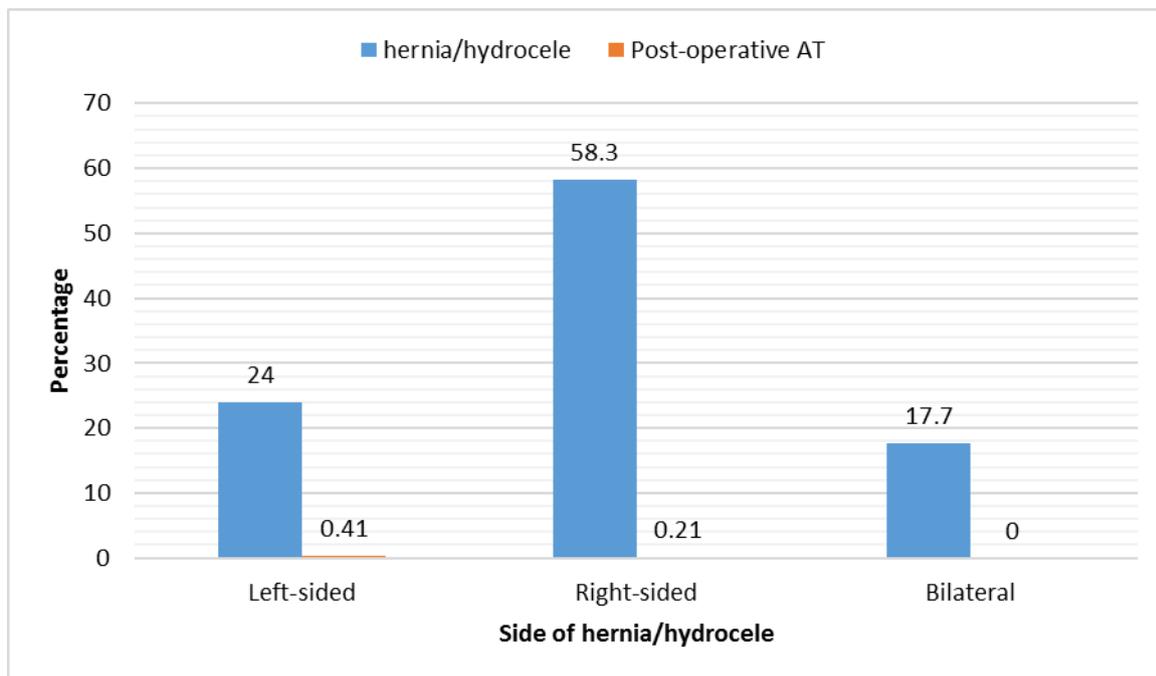


**Fig.1:** The diagram represented the categorization of the hernia/hydrocele repairs by the age.

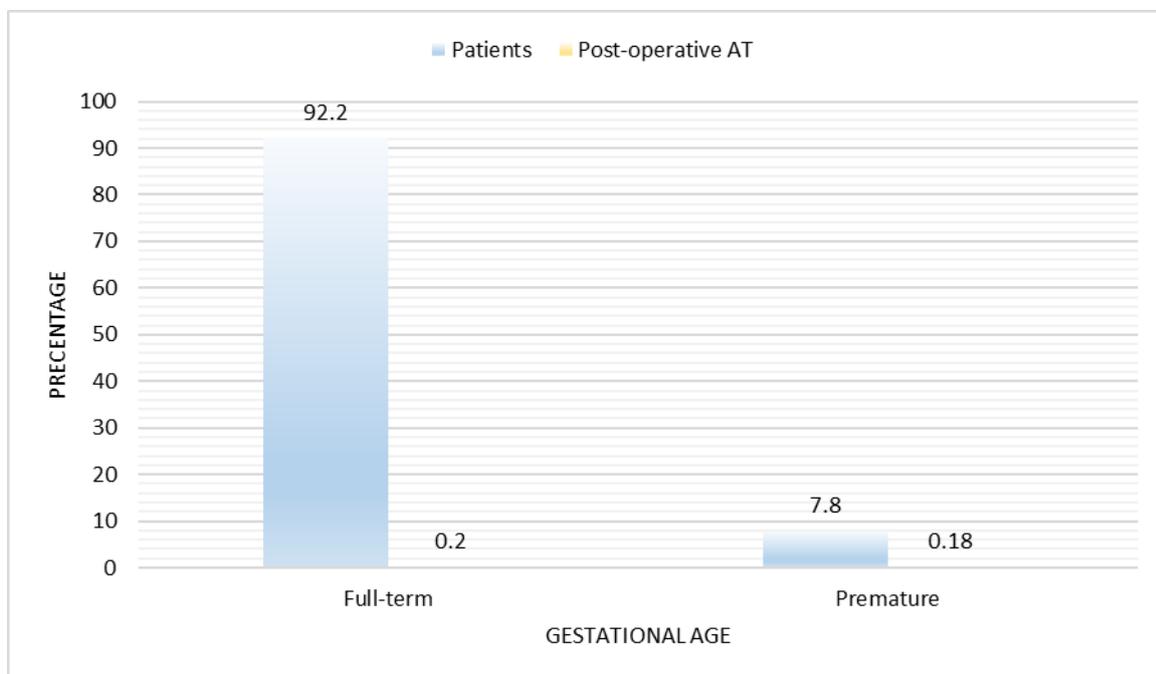
**Table-2:** Subgroup analyses of AT incidence

Variables	No AT (%)	AT (%)	P-value
<b>Operation Type</b>			
Sac/PV transection	5190(99.73)	14 (0.27)	0.023
Sac/PV +CM transection	3285(99.94)	2 (0.06)	
<b>Disease</b>			
Inguinal hernia	6903(99.80)	14 (0.20)	0.721
Hydrocele	1572(99.87)	2 (0.13)	
Hydrocele	795(99.88)	1(0.12)	
Hydrocele+ hernia	431(99.77)	1	
Spermatic cord hydrocele	323	0	
Spermatic cord hydrocele + hydrocele	23	0	
<b>Side</b>			
Right	5475(99.84)	9 (0.16)	0.719
Left	3000(99.77)	7 (0.23)	
<b>Age (cut off=1 year)</b>			
≤ 1 year	4857(99.94)	3(0.06)	0.017
> 1 year	3618(99.64)	13(0.36)	
<b>Gestational age</b>			
Full-term	7915(99.81)	15 (0.19)	0.927
Preterm	560(99.82)	1(0.18)	

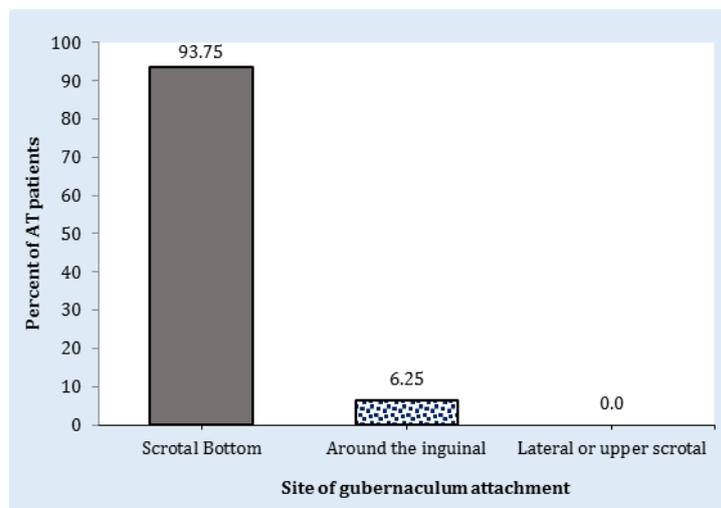
AT: Ascending testis; PV: ProcessusVaginalis; CM: Cremasteric Muscle.



**Fig.2:** The diagram represented the frequency of the hernia/hydroceles by the side as left-sided, right-sided, and bilateral with incidences of AT.



**Fig.3:** The comparison of the gestational age (full-term or premature) and incidence of AT.



**Fig.4:** The site of gubernaculum attachment in the patients with ascending testis (AT).

#### 4- DISCUSSION

Ascending testis, as a post-operative complication of an inguinal hernia repair or a hydrocelectomy (13), has a rare incidence in the literature. Variable incidences of AT from 0.03 to 0.29% and 0.30 to 4.07% have been reported concerning the open and laparoscopic approaches, respectively (5, 8-10).

Nonetheless, the incidence of AT in the male pediatrics population who underwent open inguinal hernia repair or hydrocelectomy, in the current study, is estimated at approximately 0.19%. Pivotal questions were posed in the literature regarding post-operative AT after inguinal hernia/hydrocele repair. Some investigators believe that the main culprit of AT following inguinal hernia/hydrocele repair is post-operative adhesion of the spermatic cord due to extensive scarring, as a complication of open herniotomy (7, 13). Moreover, because laparoscopic surgery results in significantly less scarring, this results less post-operative adhesion of the spermatic cord (2, 14).

However, given that there is no significant difference between the incidence of AT following the open approach and the laparoscopic procedure, and that a slightly

higher reported incidence of AT by laparoscopic procedure has been reported, it seems that spermatic cord adhesion is not the only contributor of AT following herniotomy (13). Some authors (4, 15) propose that removing the testes from the scrotum during dissection of the hernia sac, applies traction on the spermatic cord and vessels. This traction, then, causes the testes to be placed in a high scrotal position. Thereupon, it is thought that in this situation, testes adhere to the surrounding tissues due to post-operative inflammation, and eventually AT will occur. However, in our experience with 114 patients whose testes were removed from the scrotum and then replaced, no case of AT developed. Other authors have suggested that permanence of processus vaginalis causes a disturbance in spermatic cord elongation, and subsequently induces ascending testes (2, 3, 13).

They believe that keeping processus vaginalis intact during the laparoscopic procedure may be the reason for occurrence of AT following this approach (13). Accordingly, because of partial transection of processus vaginalis during the open approach in our study, it cannot play an important role on post-operative AT. Furthermore, in our experience with

302 patients whose sac was completely excised because of shortening of the sac, no case of AT developed. On the other hand, some investigators theorized that occurrence of testicular ascent may not be a post-operative complication of inguinal hernia/hydrocele repairs (5, 8-10, 16). Various explanations for this opinion have been proposed, however, one view is that because there is no significant difference between the incidence of AT in an estimated 1-2% of the normal male population, and patients who underwent inguinal hernia/hydrocele repair, it is probably not a complication of the surgery, and may, independently, be a natural course of AT.

To elaborate, abnormal elongation of spermatic cord can cause testicular ascent when the scrotum moves further from the groin as the boys growth(17). Furthermore, a patent processus vaginalis, which is found in more than 90% of patients with undescended testis, could adhere to spermatic cord and hinder testicular descent (13). However, in the open operation approach, during which the spermatic cord and processus vaginalis are completely isolated, this complication could be prevented and, therefore, this surgical technique can have a protective role in this regard (13).

Some authors claim that the ascending testes are indeed primary cryptorchid testis. They demonstrated that similar to the primary cryptorchidism, the number of germ cells is severely decreased in the contralateral descended testis, in a subset of patients with ascended testis. They supposed AT, and generally, iatrogenic undescended testes as low lying forms of UDT, and accordingly, expect that the disturbance occurs on the hormonal surge which has a crucial role in this regard (16). Accordingly, it seems that administration of the human chorionic gonadotropin (HCG) might be acceptable in this condition (4), although little evidence has

been found in the literatures to support this. Preoperative unrecognized retractile testes has been proposed as another reason for testicular ascent due to inguinal hernia/hydrocele repair (4, 18). Some authors declared that retractile testes are pulled due to hyperactivity of the cremaster muscle and therefore, careful preoperative examination for this condition is suggested (4).

Subgroup analyses of the present study demonstrated a significant difference ( $P=0.023$ ) in the incidence of AT following inguinal hernia/hydrocele repair between two methods of the operation. As the results represented in the **Table.2** indicate, AT incidence following inguinal hernia/hydrocele repair with transection of only the hernia sac/processus vaginalis was significantly higher than isolation of the vas deferens and the vessels with global transection of the remaining structures of the spermatic cord (0.30 vs. 0.07). Agree with some authors (4, 18, 19), we believed that the cremaster muscle with increased contractile activity may play an important role in AT following inguinal hernia/hydrocele repair. An ascended testis may be unable to descend into the proper position due to adhesion of the surrounding tissue after the operation. From our seven years of experience, it is obvious that the global transection of the remaining structures of spermatic cord will inevitably lead to transection of the cremaster muscle. However, we believe that since the cremaster muscle, a purported cause of AT, was transected, the hyperactivity effect of this muscle was removed, and thus as indicated by the subgroup analyses, the incidence of the testicular ascent following inguinal hernia/hydrocele repair was significantly decreased ( $P=0.023$ ).

Some authors (20) suggested that the gubernacular attachment site may play an important role in the ascending of the cryptorchid testis which was descended by

hormonal treatment. They explained that the most abnormal site of attachment was around the inguinal ring in the abdominal, inguinal and high scrotal testis. However, in our study as represented in **Figure.4**, 92.75% of the gubernacular testis proper was connected between the epididymis and scrotal bottom. Few investigators suggested that scrotal hypoplasia may contribute to testicular ascent due to herniotomy (4).

We have a similar hypothesis that hyperactivity of the dartos muscle early after surgery may cause testes to be elevated and, subsequently, adhere to inflamed surrounding tissue due to the inguinal hernia/hydrocele repair procedure. Results are presented in the **Table.2**, and indicate that AT incidence significantly increased by age until the cut-off point of one year after initial operation. Other studies, similarly indicated a significant association between the age at initial operation and incidence of testicular ascent (12, 13, 21).

Some authors explained that testicular ascend may occurs in the babies with the low birth weight. For example, in one study (10) authors found that 50% of the post-operative ascending testes had low birth weight. In another studies (11, 22) investigators reported that AT incidence was increased more than 4% in the birth weight of 5 kg or less. However, similar to previous study (13), there was no significant difference between the mean birth weight of patients with and without post-operative AT in our analyses (**Table.1**). There was no significant correlation between AT incidence and other entities including gestational age, to be either hydrocele or hernia, and side of repair, in the present study.

The strength of our study is in the review of an immense number of patients throughout long term follow-up. Notwithstanding, the current study has been faced with some limitations. First,

because it was reviewed retrospectively with a long time span and large sample size, inevitably there may be recall bias. Moreover, some patients with post-operative AT refused further participation in the study and completion of their follow-up in our institution. Finally, some patients were lost because of changing addresses. Hence, we recommended future studies to be designed, prospectively.

## 5- CONCLUSION

Ascending Testis as a post-operative complication of inguinal hernia/hydrocele repair has a low incidence rate in the literature and in our study (0.19%) as well. Various explanations have been proposed regarding the occurrence of this complication after inguinal herniorrhaphy. However, based on our more than 7 years' experience, we explained two theoretically possible reasons: (1) hyperactivity of the cremaster muscle post-operatively leads to elevation of operated testis and subsequent adherence to inflamed surrounding tissue; (2) hyperactivity of the dartos muscle after inguinal hernia/hydrocele repair caused elevation of testis and adherence to surrounding tissue.

## 6- CONFLICT OF INTEREST

The authors have no financial disclosures or conflicts of interest.

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