Surgical and morphological outcome of one-stage laparoscopic orchidopexy with preservation of gubernaculum and interruption of spermatic vessels in comparison to two-stages fowler–Stephens's orchidopexy technique with preservation of gubernaculum for impalpable testis

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Background
For the care of nonpalpable testis, laparoscopy has acquired complete acceptability in both diagnostic and therapeutic settings. Standard laparoscopic for situations where the length of the spermatic arteries can prevent tension-free testicular mobilization in the scrotum, Fowler-Stephens' (F-S) orchidopexy is a widely used and acknowledged procedure. Maintaining a healthy testis' vascularity requires gubernaculum sparing with testicular vessel cutting. Our research recommends using the F-S approach with the preservation of the gubernaculum in a single stage rather than two phases for the same outcomes. Setting: the pediatric surgery outpatient clinic at hospitals affiliated with Ain Shams University and the Armed Forces Hospitals.
Patients and methods
This was a Randomized controlled clinical trial (RCT), conducted on boys with nonpalpable testicles between 1 and 6 years old, in 2 Egyptian pediatric surgery units, between October 2019 and September 2022. The patients who met the inclusion criteria were divided into two groups to compare their outcome (atrophy and success rate): (group A with 25 impalpable testicles was subjected to one-stage laparoscopic assisted orchidopexy with interruption of spermatic vessels and preservation of the gubernaculum, while group B with 25 impalpable testicles was subjected to two-stages laparoscopic assisted orchidopexy with interruption of spermatic vessels and preservation of the gubernaculum).
Results
The mean age of all patients was (3.9±1.8), 113 nonpalpable testicles were examined during the period of our study, and 50 nonpalpable testicles met our inclusion criteria. They were divided into two groups according to surgical procedure. There were no significant differences between the two groups according to age, and preoperative testicular volume. Postoperative outcome (atrophy and success rate) had no significant differences. Operative time and hospital stay were statistically decreased in the group performed with one stage.
Conclusion
To conclude, one-stage laparoscopic F-S orchidopexy with preservation of gubernaculum is as effective as two-stage laparoscopic F-S orchidopexy with preservation of gubernaculum.

Keywords:
gubernaculums, impalpable testis, laparoscopic orchidopexy, testicular vessels

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Introduction

Testicular vascular ligation was originally researched in 1959 [1] to gain length for the transfer of the intra-abdominal testis to a scrotal location. Later, the method was changed to a two-stage treatment, consisting of an initial ligation and testicular mobilization to increase collateral circulation 6 months later, with a decreased incidence of testicular atrophy [2]. In the field of pediatric surgery, laparoscopy has acquired complete acceptability for both diagnostic and therapeutic purposes in the management of nonpalpable testes. There have been a thousand examples in the literature demonstrating the influence of laparoscopy in the management of nonpalpable testis since the initial documented cases over a quarter of a century ago [3]. Better exposure, illumination, and magnification, as well as precise anatomic evaluation of position and viability and, if necessary, ideal accessibility to the surgical problem's core, are all advantages of laparoscopy over a conventional surgical method [4]. It has been up for discussion for a long time which surgical approach is best for treating intra-abdominal testis. Standard laparoscopic for situations when the length of the testicular arteries can prevent tension-free testicular mobilization in the scrotum, Fowler-Stephens' (F-S) orchidopexy is a well-acknowledged procedure. Testicular atrophy rates, however, can reach 20%, while success rates range from 80 to 85% [5]. In a laparoscopic orchiopexy, the testicular arteries are first clipped, then the testis is completely mobilized, including the gubernaculum is cut to acquire greater length so the testis may be placed into the scrotum without strain, 6 months later [6]. We were able to analyze and precisely depict the architecture of the abdominal testis and its blood supply thanks to laparoscopy [7]. The testicular arteries that hold the testis in the abdominal position feed the abdominal testis with the majority of its blood. The vessels of the vas deferens and the vessels of the gubernaculum both give accessory vessels [8]. The anatomical delivery of the testis through the internal inguinal ring during a gubernaculum-sparing laparoscopic orchidopexy (LO) has been suggested as an alternative to the traditional laparoscopic F-S orchidopexy [9]. Regular gubernaculum cutting is not required for proper mobilization of the abdominal testis in the second stage, which is performed 6 weeks after the first stage, because collateral circulation differs from patient to patient and must be preserved once the gubernaculums demonstrate a prominent blood supply [8].

Aim

This research compared the results of a one-stage laparoscopic F-S orchidopexy with gubernaculum preservation versus a two stage laparoscopic F-S orchidopexy with gubernaculum preservation.

Patients and methods

Patients

A total of 50 patients were enrolled in the study. Study design: Randomized controlled clinical trial (RCT). Setting: The outpatient clinic in the paediatric surgery department of Ain Shams University hospitals and the paediatric surgery department clinics in Armed Forces hospitals. Target population: Pediatric patients who presented with undescended testis which is impalpable. Inclusion criteria: Pediatric patients from the age of 1 year to 6 years old who were presented to the outpatient clinic with impalpable testis. Exclusion criteria: Palpable gonads after examination under general anesthesia, Vanished testis which were discovered during the operation and peeping or canalicular testis after diagnostic laparoscopy, as they were all managed by orchidopexy without division of testicular vessels. Patients' randomization: they were divided into two groups: all patients with odd number in group A, and all patients with even number in group B (Bilateral cases was counted as two testes and were included in the same group). Group A: subjected to one stage laparoscopic F-S orchidopexy with gubernaculum preservation. Group B: two stage laparoscopic F-S orchidopexy with gubernaculum preservation. All patients had a second examination while sedated. After that, we would perform a laparoscopy if the testis was still impalpable.

Methods

Patients were subjected to the following: in both groups: initially, laparoscopies were done to determine the architecture of the gubernaculum, its connection to the internal ring, and its relationship to it, including whether it passed through a patent ring to be joined to the inguinal area outside the abdomen or was attached to a closed ring without attachment to the inguinal region. The testicular vessels were then clipped and severed as high as feasible away from the testis after that. In group A: to protect the gubernaculum and its blood supply, the lateral peritoneal fold was removed, leaving the medial peritoneal strip carrying the collateral circulation between the vassal and testicular arteries. The testis was then immediately mobilized. If necessary, the medial edge of the internal ring is excised to medize the gubernaculum. A scrotal incision was made once the testis was fully mobilised, and a long clamp was then threaded through to emerge on the lateral side of the umbilical ligament, establishing a new route for the testis to go to the scrotum. A Babcock forceps passed through the scrotal incision holding the mobilized testis, to be brought outside the abdomen into the scrotum and fixed into the median scrotal raphe using 5-0 vicryl suture. The dimensions of the testis were measured by surgical thread and compared with its dimensions in follow-up by ultrasound. Then we calculated the volume of the testis by the equation for ellipsoid organs (Testicular volume=Lenght$\times$ Width^{2}x0.52) (TV=L$\times$W^{2}x0.52) to be compared later with Ultrasound records [10]. While in group B: In the initial stage, a surgical thread was inserted into the abdomen to measure the testis' size. Six weeks later, the second stage was performed. The vitality of the testis was evaluated during a laparoscopy. The same steps were done for group 1. Once more, the testis' dimensions were measured using surgical thread so that their ultrasonic follow-up measurements could be compared (Volume=L×W^{2}x0.52).

Primary outcome measures

Testicular atrophy, defined as the capacity to palpate a nubbin or the inability to palpate a testis (total atrophy), is the main (dependent) outcome of this research. It was measured at 3, 6, and 9 months after surgery. Doppler ultrasonography and ultrasound are frequently used to advance the diagnosis of testicular atrophy.

Follow-up parameters

Short-term follow-up performed (3, 6, and 9 months) postprocedure to assess the viability, size and site of the testis by ultrasound and Doppler to be compared with the size of the testis which was taken during the operation and apply TAI (Testicular atrophy index) TAI = (contralateral testis volume - affected testis volume)/contralateral testis volume x 100 and expressed as a percentage [11].

Ethical considerations

(1) All patients were included in this study only after taking informed consent.

Statistical analysis

Sample size

The proportion of atrophy changes is used to estimate the sample size. Group sample sizes of 20 cases/group achieve 80% power to reject the null hypothesis of zero effect size when the population effect size is 0.80 and the significance level (alpha) is 0.050 using a one-sided z-test. Five cases should be added to each group to compensate for the loss of follow-up resulting in a sample size of 25 cases/group.

MedCalc ver. 20 (MedCalc, Ostend, Belgium) was used for data entry, processing, and statistical analysis. The Mann-Whitney's, χ^2, Spearman's correlation, and receiver operating characteristic (ROC) Curve analyses were performed as tests of significance.

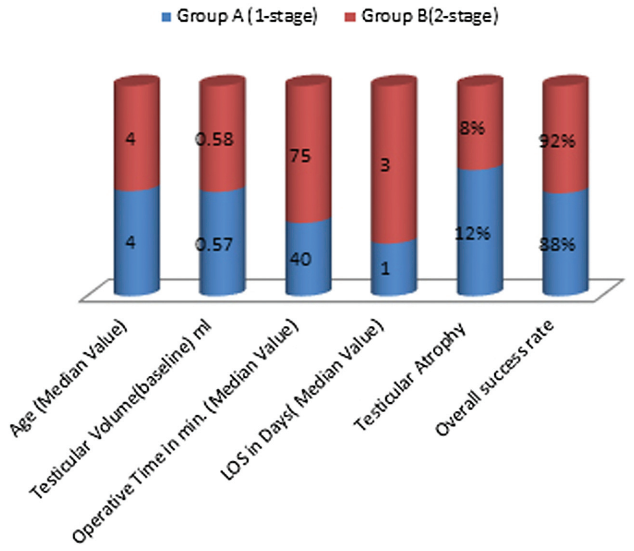
Results

One hundred thirteen nonpalpable testicles were brought into the clinic; 11 (10%) of these were eliminated because the gonads could be felt after examination under anesthesia, and nine (8%) were eliminated because all of the nonpalpable testicles that had peeping or canalicular testis after diagnostic laparoscopy were treated with orchidopexy without the division of testicular vessels. Fourty-three (38%) of the 93 nonpalpable testes that were still present were vanishing testes, leaving 50 (44%) genuine Intra Abdominal Testicle (IAT) that was handled by LO and made up our research sample. A randomized controlled clinical study (RCT) was conducted here, which compared the results of a one-stage LO with testicular vessel interruption and gubernaculum preservation to a two-stage laparoscopic F-S orchidopexy with preservation of the gubernaculum on the remaining 50 nonpalpable undescended testes that met our inclusion criteria. Regarding comparison investigations, the 50 undescended testes that could not be palpated were divided into two separate groups based on the surgical technique: group A (1-stage) (25 Impalpable testis) and group B (2-stage) (25 Impalpable testis). In the tables and figures below, comparative studies are displayed; A comparison of the two groupings, Except for operative time and LOS, which are statistically significantly lowered in 1 stage (group A) compared with 2 stages (group B), there was no significant difference in any of the data disclosed ($P > 0.05$) (Table 1).

Table 1 Comparison between the two groups as pre and postoperative data using Mann–Whitney's *U* test

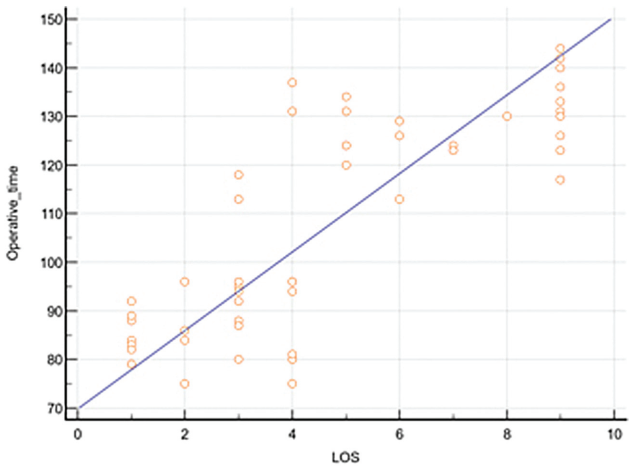
Variable	Group A (1-stage) (25)	Group B (2-stage) (25)	*P* value
Age	4 (2.7–5.2)	4 (2.7–5.2)	=0.9133
Testicular volume (baseline) (ml)	0.57 (0.52–0.61)	0.58 (0.54–0.64)	=0.5726
Operative time (min)	40 (35-45)	75 (70-80)	<0.0001**
LOS (days)	1 (1–2)	3 (2–4)	<0.0001**
Testicular volume postoperative follow-up			
(3-months) (ml)	0.56 (0.51–0.6)	0.58 (0.54–0.64)	=0.2846
(6-months) (ml)	0.57 (0.51–0.61)	0.58 (0.53–0.64)	=0.3213
(9-months) (ml)	0.56 (0.52–0.61)	0.57 (0.54–0.64)	=0.2678
Testicular atrophy	3 (12%)	2 (8%)	=0.7156
Overall Success rate	22 (88%)	23 (92%)	=0.7156

Figure 1



Comparison between group A (1-stage) and group B (2-stages) as regards all parameters.

Figure 2

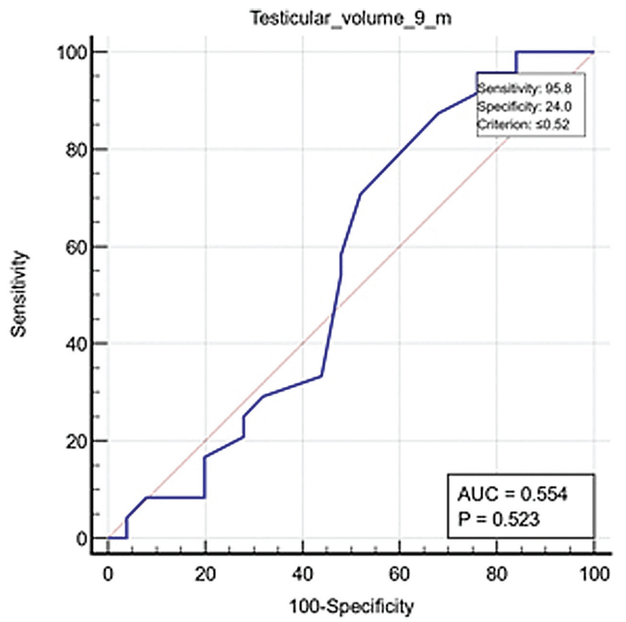


Correlation between LOS and Operative time.

According to correlation studies between postoperative outcomes and its relative independent predictors (basic clinical, peri-operative data, and surgical technique variables), operative time had a highly significant positive correlation with LOS (P 0.0001), according to Spearman's correlation analysis (Figs. 1–4).

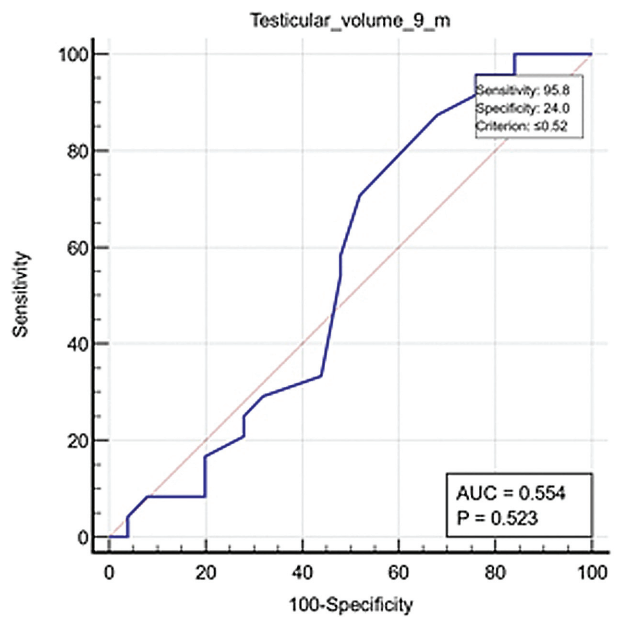
Using ROC curve analysis to predict surgical technique efficacy revealed that; 1-stage technique predicted patients with the same Testicular volume (9 months), with sensitivity= 92% and specificity = 28% (P > 0.05).2-stage technique showed nonsignificant predictive values regarding Testicular volume (9 months) (P > 0.05).

Figure 3



Receiver operating characteristic curve of 1-stage technique –testicular volume (9-months).

Figure 4



Receiver operating characteristic curve of 2-stages technique – testicular volume (9-months).

Discussion

Today, laparoscopic orchiopexy is the accepted method of treating intraabdominal testis. The whole anatomy, viability, and existence or absence of an intraabdominal testis may all be precisely determined by laparoscopy [3]. A tension-free mobilization of an intraabdominal testis is often limited by access to the whole course of the testicular arteries to their origin, which is made possible through laparoscopic orchiopexy. Because the surgeon may move throughout the whole abdominal cavity while using laparoscopic equipment, close dissection of the testicular arteries is feasible. The primary and collateral blood supply can be preserved and dissected more easily when these tiny arteries are magnified [3]. Fowler and Stephens first described the vascular supply of the testis in children with intraabdominal testis in 1959. They then suggested ligating the testicular vessels in the hopes of preserving function through collateral circulation through the deferential artery, a branch of the inferior vesical artery, and the cremasteric artery, a branch of the inferior epigastric artery. The two-stage method with a 6-month gap was first suggested by Ransley *et al.* in anticipation of the emergence of a collateral blood supply following the division of testicular arteries [2]. Understanding the testicular blood flow is essentially the key to managing elevated intraabdominal testis. After the testicular artery is divided, the testis becomes more dependent on collateral blood supply [12]. The vas deferens artery, an inferior vesical artery branch of the internal iliac artery, and the cremasteric artery, an external iliac artery branch via the inferior epigastric artery, both supply collateral blood to the testis. Additionally, it has been demonstrated that the gubernaculum has an excellent blood supply [13]. The preservation of the gubernaculum and its collateral blood supply (cremasteric vessels) during LO may lower testicular atrophy rates, according to research from Hay and Braga and colleagues [5,8]. Our findings suggest that, for children with nonpalpable undescended testis, we can perform LO with preservation of guberuculum and ligation of its testicular vessels in one stage rather than using the same technique in two stages, with no appreciable differences in the final postoperative result. The method for maintaining the IAT's blood supply during LO is not a recent development; DeMaria and Liaconis were the first to describe it in 2003 and successfully use it in infants with Non-Palpable Testicle (NPT) [14]. Wang and Shaul then used the same gubernaculum preservation strategy for 14 boys with IAT who underwent two-stage LO in 2004 [15]. When Hay, Robertson *et al.*, and others reported on their experiences with Gubernaculum Sparing Laparoscopic Orchiopexy (GSLO) in 2007 [8,9], they found very low atrophy rates that varied from 0 to 3%.In 25 patients who had 2-stage GSLO. In 2014, Ellis and colleagues [13] discovered a 100% testicular survival rate, indicating that the preservation of this extra blood supply contributed to their outstanding results. When the gubernaculum vascularization is well established, its preservation can only assist avoid testicular atrophy since the deferential artery often has weak collateral arteries, even if collateral blood flow is varied and unique to each patient [8]. The gubernaculum should be retained for extra collateral blood flow if the aim is to proceed with one-stage F-SO, according to Nayci *et al.*'s conclusion from 2107 [12]. For a variety of reasons, the GSLO procedure may enhance testis survival. First, anatomical investigations have demonstrated that there are three main sources of testicular blood supply for IAT: the deferential artery, which emerges from the internal iliac artery or superior vesical artery, the testicular or internal testicular artery, and the cremasteric artery, which is a branch of the inferior epigastric artery [13]. Second, compared with procedures that preserve these vessels, laparoscopic orchidopexies with transection of the testicular vessels have been shown to have greater rates of testicular atrophy [16,17]. Therefore, it makes intuitive sense that maintaining two sources of collaterals (the deferential and cremasteric arteries in GSLO) should be preferable to maintaining one (the deferential artery alone in Conventional Laparoscopic Orchiopexy (CLO)) if preserving three sources of blood supply (not clipping the testicular vessels) is better than maintaining two (clipping) [5,8]. Additionally, the GSLO approach prevents harm to an occasional long loop vas deferens (together with the associated deferential artery) by not mobilizing or transecting the gubernaculum inside the inguinal canal [5]. A longer rate of testicular atrophy was seen after a two-stage F-S LO with a long loop vas (transection of the gubernaculum and cremasteric arteries) in comparison to an open technique under the same conditions (which maintains the gubernaculum) in 2009, according to Dave *et al.* [18]. Additionally, Abdelhalim and colleagues found that testicular atrophy after staged orchidopexy occurred following testis manipulation during the second stage rather than testicular vascular cutting during the first stage. Although they split the gubernaculum and cremasteric collaterals during LO, these authors nevertheless experienced a 34% atrophy rate [19]. However, when Alam *et al.* evaluated testicular atrophy and malpositioning rates between staged F-S procedures and one-stage LO techniques retrospectively in 2017 [20], they found no appreciable difference in atrophy rates between the 2 methods. Braga *et al.*'s research from 2019 showed that GSLO is a feasible substitute for CLO. Testicular atrophy rates may be greatly reduced if the testicle is satisfactorily relocated in a dependent scrotal position provided the deferential and cremasteric arteries are preserved as shared sources of blood supply to the testis [5]. To compare the results of a one-stage laparoscopic F-S orchidopexy with gubernaculum preservation to a two-stage laparoscopic F-S orchidopexy with gubernaculum preservation, we performed a RCT on 50 nonpalpable undescended testes for our study. Testicular atrophy, defined as the capacity to palpate a nubbin or the inability to palpate a testis (total atrophy), was the main (dependent) outcome of this study. It was measured at 3, 6, and 9 months after surgery. Doppler ultrasonography and ultrasound are frequently used to advance the diagnosis of testicular atrophy. Performing short-term follow-ups at 3, 6, and 9 months after the surgery to gauge its viability, Testicular size measured by ultrasonography and Doppler will be compared with testicular size measured following surgery. We discovered that the mean age of all patients was (3.9±1.8) years based on pre-operative data. According to which Alzahem, AbdElsalam *et al.*, Braga *et al.*, and Iqbal *et al.* 2020 were all in accord [5,21–23]. According to Braga *et al.*, 2019, the mean and median ages at surgery ranged from 9 to 120 months [5] and were 25.7±13.3 months and 22 months, respectively. According to Alzahem, the average age at presentation was 24 months (9–96 months) [21]. AbdElsalam et al. comprised 37 males with cryptorchids and 40 nonpalpable testicles. They were 9 months to 11 years old (mean 3.46 SD 3.1 years) [22]. Iqbal *et al.* also said that the median age of children was 48 months (range: 12 to 108 months) and that the mean age of children was 4.11±1.98 years (49.2 months mean age) [23]. A total of 19 males were operated on at a mean age of 5.6 months and followed for a mean of 2.35 years, according to Hindi and Khalaf's analysis [24] (Table 2).

The average preoperative testicular volume was (0.57 ±0.07) ml, which was in accordance with Al Hindi and Khalaf's findings from 2021, who said that preoperative testicular volume was at a mean of 0.42 ml (range: 0.39–0.45 ml) [24]. According to surgical technique, the 50 nonpalpable undescended testes were divided into two separate groups: group A (1-stage) (25 Impalpable testes) and Group B (2-stages) (25 Impalpable testes). Age differences between the two groups were not statistically significant ($P > 0.05$), according to a comparison study. Testicular volume (baseline) was compared between the two groups, although there was no statistically significant difference ($P > 0.05$). In line with Comploj and colleagues and Bawazir and Maghrabi [25,29], respectively. Additionally, preoperative statistics were equivalent across the two groups, according to Bawazir and Maghrabi's study [29]. A comparison between the two groups showed that group A one-stage) had a

Table 2 Comparison between different studies

	No. Of cases	Mean age	Preoperative volume	LOS		Operative time (min.)		Success rate		Atrophy rate	
				One stage	Two stages	One stage	Two stages	One stage	Two stages	One stage	Two stages
Current study	50	3.9±1.8 years	0.57±0.07 ml	1-2 Days	2-4 Days	40 (35-45)	75 (70-80)	88%	92%	12%	8%
Braga *et al.*, 2019 [5]	212	25.7±13.3 months	N/A	N/A	N/A	N/A	N/A	99.4%	71.7%	0.6%	28.3%
Alzahem (2013) [21]	34	24 months (9-96 months).	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AbdElsalam *et al.*, 2019[22]	N/A	3.46 SD 3.1 years	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Iqbal *et al.*, 2020[23]	N/A	4.11±1.98 years	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hindi & Khalaf's 2021[24]	N/A	5.6 months	0.39-0.45 ml	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Comploj *et al.*, 2011[25]	33	N/A	N/A	N/A	N/A	N/A	N/A	78%	82%	22%	18%
In Sahin *et al.*, 2002[26]	N/A	N/A	N/A	3 Days	9 days	N/A	N/A	100%	100%	none	none
Farhan & Howidi's 2013[27]	N/A	N/A	N/A	N/A	N/A	86.6±10.1	122.7±13.5	N/A	N/A	N/A	N/A
Elyas *et al.* (2010)[28]	204	N/A	N/A	N/A	N/A	N/A	N/A	80%	85%	20%	15%

statistically significant reduction in operational time and LOS compared with group B (two-stage) (P 0.05, respectively). In Sahin *et al.* and Farhan and Howidi [26,27], the outcome was the same. According to Sahin *et al.* patients who underwent one-stage laparoscopic orchiopexy spent an average of 3 days in the hospital, as opposed to 9 days for patients who received two-stage laparoscopic orchiopexy [26]. The operative time difference between the two groups was large, according to Farhan and Howidi's paper (86.6 ±10.1 min for one-stage vs. 122.7±13.5 min for two-stages FSO) [27]. Testicular atrophy and postoperative testicular volume were not significantly different between the two groups (both procedures were successful) ($P > 0.05$). This was in line with Sahin *et al.*, Elyas *et al.*, Comploj *et al.*, Farhan and Howidi, Wang and colleagues [5,25–28,30,31], Ostlie and colleagues [5,25–28,30,31], and Braga and colleagues [5,25–28,30,31]. According to Sahin *et al.* none of the patients had testicular atrophy, and their serum testosterone levels were all within normal limits. 5 (33%) of the 15 patients in the two-stage orchiopexy group and 2 (25%) of the 8 patients in the one-stage group both saw volume decreases that were on average 30% and 40%, respectively [26]. Elyas *et al.* compared one-stage and two-stage Fowler-Stephens orchidopexy in a systematic study. Based on 9 papers and 204 testes, the combined projected success percentage of a one-stage F-S orchidopexy was 80%; based on 36 publications and 751 testes, versus 85% for a two-stage F-S orchidopexy [28]. The Kaplan-Meier plot of the cumulative incidence of testicular atrophy did not show any statistically significant differences between the one-stage F-S and two-stages F-S treatment subgroups, according to Comploj and colleagues report [25]. Testicular Doppler analysis indicated four atrophied testes in the group of individuals with one-stage F-S O. (22.2%), compared with two atrophied testes in the group of individuals with two-stages F-S O. (18%). However, this difference was statistically insignificant. Additionally, the difference in the ideal scrotal location was inconsequential [27]. Wang *et al.* additionally said that neither the one-stage F-S group nor the two-stage F-S group saw a significant decrease in postoperative testicular volume ($P > 0.05$). The postoperative T levels in both groups were considerably higher than the preoperative levels (P 0.05), although the postoperative FSH and E2 levels were significantly lower (P 0.05). Between the two surgical procedures, there were no appreciable variations in testicular volume, T, FSH, or E2 levels ($P > 0.05$) [30]. The final postoperative results (success rate and atrophy) for the two groups were not significantly different (both approaches were effective), with success rates of 88 and 92%, and atrophy rates of 12 and 8% for one-stage and two-stage procedures, respectively ($P > 0.05$). That was in line with Sahin and colleagues, Elyas and colleagues, Comploj and colleagues, and Braga and colleagues [5,25,26,28]. According to Sahin *et al.* patients with abdominal testes can successfully undergo either a two-stage F-S orchiopexy or a conventional one-stage laparoscopic orchiopexy, and the testes can be fixed to their palpable original positions without affecting the secretion of testosterone. Their experience implies that single-stage laparoscopic orchiopexy is the preferred technique, despite the same results [26]. Concerning the conventional FS method (without preserving the gubernaculum), Comploj *et al.*, Fowler-Stephens orchidopexy one stage (FSI) had an overall success rate of 79%; 64% (21/33) of the patients had normal scrotal size and location; 15% (5/33) were not at the deepest scrotal point; and 21% (7/33) had atrophy of the testicles. The total success rate for Fowler-Stephens orchidopexy two stages (FSII) was 82%: 76% (13/17) of the testicles were discovered to be normal size, 6% (1/17) to not be in the deepest region of the scrotum, and 18% (3/17) to have testicular atrophy [25]. After a meta-analysis comparing one versus two-stage CLO discovered no difference in success rates between these 2 techniques [28], Elyas *et al.* came to that conclusion. Moreover, Alzahem's overall success rates for LAO and FSO were 88 and 63%, respectively, it was stated. For LAO and FSO, the overall rates of testicular atrophy were 3 and 30%, respectively (OR 0.08 [95% CI, 0.01–0.69], $P = 0.006$) [21]. In their 2015 study, Ostlie and colleagues described 27 of the 112 patients who had intraabdominal testes and needed to have their testicular arteries divided after laparoscopic orchiopexy. The results were identical in both groups, with 14 receiving a one-stage F–S operation and the remaining 13 receiving a two-stage surgery [31]. However, while employing the guburnaculum sparing approach, Braga and colleagues reported that, a single in 44 (21%) cases, a stage process was used, and in 168 (79%) cases, a two-stage strategy was used. In 46 (22%) patients CLO was performed, and in 166 (78%) GSLO. The total percentage of atrophy was 6.6% (14/212). In the GSLO group, one out of 166 testes atrophy while only 13 out of 46 do in the CLO group (0.6% vs. 28.3%, P 0.01). GSLO single stage showed no atrophy over 20 instances in comparison to GSLO two-stage, which had one atrophy over 148 (0.6%) cases [5]. Eight of 44 tests exhibited atrophy after CLO one-stage repair compared with 6 of 168 after CLO two-stage surgery (18.2 vs. 3.5%, P 0.01).

Our study revealed that, no significant difference in the final outcome between one or two stages of laparoscopic F-S in case of preservation of the gebrnauclum. This intuitively obviates children's two hospital admissions with its hazards, reduce the risk of exposure to anesthesia, save the hospital resources and protect the child's psychology from experiencing entering the operative room multiple time.

Conclusion

Consequently, one-stage laparoscopic F-S orchidopexy with preservation of the gubernaculums is just as successful as two-stage laparoscopic F-S orchidopexy with preservation of the gubernaculum.

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Authorship: All the listed authors contributed significantly to the conception and design of study, acquisition, analysis, and interpretation of data and drafting of the manuscript, to justify authorship.

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Conflicts of interest

There are no conflicts of interest.

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