# Laparoscopic classification of the impalpable testis: an update

Amr A. AbouZeid, Hesham Soliman Safoury and Sameh Abdel Hay

***Purpose*** **We present a classification for the nonpalpable testis (NPT) based on laparoscopic findings and suggest guidelines for the interpretation of these findings.**

***Patients and methods*** **From October 2002 to December 2010, 121 patients with NPT underwent laparoscopy at two tertiary centers of Pediatric surgery in Egypt. The lower abdomen and pelvis were inspected to identify the following structures and their inter-relationships: the internal inguinal ring (and its patency), spermatic vessels, vas deferens, and testis. The laparoscopic findings were documented by one of the authors who attended all procedures, and video recordings were available in some cases. Further management was dependent on laparoscopic findings, classification, and plan of treatment.**

***Results*** **The study included 117 patients with 142 nonpalpable testes. Their mean age was 4.9 years. Among patients with unilateral NPT, a contralateral palpable undescended testicle was always associated with a viable NPT (100%), whereas a contralateral scrotal testis had an equal chance (50%) of finding a viable NPT, without a significant difference whether it was right or left sided.**

***Conclusion*** **Failure of normal testicular descent leads to a spectrum of anatomical variations that can be precisely and safely defined by laparoscopy in about two-thirds of patients with nonpalpable testes. In the remaining one-third of patients, including inguinal exploration after laparoscopy can help us to exclude a missed viable inguinal testis.** ***Ann Pediatr Surg*** **8:116–122 © 2012 Annals of Pediatric Surgery.**

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## Introduction

Cryptorchidism is one of the most common anomalies in male individuals, which has for many years been a source of great controversy in terms of its pathophysiology and the optimal form of treatment [1]. Infertility is the most important consequence of cryptorchidism, and the main goal of treatment is to improve the fertility potential. Hadziselimovic [2] stated that every boy with cryptorchidism is born with germ cells, which start disappearing gradually if no intervention occurs. Several studies on testicular biopsies have supported this statement, which has led to a decrease in the recommended age for orchiopexy (below 1 year) [3].

Although standard orchiopexy is considered a satisfactory operation for the palpable undescended testis, management of the high undescended testis remains a challenging clinical problem. Different modalities have been suggested for the preoperative localization of an impalpable testis; however, all patients will require exploration. Cortesi and colleagues in 1976 first used laparoscopy to locate undescended testicles, following which there was an increase in recognition of its role in location of undescended testicles, owing to its obvious advantages of being a minimally invasive technique with very high sensitivity and specificity. The initial enthusiasm for the use of laparoscopy was tempered overtime by the finding that not all patients with impalpable testes benefited from laparoscopy [4]. A high percentage of patients are reported to have inguinal testes or remnants, and performing laparoscopy on these patients has been criticized [5].

There is no generally accepted management protocol for impalpable testis, and it may be difficult to decide which intra-abdominal testis should be treated by standard open or laparoscopic orchiopexy and which should be treated by sectioning of the spermatic vessels [6]. Hence, classification-based management and strict procedures are needed to evaluate and compare the results of different centers [7]. In 1999, on the basis of our initial experience, we proposed a laparoscopic classification and treatment plan for impalpable testes [8]. With an increase in our experience, new subtypes could be identified. On the basis of our observations and on reviewing reports from other centers, we felt the need to update our classification in order to make it more inclusive of different possible laparoscopic findings. In addition, we tried to suggest guidelines for interpretation of these findings.

## Patients and methods

From October 2002 to December 2010, 121 consecutive patients with nonpalpable testis (NPT) underwent laparoscopy at two tertiary centers of Pediatric surgery in Egypt (Ain-Shams University Children's Hospital and Benha Specialized Children's Hospital). Patients with specific syndromes (prune belly, persistent Mullerian duct) were excluded. Examination under anesthesia preceded laparoscopy to confirm the diagnosis of NPT. Laparoscopy was initiated through an open (Hasson) technique using a supraumbilically placed 5-mm cannula. Thereafter, the peritoneal cavity was insufflated with $CO_2$ (pressure 6–12 $cmH_2O$). With the patient in the Trendelenburg position, the lower abdomen and pelvis were inspected to identify the following structures and their inter-relationships: the internal inguinal ring (and its patency), spermatic vessels, vas deferens, and testis.

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The laparoscopic findings were documented by one of the authors who attended all procedures, and video recordings were available in some cases.

According to laparoscopic findings, management was based on the Ain-Shams laparoscopic classification and plan of treatment (Table 1) [8].

In an attempt to update our classification, we evaluated the need to add new subtypes on the basis of the laparoscopic findings in this new series. This was performed guided by experiences of other centers as well, which were known by reviewing the literature through the Egyptian Universities Libraries Consortium database.

Patients who underwent orchiopexy were contacted by phone to attend follow-up assessments for testicular viability and location. Testicular atrophy was defined when the testis could neither be palpated in the scrotum nor the inguinal canal; and this was confirmed by ultrasongraphy.

## Results

The study included 117 patients who underwent laparoscopy for 142 nonpalpable testes. Their age ranged from 6 months to 13 years (mean 4.9 years). Of these patients, 25 (21%) had bilateral NPT, whereas the rest had unilateral NPT in which the contralateral testis was scrotal in 74 patients (63%) and palpable undescended in 18 (15%). Notably NPT was always viable (100%) when the contralateral testis was palpable undescended. However, viable testis was found in 80% of patients with bilateral NPT, and in 50% of patients with unilateral cryptorchid NPT. In the latter group, 57% of NPT were on the left side (45% viable) and 43% were on the right side (56% viable). Contrary to a nubbin, a viable testis (even if small) has well-identified structures: epididymis and glandular tissue.

Table 1 represents the distribution of nonpalpable testes according to laparoscopic findings and subsequent interventions in them. It was found that an open internal ring (types 2 and 3) was always associated with the presence of a viable testis; however, with a closed ring (types 1 and 4), a viable testis could be found in only 43%.

Only 28 patients who underwent orchiopexy (32 testes) were available for follow-up (mean period 4 years; range 6 months–8 years). Among patients who underwent Fowler–Stephens orchiopexy (FSO), atrophy was noted in three testes (type 4a) and another testis (type 3a) was found at a high position (scrotal neck); however, no atrophy was detected with spermatic vessel preservation (primary orchiopexy), and one testis (type 2) was at a high position.

## Discussion

In this study, we evaluated the role of laparoscopy in the management of impalpable testes. In 6% of patients with intra-abdominal vanishing testes (type 1a), laparoscopy provided definitive diagnosis and made further intervention unnecessary. In another 65% of patients, laparoscopy ascertained the location of the testis, whether transinguinal, intra-abdominal, or pelvic, and provided guidance on preserving or dividing the testicular vessels during orchiopexy. Primary orchiopexy with preservation of vessels was performed for 34 testes (types 2 and 4b) either by the standard (inguinal) or the laparoscopic approach. The laparoscopic approach was obviously superior in type 4b (seven testes) in which the ring was closed and the testis was away in the pelvis; however, in type 2, laparoscopic orchiopexy appeared more demanding and required special expertise, in contrast to the straight-forward standard (inguinal) approach. For individuals with abdominal testes and short vessels (58 testes), laparoscopy was beneficial in performing high ligation of testicular vessels as the first step in staged FSO orchiopexy to be followed later by the second stage (also performed laparoscopically).

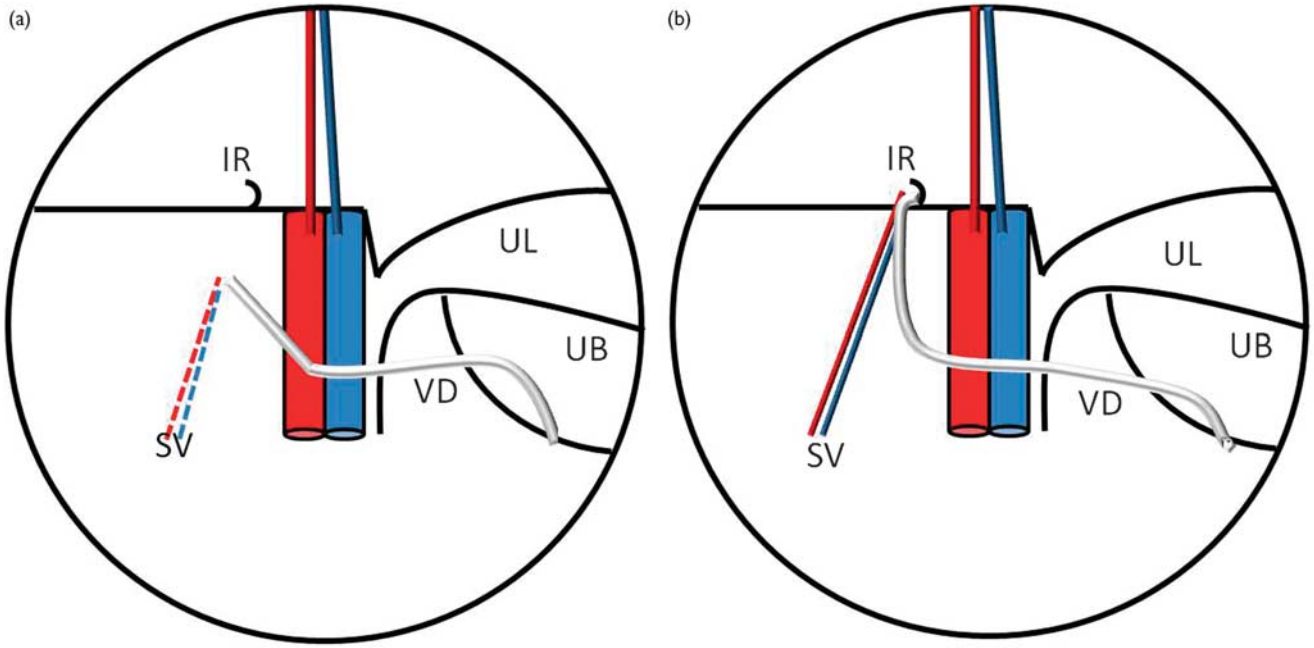
Collectively, laparoscopy was found to be a valuable tool in the management of about 71% of our patients with nonpalpable testes by providing a definitive diagnosis in all and by contributing by variable amounts to the therapeutic surgical action. However, in the rest of the patients (29%), when laparoscopy showed vas and

**Table 1 Distribution of nonpalpable testes into types and subtypes according to laparoscopic findings**

| Type | Classification 1999 | Modification 2011 (subtypes) | Number of NPT | Procedure |
|---|---|---|---|---|
| 1 | Internal ring closed; no testis seen | (a) Vas and vessels ending blind before closed ring (Fig. 1a) | 9 | No further intervention |
| | | (b) Vas and vessels exiting the abdomen through a closed ring (Fig. 1b) | 41 | Inguinal exploration |
| 2 | Internal ring open; testis at the ring; vas and vessels reaching up into the ring | The testis is peeping (transinguinal) (Fig. 2) | 27 (five available for follow-up) | Primary orchiopexy (open or laparoscopic) |
| 3 | Internal ring open; testis proximal to ring; vessels ending at testis short of the ring | (a) Nonlooping vas (Fig. 3a) | 26 (11 available for follow-up) | Staged Fowler-Stephens Orchiopexy |
| | | (b) Vas looping into canal (Fig. 3b) | Seven (two available for follow-up) | Staged Fowler-Stephens Orchiopexy |
| 4 | Internal ring closed; testis away from ring (>2 cm) | (a) Testis is high (iliac) (Fig. 4a) | 25 (12 available for follow-up) | Staged Fowler-Stephens Orchiopexy |
| | | (b) Testis is down (pelvic) (Fig. 4b) May have short vas | Seven (two available for follow-up) | Laparoscopic primary orchiopexy |
| 5 | | Syndromes associated with NPT (prune belly; persistent Mullerian duct) | Four patients excluded from the study | |

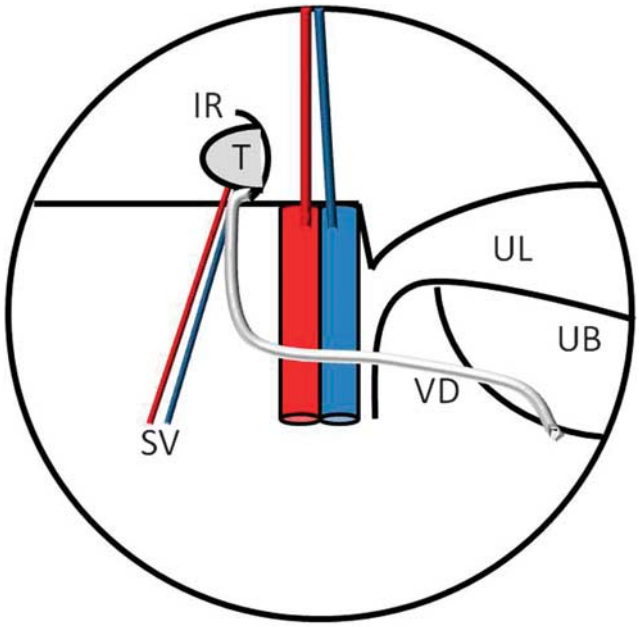
NPT, nonpalpable testis.

**Fig. 1**




Type 1: closed internal ring; no testis in the abdomen. (a) Type 1a: vas and vessels ending in the abdomen; (b) type 1b: vas and vessels exit through closed ring. IR, internal ring; SV, spermatic vessels; T, testis; UB, urinary bladder; UL, umbilical ligament; VD, vas deferens.

**Fig. 2**




Type 2: peeping testis. IR, internal ring; SV, spermatic vessels; T, testis; UB, urinary bladder; UL, umbilical ligament; VD, vas deferens.

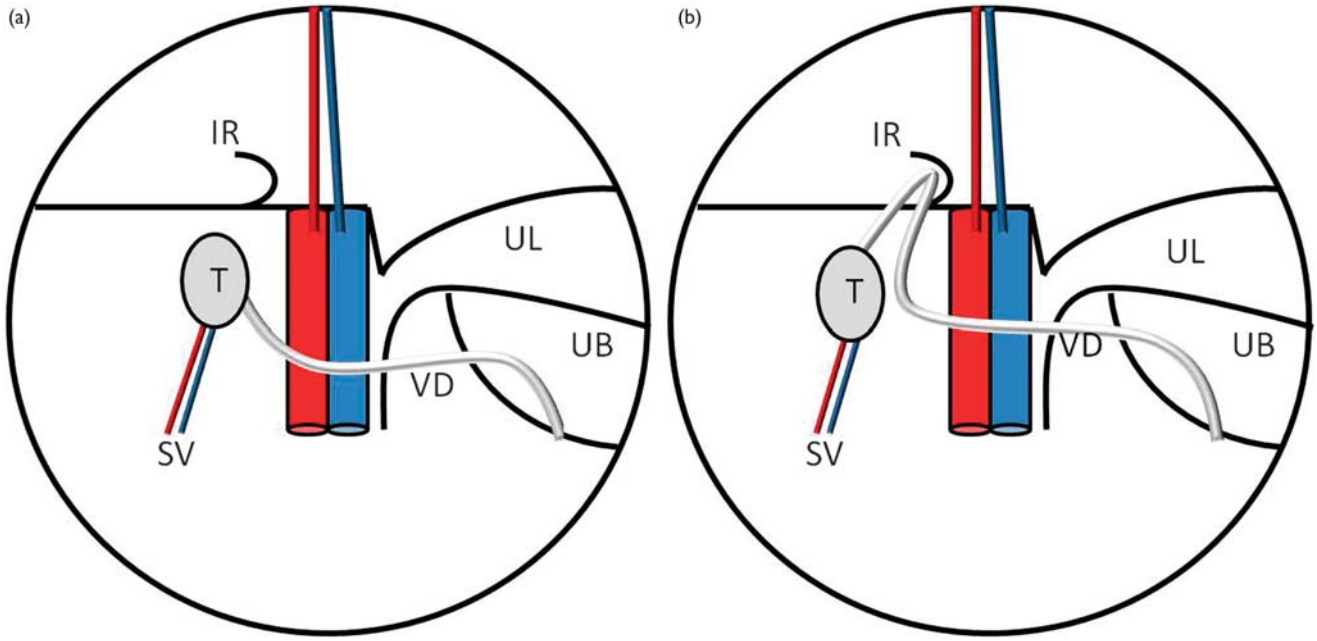
vessels exiting the abdomen through a closed internal ring (type 1b), inguinal exploration was needed to exclude a viable inguinal testis that might have been missed on examination.

The traditional approach to NPT, starts with a standard inguinal incision, followed by an abdominal exploration if the inguinal canal is empty (no viable or atrophic testis) [6]. Analyzing our data, we can expect that conventional inguinal exploration alone would have been sufficient in about 48% of patients (types 1b and 2), whereas in the rest, either extending the inguinal incision or adding laparoscopy to the procedure would be needed.

Earlier studies in the literature showed that more than half of NPT or remnants are in the inguinal canal and, therefore, do not benefit from laparoscopic localization; however, this has changed in later studies, which showed that 53–60% of NPT have not passed the region distal to the inguinal ring. This change may be attributed to examination under anesthesia leading to more appropriate patient selection through exclusion of a number of missed inguinal testes [5].

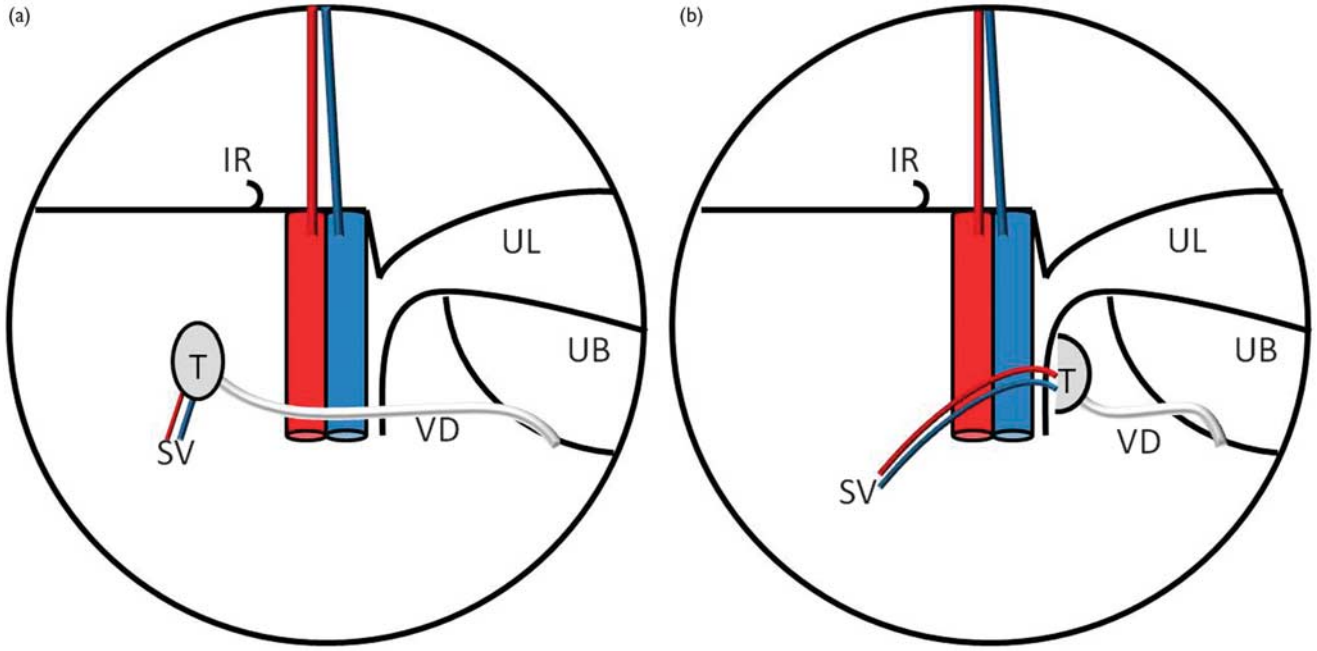
However, this change did not solve the debate on laparoscopy. Some authors advocate that the benefit of laparoscopy does not compensate for the risk of injury to abdominal organs and the added expense; however, the inguinal approach with transperitoneal extension should enable localization of all undescended testes without these disadvantages [9]. Others recommended laparoscopy only for abdominal testes with closed rings [10]. Alam *et al.* [4] advocated beginning with inguinal exploration rather than laparoscopy in patients with unilateral NPT, whereas Belman and Rushton further specified this 'bottoms up' approach for the combination of a nonpalpable left testis and an enlarged right testis (highly predictive of perinatal testicular torsion) [11]. One drawback of this approach is that a looping vas may be confused for a remnant, and extensive dissection can disrupt collateral blood supply, making the Fowler–Stephens procedure inadvisable [12]. In our series, a contralateral scrotal testis had an equal chance (50%) of finding a viable NPT, without a significant difference

**Fig. 3**




Type 3: testis proximal to an open internal ring. (a) Type 3a: nonlooping vas; (b) type 3b: looping vas variant. IR, internal ring; SV, spermatic vessels; T, testis; UB, urinary bladder; UL, umbilical ligament; VD, vas deferens.

**Fig. 4**




Type 4: testis away from a closed ring. (a) Type 4a: high iliac testis; (b) type 4b: pelvic testis. IR, internal ring; SV, spermatic vessels; T, testis; UB, urinary bladder; UL, umbilical ligament; VD, vas deferens.

whether it was right or left sided; however, unfortunately, there was no documentation on the size of the contralateral scrotal testis.

Another point of debate is the need for inguinal exploration when there is laparoscopic evidence of the vas and vessels exiting a closed internal inguinal ring (type 1b). We have two concerns: a testis in the inguinal canal may not be palpable even under general anesthesia, and there is a potential risk for malignant degeneration of the testicular remnant. Elder [13] observed that spermatic vessels and vas entering a closed internal inguinal ring are

usually associated with an atrophic testicular or epididymal remnant. In addition, reports have found viable germ cells in only 7–14% of testicular remnants [14,15], suggesting a remote possibility of malignant degeneration. Accordingly, some authors advocated abandoning groin exploration in this situation, thus increasing the value of laparoscopy [6]. In our series, three viable testes were found during inguinal exploration of this group (7%), which emphasizes that it is usual, but not always, to find an atrophic remnant. Thus abandoning inguinal exploration in this group remains questionable.

Testis with short vessels can be managed by FSO, testicular autotransplantation, or a staged procedure without vessel transaction, and recently, a new technique based on gradual controlled traction on the testicular vessels has been introduced [16]. Although several studies have shown a higher testicular atrophy rate when testicular vessels are transected, FSO remains an accepted procedure and perhaps the most commonly practiced one worldwide. A critical question in managing abdominal testis is whether the spermatic vessels are short and need to be divided. Although laparoscopy is superior in identifying the exact location of the testis and related structures, it has been suggested that there is bias toward FSO in patients treated laparoscopically [4]. Different criteria have been suggested to help in answering this question: testis position and distance from ring (more or less than 2.5 cm) [5], mobility and length of spermatic vessels (stretch maneuver) [17], and the patient's age. One important aim of the classification is to provide a guide that may simplify the surgical decision based on the patency of the ring and course of spermatic vessels. Preservation of vessels is likely with an open ring when the vessels are coursing up into the ring (type 2) and with a closed ring when vessels are coursing down to a pelvic testis (type 4b).

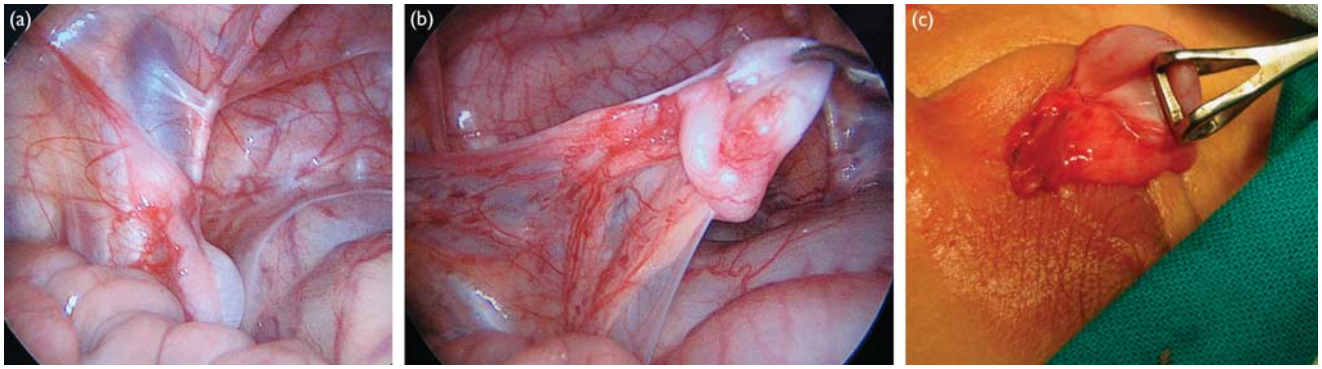
Concerning the surgical approach to FSO, we have to first differentiate between long-loop vas orchiopexy originally described by Fowler and Stephens and the vas pedicle flap technique, which represents a laparoscopic evolution of the former. Fowler and Stephens described their technique for a particular variant of a high undescended testis, in which the vas is long and coursing (looping) down the inguinal canal and then up again to a high testis with short vessels [18]. It was recommended, after dividing the vessels, that the testis should be placed in the scrotum along its route, rather than brought medial to the inguinal canal to preserve collateral circulation from vas and gubernaculums [12]. These technical concepts were not exactly replicated in the laparoscopic approach, which was applied for all high testes, even those without a looping vas. A wide flap of peritoneum around the testis and vas is dissected, pedicled medially on the vas and surrounding delicate blood supply (vas pedicle flap); then, the distal gubernacular attachments are divided to free the testis, which is rerouted medial to the inferior epigastric vessels applying the concept of Prentiss.

In their review, Dave *et al.* [19] found similar testicular atrophy rates when using open and laparoscopic staged FSO. Although laparoscopy would offer magnification, better visualization, and decreased postoperative morbidity, the open second stage can better preserve additional collateral supply from cremasteric and inferior epigastric vessels. The latter seems more suitable for the long-looping vas variant in which the cremasteric blood supply is more prominent and may have an important role in testicular blood supply. This has been highlighted by Dave *et al.* [19], who reported a higher atrophy rate following laparoscopic second stage FSO for the long-looping vas variant. In our study, the second stage was performed laparoscopically in all cases; however, we found it more challenging with the long-looping vas variant (type 3b). Dissection around the vas that loops into the inguinal canal seemed more demanding, with risk of injury to the vas and its surrounding delicate blood supply. A laparoscopic modification has been adopted by one of the authors (S.A.H) to preserve the gubernaculum and its additional blood supply in selected cases [20], which was also described by Robertson *et al.* [21].

Several classifications have been proposed for the impalpable testis [5,8,22,23]; however, none have gained widespread acceptance. Although classifications may differ in their structure and complexity, many similarities exist between all of them. Here, we tried to update our classification to be more inclusive of different possible variants that may be encountered during laparoscopy, while keeping it as simple and indicative as possible. The internal ring represents an important landmark during laparoscopy, which when patent, usually indicates a viable testis beside the ring (types 2 and 3). In type 2, the vessels that reach up into the ring can usually be stretched down to the scrotum. In contrast, a closed ring indicates either an absent testis or a viable testis that is far from it. Although a high testis with a closed ring (type 4a) is definitely associated with short vessels that would necessitate its transection, a pelvic testis (type 4b) usually has longer vessels that can be stretched down to the scrotum (Fig. 5).

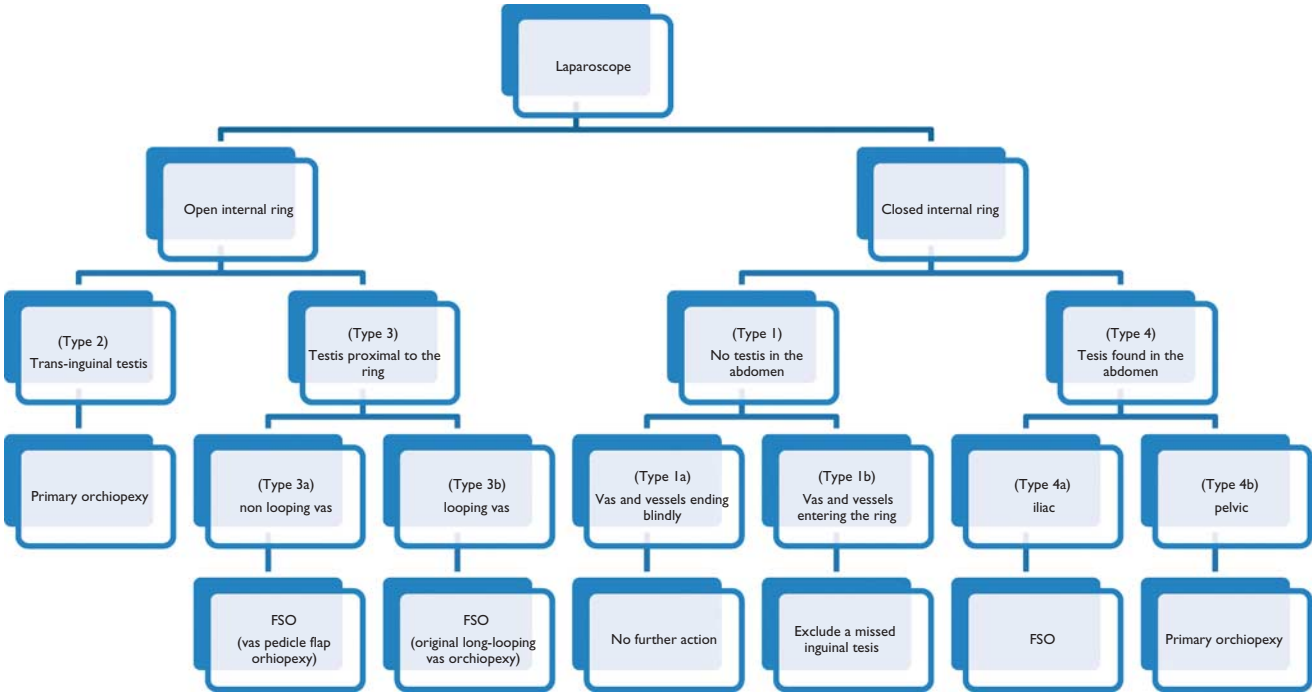
This study is limited by the small percentage (33%) of orchiopexy patients who were available for follow-up (32 of 95 orchiopexies). In addition, the proposed management plan has not been tested against other treatment options, which perhaps needs testing in further studies. However, we believe our classification can offer clear guidelines in most situations (Fig. 6). Type 1a requires no further management, whereas type 1b will need exclusion of a missed viable inguinal testis (this may be possible radiologically or by palpating a nubbin in the scrotum; otherwise, inguinal exploration is justified). Type 2 (peeping testis) can be treated by standard inguinal orchiopexy. Types 3b and 4a will always have short vessels that will need to be divided. Vessel preservation is usually feasible in type 4b (pelvic), with an obvious advantage of the laparoscopic approach in rerouting of the testis down the scrotum. All cases of type 3a in this study were managed by FSO; however, vessel preservation may still be another option. Answering this question remains difficult and requires further studies [24].

**Fig. 5**




Four-year-old boy with nonpalpable testis. (a) Laparoscopic view of pelvic testis (type 4b); (b) stretch test for testicular vessels; (c) testis brought down to the scrotum with preservation of its vessels.

**Fig. 6**




A flow chart to summarize management according to laparoscopic findings.

We believe that the debate on laparoscopy will continue; however, this can be solved locally based on laparoscopic facilities and experience in individual centers. At our centers we use laparoscopic procedures in the treatment of a variety of pediatric surgical and urological diseases, using autoclavable ports and instruments to decrease expenses. We did not injure intra-abdominal organs or vascular structures during introduction of the scope using the open (Hasson) technique, and we achieved comparable success rates with less pain and discomfort to the patients.

## Conclusion

Failure of normal testicular descent leads to a spectrum of anatomical variations that can precisely and safely be defined by laparoscopy in about two-thirds of patients with nonpalpable testes. In the remaining third of patients, including inguinal exploration after laparoscopy can help exclude a missed viable inguinal testis.

## Acknowledgements

### Conflicts of interest

There are no conflicts of interest.

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