Testing the undescended testis

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Peri-operative surgical findings in congenital and acquired undescended testes

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ABSTRACT

Background
Perioperative surgical findings in congenital and acquired undescended testes (UDT) were prospectively assessed.

Methods
We included all boys with congenital or acquired UDT who underwent orchidopexy at our hospital between January 2006 and August 2009. Perioperatively, we scored the position and volume of the testis, the insertion of the gubernaculum, the patency of the processus vaginalis, and the obtained position.

Results
We included 69 boys (aged 0.9-14.6 years) with 76 congenital UDT and 28 boys (aged 2.2-18.5 years) with 30 acquired UDT. In the congenital group, the testis was in intracanalicular position in 55 cases (72%), whereas in the acquired UDT group, this was in 11 cases (37%; p = .001). The insertion of the gubernaculum was at the bottom of the scrotum in 13 cases (17%) of the congenital UDT group and in 12 cases (40%) of the acquired UDT group (p = .05). The processus vaginalis was open in 63 cases (83%) of the congenital and in 9 cases (30%) of the acquired UDT group (p = .001).

Conclusion
Compared to congenital UDT, acquired UDT are more likely to be situated in the superficial inguinal pouch, to have a normal insertion of the gubernaculum, and to have a closed processus vaginalis.
INTRODUCTION

Undescended testis (UDT) is a common genital abnormality in boys. At present, it is categorized into congenital and acquired forms. The etiology of congenital UDT is multifactorial with hormonal, genetic, and environmental influences. However, the pathogenesis of acquired UDT is less well-known. Possible etiologic factors include a persistent processus vaginalis, which allows the testis to ascend, spasticity of the cremaster muscle, and a relative cranial migration of the testis as the boy grows. In this prospective study, we report on the perioperative surgical findings of congenital and acquired UDT. These findings may contribute to a further clarification of the enigma of acquired UDT.

METHODS

Population
We included all consecutive boys younger than 19 who underwent orchidopexy for uni-or bilateral UDT in our hospital between January 2006 and August 2009. We excluded boys who had had former inguinal surgery (secondarily acquired UDT), boys with chromosomal abnormalities, and boys whose testes were preoperatively found to be positioned low in the scrotum.

Definitions
A retractile testis was defined as a nonscrotal testis that can be manipulated into a low scrotal position, where it remains in a stable position until the cremasteric reflex is elicited, whereas traction on cord structures is not painful.
A UDT was defined as a testis that cannot be manipulated into a stable scrotal position in its most caudal position and further traction on cord structures is painful.
Congenital UDT was defined as a UDT that has not been descended previously, and an acquired UDT was defined as a UDT that was previously descended.

Design of the study
All boys referred to the outpatient clinic for nonscrotal testis were seen by the same pediatrician (WH). Each boy underwent a full physical examination. Testis position was
determined with a 2-handed technique, both with the patient in supine position and in squatting position. If the testis was diagnosed as undescended, it was categorized into congenital or acquired, based on information on previous testicular position obtained from the Youth Health Care Institution Hollands Noorden. This is an institute for youth health care which examines from birth all children according to a fixed schedule. With this, the position of the testes is assessed and noted several times during the first years of life. For boys with a congenital UDT, orchidopexy was planned around the age of 12 months. If referral occurred after the boy’s first birthday, orchidopexy was performed within a few weeks of referral. If the UDT was diagnosed as acquired, a “wait-and-see” policy was followed until puberty, in accordance with the Dutch Consensus on nonscrotal testis. If descent had not already taken place, orchidopexy was performed at puberty (stage 3 according to Tanner, with testis volume measuring 10-15 ml).

**Orchidopexy**

All orchidopexys were performed in boys under general anesthesia as an outpatient procedure. Before the start of the operation, the position of the testis was verified. If an inguinal position of the testis was expected, orchidopexy was started with an inguinal incision. Subsequently, exploration of the groin took place to assess testis position and volume. The testis was mobilized, and if present, the open processus vaginalis was separated from the cord structures and ligated. Retroperitoneal funiculolysis and separation of the cremaster muscle was performed to mobilize the cord. Finally, the testis was fixated scrotally by a scrotal incision in a created dartos pouch. If an abdominal position of the testis was expected, a laparoscopic approach was chosen. If the testis was indeed found in the abdomen, it was laparoscopically brought into the inguinal canal and the procedure was followed as described above. All orchidopexys were performed by the same surgeon (RM).
Surgical findings
During orchidopexy, the following items were scored:

Testis position
With the least as possible manipulation, the position of the testis was assessed as absent, abdominal (proximal to the internal inguinal ring), canalicular (between internal and external ring), superficial inguinal pouch (beyond the external ring), or high scrotal (just inside the scrotum).

Testis volume
During orchidopexy, the volume of the UDT was judged visually as being of normal size for age, small for age or atrophic. No orchidometrical or ultrasonographical measurements were performed.

Gubernaculum insertion
The location of the insertion of the gubernaculum was assessed by pulling at the gubernaculum and determining where the retraction occurred. This was scored as at the bottom of the scrotum (normal) or as upper scrotum, external annulus, elsewhere in the groin, or absent (all abnormal).

Processus vaginalis
The processus vaginalis was judged as being open or closed. No distinction was made between wide or slightly open processus vaginalis.

Obtained testis position
The testicular position after orchidopexy was categorized as high scrotal, mid scrotal, low scrotal, or absent.

Statistical analysis
All data were analyzed with SPSS, version 14.0 (SPSS Inc, Chicago, Ill). The Mann-Whitney test was used to calculate the differences in age at operation between all groups. To compare the differences in surgical findings, we performed statistical analysis using the Fisher’s Exact test. A p-value of less than .05 was considered statistically significant.
Ethical approval
This study was approved by the Ethical Committee of the Hospital (reference no. M06 - 033).

RESULTS

Number of boys and diagnosis
We saw 103 boys with an indication for orchidopexy because of UDT. Six patients with a mean age of 7.9 years (range, 1.3-14.3 years) were excluded. One boy had Klinefelter’s syndrome, and in another boy, the testis appeared to be positioned low in the scrotum. Four other boys were excluded because their UDT was secondarily acquired (2 after hernia repair, 2 after orchidopexy).
Of the 97 included boys, 9 had bilateral UDT and 88 had unilateral UDT (45 left-sided, 43 right-sided). Congenital UDT was diagnosed in 69 boys (7 bilateral and 62 unilateral, of which 33 were left-sided and 29 right-sided), and 28 boys were diagnosed with an acquired UDT (2 bilateral and 26 unilateral, of which 14 were left-sided and 12 right-sided).
In the acquired UDT, in 2 of 30 (6.7%) cases, a previous scrotal position was documented at least once, in 10 of 30 (33.3%) at least twice, in 4 of 30 (13.3%) at least 3 times, and in the remaining 14 of 30 (35%) cases more than 3 times.
There was no significant difference between the congenital and acquired group in the division of unilateral and bilateral UDT (Figure 1).

Age at operation
The age at orchidopexy in the congenital group ranged from 0.9 to 14.6 years (mean ± SD, 1.5 ± 2.25 years) and in the acquired group from 2.2 to 18.5 years (14.5 ± 3.7 years; p<.001) (Figure 2).

Approach of orchidopexy
An inguinal approach was chosen for 92 boys. In 5 boys, a laparoscopic approach was chosen for nonpalpable UDT. All 5 boys had congenital UDT, which was bilateral in one of the boys. Of these 6 nonpalpable testes, 4 were found in the abdomen. Three of these abdominal testes could be placed into the scrotum (in one boy of 2.1 years with
bilateral UDT and a boy of 1.8 years), and one abdominal testis was removed because the funiculus was too short (in a boy of 3.7 years). In a 1.7-year-old boy, the testis was found atrophic in the inguinal canal and was removed. In one boy (1.5 years), only a blind-ending cord structure was found.

Figure 1 Flowchart of boys included in this study with congenital or acquired UDT.

Orchidectomy
Orchidectomy was performed in 7 cases. In 6 of the boys, the surgeon considered the testis to be too atrophic for an orchidopexy (5 congenital UDT, age at operation, 1.3-6.7 years [mean, 2.8 ± 2.2 years]; one acquired UDT, age at operation, 18.5 years). In one
boy, the testis was removed as a result of a funiculus that was too short (congenital UDT, age at operation, 3.7 years).

![Graph](image)

**Figure 2** The numbers of congenital and acquired UDT operated vs age at orchidopexy.

**Anatomical findings**
The perioperative surgical findings of the congenital and the acquired form of UDT are listed in Table 1.

**Testis position**
In the congenital group, 57 (75%) of the 76 testes were in intracanalicular position. In the acquired group, 11 (37%) of the 30 testes were in intracanalicular position (p < .001), whereas the other 19 (63%) were located in the superficial inguinal pouch.
### Table 1 Surgical findings in a cohort of congenital and acquired UDT, indicated for orchidopexy.

<table>
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<th>acquired UDT n = 30</th>
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</tr>
<tr>
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</table>

* Fisher’s Exact Test

**Testis volume**

In 63 (83%) of the 76 congenital UDT the volume was judged as normal, in 4 (5%) as too small for their age and in 6 (8%) as atrophic. Of the 30 acquired UDT, in 5 (17%) the testis volume was considered normal (p < .001), in 24 (80%) it was judged as too small for their age (p < .001) and in 1 (3%) as atrophic.
**Gubernaculum insertion**

In the congenital group, the gubernaculum was absent in 8 of the boys, whereas in the acquired group all boys had a gubernaculum ($p = .03$). In both groups, in 57% the gubernaculum was inserted high in the scrotum (not significant [NS]). In the congenital group, there was a normal insertion (at the bottom of the scrotum) in 13 (17%) of the 76 cases and in the acquired group in 12 (40%) of the 30 cases ($p = .01$).

**Processus vaginalis**

The processus vaginalis was open in 63 (83%) of the 76 cases in the congenital group and in 9 (30%) of the 30 cases in the acquired group ($p < .001$).

**Obtained testis position**

The testis was brought low into the scrotum in 45 (59%) of the 76 cases of congenital UDT and in 21 (70%) of the 30 cases of acquired UDT (NS) (Figure 3).

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**Figure 3**  Schematic drawing of the position of the UDT before (A) and after (B) orchidopexy. (A) At the right side, the congenital UDT, proximal to distal: abdominal (4), intracanalicular (56), superficial inguinal pouch (11), high scrotal (2), and absent (3); at the left side, the acquired UDT: intracanalicular (11) and in superficial inguinal pouch (19). (B) At the right side, the congenital UDT with proximal to distal: high scrotal (12), mid scrotal (10), low scrotal (45), and absent (inclusive removed) (9); at the left side, the acquired UDT: high scrotal (5), mid scrotal (3), low scrotal (21), and removed (1).
Unilateral vs bilateral UDT

We included 88 unilateral UDT, 62 of which were congenital, with an age at operation of 0.9-14.6 years (mean, 2.6 ± 2.3 years), and 26 acquired UDT, with an age at operation of 2.3 to 18.5 years (mean, 13.5 ± 4 years). We studied 18 bilateral UDT, 14 of which were congenital, with an age at operation of 0.9 to 4.6 years (mean, 2.3 ± 1.5 years), and 4 were acquired, with an age at operation of 13.4 to 14.6 years (mean, 14 ± 0.7 years).

Both in the congenital and the acquired group, the differences in age at operation and in surgical findings between unilateral and bilateral UDT were not significant. However, there was one exception: the obtained low scrotal position of the testis in the congenital group; 33 (53%) of the 62 cases of unilateral UDT vs 12 (86%) of the 14 cases of bilateral UDT were brought in a low scrotal position (p = .02) (Table 2).
**Table 2** Surgical findings in a cohort of congenital and acquired UDT, indicated for orchidopexy, subdivided into unilateral and bilateral UDT.

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* Fisher’s Exact Test
DISCUSSION

To the best of our knowledge, this is the first prospective study on perioperative surgical findings, comparing the congenital and acquired form of UDT. The results of our study show that 72% of the congenital UDT are in intracanalicular position, whereas 63% of the acquired UDT are situated in the superficial inguinal pouch. In 40% of the acquired UDT, the gubernaculum is normally inserted at the bottom of the scrotum, whereas this was the case in only 17% of the congenital UDT. Furthermore, congenital UDT was more likely to have a patent processus vaginalis compared to acquired UDT (83% and 30%, respectively).

The pathogenesis of congenital UDT is considered to be multifactorial, including hormonal, genetic, and environmental factors.\textsuperscript{10,11} Surgical findings reported earlier include an abnormal attachment of the gubernaculum in 80\% to 83\%\textsuperscript{12,13} and a patent processus vaginalis in 52\% to 87\%.\textsuperscript{12-15} In these studies, the ages of the patients varied between 2 months and 33 years, and no distinction was made between congenital and acquired UDT.

With a prevalence of 1.1\% to 2.2\% in the general population, acquired UDT is a significant subset of UDT cases.\textsuperscript{16} However, the pathogenesis of acquired UDT has been studied less extensively, and only a few studies have been published on anatomical findings. In their retrospective study, Rusnack et al\textsuperscript{17} distinguished between the ascending testis and the testis undescended since birth. In agreement with our results, they found the processus vaginalis to be more likely to be closed in the ascending testis than in the testis undescended since birth (57\% and 36\%, respectively).

Donnell et al\textsuperscript{18} found an open processus vaginalis in 100\% of the congenital UDT and in only 28\% of the acquired UDT. Nevertheless, conflicting findings are reported about the processus vaginalis in acquired UDT with a patency rate varying from 48\% to 78\%.\textsuperscript{19,20}

Clarnette et al\textsuperscript{21} documented a fibrous remnant of the processus vaginalis situated deep to the cremasteric muscle and spermatic fascia in 33 orchidopexy performed for ascending testis. However, in our study, we did not discriminate any fibrous remnant in the cord structure. This is because of the close proximity of the spermatic fascia, cremaster muscle, ductus deferens, spermatic artery, and vein, which makes the detection of a fibrous remnant nearly impossible.

Barthold et al\textsuperscript{8} reviewed published cases of testicular ascent and concluded that testis position was in the superficial inguinal pouch in 29\% of the cases, in inguinal position
in 22%, and in prescrotal/high scrotal position in 48%. In our study, the acquired UDT was most frequently located in the superficial inguinal pouch (63%). Similarly, in a study by Guven and Kogan 19, 74% of ascending testes were located in the superficial inguinal pouch and 13% in intracanalicular position.

Comparing the unilateral and the bilateral UDT, the only significant difference we found was that we brought more bilateral than unilateral congenital UDTs in a low scrotal position (86% vs 53%; p = .02). The reason for this finding is unclear and as far as we could ascertain this has not been reported in the literature.

To understand more of the etiology of the acquired UDT, one might wonder whether acquired UDT is in fact a low-lying congenital UDT, as was suggested by Redman 22 and Roszanki and Bloom.23 The significant differences we found between the surgical findings of both groups might indicate that they are not. On the other hand, congenital aspects in the acquired UDT, such as patent processus vaginalis (30%) and abnormal insertion of gubernaculum (60%), cannot be ignored.

Therefore, the hypothesis that acquired UDT is in fact a variant of congenital UDT seems to make sense. Of the acquired UDT with an abnormal insertion of the gubernaculum, 39% (7/18 cases) had an open processus vaginalis, whereas of the acquired UDT with a normal insertion of the gubernaculums, 17% (2/12 cases) had an open processus vaginalis (NS). The hypothesis that an open processus vaginalis allows the testis to ascend 8 might be realistic. However, in 70% of the acquired UDT in this study the processus vaginalis was closed. Therefore, it seems likely that, as in congenital UDT, the etiology of acquired UDT is multifactorial.

Because we only studied acquired UDT that did not descend spontaneously, it may be interesting to compare the surgical findings of our selected group with the surgical findings observed in earlier studies of the entire group of acquired UDT. Meijer et al 24 retrospectively studied surgical findings in 461 acquired UDT. They documented a normal attachment of the gubernaculum in 99% (121/ 122 cases), whereas in our study, this was only the case in 40% (12/30 cases) (p < .001). This might indicate that an abnormal insertion of the gubernaculum inhibits spontaneous descent. Furthermore, Meijer et al 24 documented an open processus vaginalis in 55% (113/207 cases). This differs significantly from the 30% (9/21 cases) of open processus vaginalis that we observed (p = .01). This might suggest that an open processus vaginalis promotes a spontaneous descent; however, a more realistic explanation may be that an open processus vaginalis has been noted more often than a closed one in this retrospective study.
Although our intention was to perform orchidopexy around the 12th month of age for boys with a congenital UDT, the age at operation of these boys ranged from 0.9 to 14.6 years (mean ± SD; 1.5 ± 2.3 years) with a median of 1.5 years (Figure 2). Late referrals and misdiagnosis were the main reasons for this discrepancy. Additional, at present, orchidopexy is advised between 6 and 12 months of age.\textsuperscript{25}

In the acquired group, a “wait-and-see policy” was followed till puberty. In case of nondescent, orchidopexy was performed at puberty. Although, the age at operation of the boys with an acquired UDT was 2.2 to 18.5 years (14.5 ± 3.7 years) with a median of 15 years (Figure 2). In 3 boys, operation before puberty was performed, at 2.2, 3.3, and 6.1 years of age. In 2 boys because of hernia inguinalis, and in one boy, the parents preferred surgical correction.

Of the acquired UDTs, 80\% were judged to be too small for age at the time of orchidopexy. It should be noted that formerly cryptorchid adults usually present later in life with a testis volume half of its counterpart.

Furthermore, we recently performed a long-term follow-up study on testicular growth of acquired UDT after pubertal orchidopexy. We found after pubertal-orchidopexy for nondescent, of the 85 measurements, 79 (93.0\%) were at the 10th centile or higher, 53 (62.4\%) were at the 50th centile or higher, and 12 (14.1\%) were the 90th centile or higher.\textsuperscript{26} In unilateral cases after pubertal orchidopexy, 40 (70.4\%) of the 51 testes were smaller and 9 (17.6\%) were equal in size. Therefore, despite its smaller volume at orchidopexy long-term testicular volume growth seems to be within normal range.

The limitations of this study need to be addressed. The distinction between congenital and acquired UDT is based on information on previous testicular position documented at the Youth Health Care Institution. Because of the Dutch consensus on “nonscrotal testis,” the importance of adequate assessment of the testicular position in early years is wellknown. The number of physicians involved is unknown as well as the interobserver variation. Another limitation of this study is the subjective method that was used to measure testis volume. Although judged by an experienced surgeon, the volume of the testis was only assessed visually. Possible reactive hypertrophy of the contralateral testis has been taken into account. Still, a more validated method, with a ruler or with ultrasound, would have given more objective results. Furthermore, the group of acquired UDT studied is small. Because of spontaneous descent of most of the acquired UDT, we could only include 30 acquired UDT in a period of 3.5 years. A larger study group would have given more solid results. Moreover, we studied acquired UDT that
did not descend spontaneously, and consequently, no anatomical findings are available for acquired UDT that descended spontaneously. Therefore, our population may differ significantly from most other published groups of acquired UDT because in these studies orchidopexy was scheduled as soon as the boy was diagnosed with an acquired UDT.

We believe that further clinical research should focus on the whole and accordingly larger group of boys with acquired UDT with a more accurate testis volume measurements. Furthermore, future research is required to determine whether an acquired UDT will descend spontaneously. Studies have shown that spontaneous descent occurs at the beginning of puberty in 57% to 76% of the cases. Identifying possible factors influencing spontaneous descent, such as an open processus vaginalis or gubernaculum insertion, might help to predict which acquired UDT will descend spontaneously and which will not.

**CONCLUSION**

There are differences between congenital and acquired UDT in testis position, testis volume, open or closed processus vaginalis, and the location of the gubernaculum insertion. This seems to support the theory that these are two different identities, although congenital aspects are clearly present in acquired UDT.

We believe further research is necessary that should include larger groups of boys with acquired UDT including prepubertal boys.
References