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ORIGINAL ARTICLE

A Comparison of Outcomes of Staged Laparoscopic traction Orchiopexy and Two Stage Fowler-Stephens Orchiopexy in the management of Intra-abdominal Testicle; Prospective controlled clinical trial study.

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ABSTRACT

Background and aim: An established and widely used procedure for intra-abdominal testis is laparoscopic orchiopexy. Unlike the two-stage Fowler-Stephens approach, which divides the testicular vessels, the traction technique is focused on elongating the vessels without cutting them. The current study compared two stage Stephen Fowler laparoscopic orchiopexy for the abdominal testis with phased laparoscopic traction orchiopexy (Shehata technique). **Methods:** This prospective study was conducted at Pediatric Surgery Department, Zagazig University Hospitals on twenty-four patients with impalpable undescended testes. Patients were categorized into two groups; the first group underwent staged laparoscopic traction orchiopexy (Shehata technique), and the second group underwent staged laparoscopic Fowler Stephens orchiopexy (FSO). **Results:** There was an increase in frequency of diminished testicular vascularity at 1, 2 & 3 months in Group II compared to Group I but without statistical significance. No cases had testicular retraction in both Groups. Regarding testicular position, there was an increase in frequency of low scrotal position in Group I compared to Group II (91.7% versus 75%) but without statistical significance.**Conclusion:** The favoring results of Shehata technique make it as a good alternative to Fowler Stephens technique. As it results in significant elongation with preservation of TV and is associated with low rate of testicular atrophy However long-term follow- up is needed to assess its effect on fertility. **Keywords:** Orchiopexy, Fowler-Stephens Orchiopexy, Intra-abdominal Testicle.

INTRODUCTION

One of the most prevalent congenital anomalies in the male genital system is the undescended testis, which affects 3%–5% of full-term babies and almost one-third of preterm kids. The testis that is not descended may be impalpable or palpable. Twenty percent of individuals have impalpable undescended testicles, and of those, fifty percent are either missing or atrophic **[1].**

Imaging modalities are used in addition to clinical evaluation to confirm the diagnosis of undescended testis. In order to localize the testis and aid in the planning of the ensuing surgical therapy, laparoscopy is frequently utilized in the care of intra-abdominal testis **[2].**

When evaluating the testicular location in a patient with intra-abdominal testis, there are two criteria: Testis discovered less than 2 cm from the ipsilateral internal inguinal ring indicates low levels of testis found within the abdominal cavity; testis found more than 2 cm from the ipsilateral internal inguinal ring indicates high levels of testis located within the abdominal cavity **[3].**

The length of the testicular vessels affects the laparoscopic management of intra-abdominal testis because it prevents the vessels from being adequately mobilized into the scrotum. Laparoscopic orchiopexy techniques have been described in several ways. There are two stages to a Fowler-Stephens laparoscopic orchiopexy procedure. The testicular veins are separated during a two-stage Fowler-Stephens laparoscopic orchiopexy to enable sufficient mobility of the testis into the scrotum. Nonetheless, a benefit of the Shehata approach for staged laparoscopic traction orchiopexy is that the testicular arteries are preserved **[1].**

Two-phase Depending on the testis's collateral vascular supply, Fowler-Stephens orchiopexy is utilized in intra-abdominal testis with small vessels to lengthen the spermatic cord and transport the testis to the scrotum **[4].**

The primary testicular blood supply is spared during Staged Laparoscopic Traction Orchiopexy (Shehata technique) because the testicular arteries are not split. The idea is to gently pull on the stretched veins to the medial iliac spine, contralateral side, and upwards without cutting them in order to expand the testicular vasculature. The weight of the intestine on the stretched testicular arteries causes this steady traction. Additionally, the abdominal wall muscles' breathing action may facilitate this elongation process **[5].**

PATIENTS AND METHODS

This is a prospective study of laparoscopic management of impalpable undescended testis (UDT) either unilateral or bilateral. It was done at Pediatric Surgery Department, Zagazig University Hospitals during the period from March 2023 to February 2024. Informed consent was obtained from either the parents or caregivers for all cases. The study was approved by the ethical committee of the faculty of medicine, Zagazig (10501-5-3-2023). The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

During the study period, twenty-four patients with impalpable undescended testes were enrolled. Patients were divided into two groups: the first group had staged laparoscopic Fowler Stephens orchiopexy (FSO) and the second group had staged laparoscopic traction orchiopexy (Shehata technique).

Patients with negative laparoscopic stretch tests (during diagnostic laparoscopy, the vessels were found to be short and the testis was unable to reach the contralateral internal ring) who suffered from unilateral or bilateral impalpable UDT and belonged to the pediatric age group (6 months to 12 years) were included in the study.

Patients with palpable gonads under general anesthesia were excluded from the study because surgery was performed by an open mode, presence of one of the following intraoperative findings during laparoscopic procedure: vanished testis, blind- ended vas deference and testicular vessels, testicular vessels and vas deference penetrating the internal ring and the intraabdominal testis could be reached by stretching to contralateral internal ring without tension (positive laparoscopic stretch test), this indicates that the case can be treated with a single stage of laparoscopic aided orchiopexy; it was not included in the research..

A complete history was taken from the parents or caregivers of the child with a special stress on previous observation or palpation of the testis in the scrotum, associated anomalies especially hypospadias, inguinal hernia, the developmental history, either physical or mental, drug intake by the patient especially hormonal therapy (HCG), history of any surgical intervention especially inguinal exploration for undescended testis or previous hernia repair, family history of a similar condition and history of special diseases like Prune Belly syndrome.

General and local examination was done to be sure that the patients are fit for operation and exclude other congenital anomalies. (Congenital heart diseases, orthopedic …. etc.). Both frog-legged and supine positions were used to examine the patients. Testicular palpability, position, mobility, size, and scrotal development on both the affected and contralateral sides (scrotal asymmetry is a clinical sign in unilateral UDT) should all be documented during the examination, along with any concomitant findings like hernias, hydrocele, hypospadias, and scars from prior surgeries. Additionally, ectopic testis sites were investigated.

Preoperative investigations included blood grouping and blood picture, coagulation profile, renal function tests, liver function tests and hormonal assay.

Operative procedure:

Anesthesia via a general endotracheal tube was used for the surgery. Patients received a prophylactic parenteral antibiotic shortly after anesthesia was induced. In order to identify an inguinal or canalicular testis, the patient was then checked once more while under general anesthesia. In order to prevent bladder damage, decompress the bladder by insertion of Foley's catheter. The patient was positioned at a 20–30° Trendelenburg angle. The laparoscopic operation began with full vision of the pelvis and abdomen. In order to locate the intra-abdominal testis and visualize both internal inguinal rings (IIRs), the normal side was examined first, which gave a view that could be compared to the other side. Laparoscopic search for the non-palpable testis was done. Firstly, certain landmarks are identified namely. The first landmark is the bladder, it is identified at the middle of the field by moving the inserted urethral catheter inside the bladder. The second landmark is the medial umbilical ligaments, which are seen like peritoneal folds extending from the bladder towards the umbilicus. The third landmark is the IIR; it is located lateral to the inferior epigastric vessels. The fourth landmark is the vas deferens which is seen appearing from behind the bladder and crossing over the medial umbilical ligament towards the IIR. The fifth landmark is the spermatic vessels which are seen passing parallel to the iliac vessels and join the vas deferens at the IIR where they form together an inverted V- shape (figure 1S).

Figure (1S): laparoscopic view of right vas, spermatic vessels and internal ring

The patency of the processus vaginalis was noted and reported, and the area of the IIR ring was assessed. They were divided into the following categories based on the position and presence of the testis: 1. Vanished testis proximal to the internal ring; vas and vessels end blindly before the ring and no additional surgical intervention was performed (figure 2S).

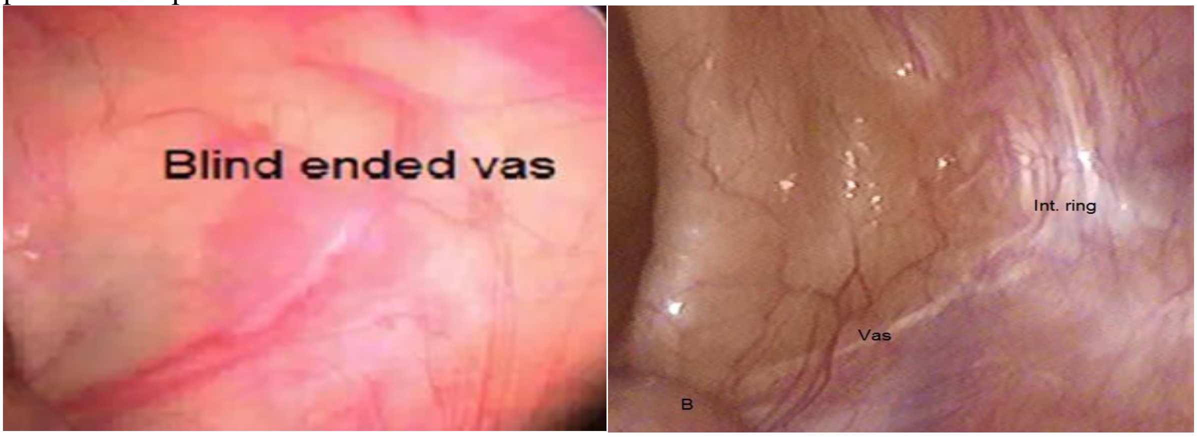

Figure (2S): Vanished testis with the presence of vas and attenuated vessels ended blindly proximal to IR.

When the testis was disappearing, inguinal exploration was done and the cord remnant removed since the testicular arteries and vas exit the internal ring. Orchiopexy was done when the testis was small size. 2. Low Intra-abdominal testis was either peeping or residing within 1 to 2 cm of the internal ring and stretch test was positive so one stage orchiopexy was done (figure 3S).

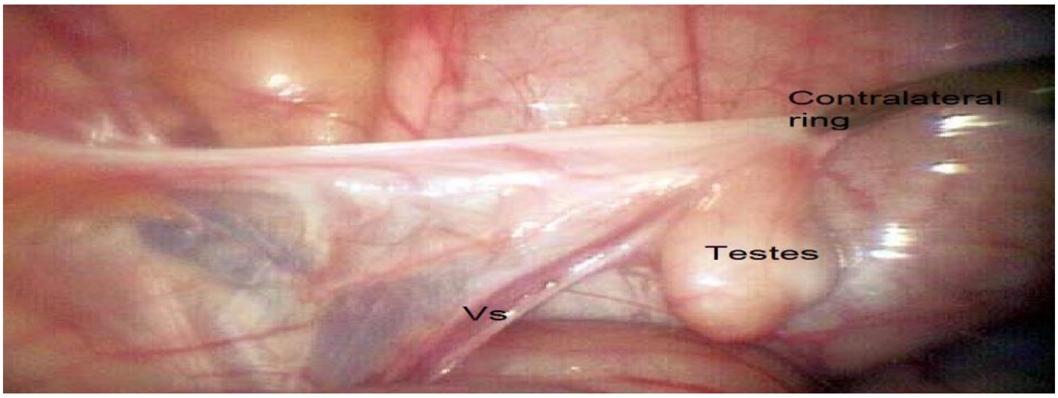

Figure (3S): low intra-abdominal testes with positive stretch test.

All of those previous mentioned cases were excluded from this study when encountered during laparoscopic procedure. 3. Only the two steps of testicular traction, also known as Shehata technique or FSO, were included in this study because the high intra-abdominal testis measured more than 2 cm of the internal ring and the stretch test was negative.

Operative technique of Staged Laparoscopic traction orchiopexy:

The first stage:

Under direct vision, two 3-mm supplementary trocars are placed at the umbilicus level on the lateral edges of both recti muscles. It is measured and documented how far the ipsilateral IIR is from the lower pole of the testis. To find the shortest distance, the inferior mobile testis is gently tractioned. To prevent the "long-looping vas," the gubernaculum is separated under direct vision. Sharp dissection of the peritoneal covering mobilizes the testis, and the peritoneum lateral to the testicular arteries is incised. The testis is secured to the fixation point one inch above and medial to the contralateral anterior superior iliac spine (ASIS) using a single round needle stitch of EthibondTM 2/0. The predetermined place on the skin is where the suture is inserted; it is then received within the belly and passed through a broad bite in the lower pole of the testis. The suture is then returned outside the abdominal wall, where its two ends are connected extracorporeally and buried beneath the skin (figure 4S).

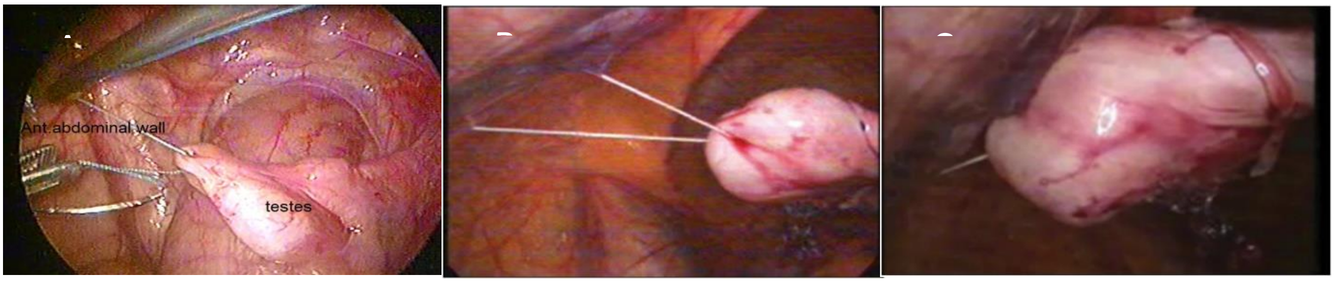

Figure (4S):(A, B & C) showed steps of traction of intraabdominal testis to fixing point in the anterior abdominal wall

The second stage:

After 12 weeks, a second stage laparoscopic aided orchiopexy was scheduled. The preoperative planning, placement, and trocar positions are the same. The abdominal cavity was examined for the presence of adhesive bands, internal herniation, testicular retraction and suture slippage, and the position of the intestine with respect to the testicular arteries was documented. The traction stitch was divided, and the intraabdominal testis (IAT) was visible. Upon visualization, the gonadal vascular pedicle was shown to be extended (figure 5S).

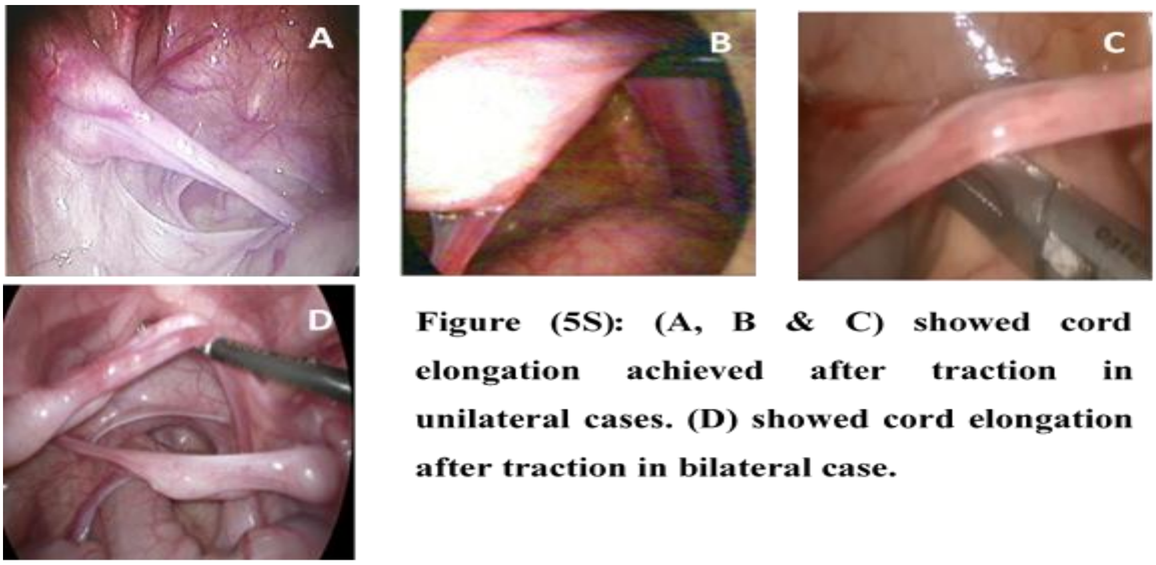

Figure (5S): (A, B & C) showed cord elongation achieved after traction in unilateral cases. (D) showed cord elongation after traction in bilateral case.

A curved hemostat was inserted into the peritoneal cavity medial to the inferior epigastric vessels via a little scrotal incision (figure 6S).

Figure (6S): (A) Creation of new internal ring opening medial to inferior epigastric vessels. (B) Exteriorization of testis through scrotal incision.

Grasping the gubernaculum, the person dragged it through the newly formed scrotal orifice (figure 7S).

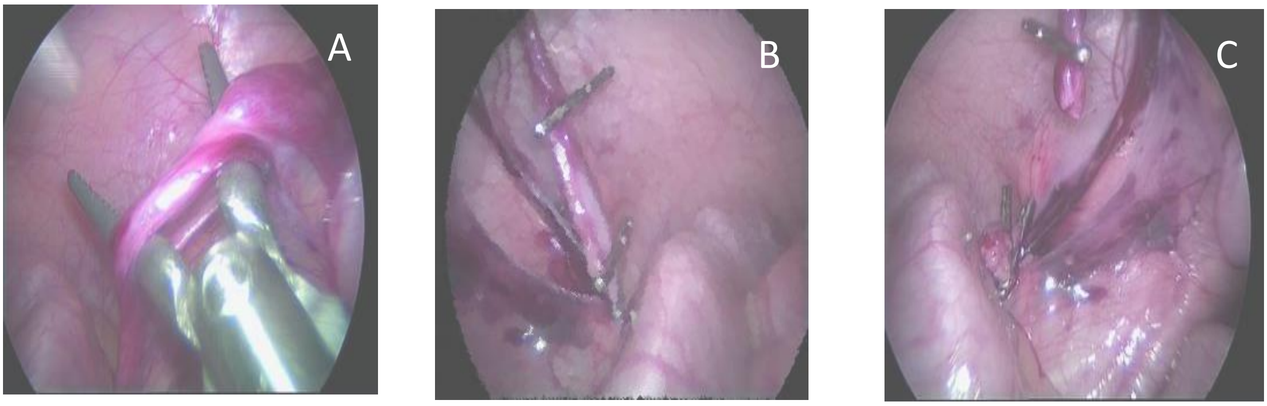

Figure (7S): (A) A window was created posteriorly to the testicular vessels. (B&C) Testicular vessels was clipped proximally and distally then was transected in between.

The spermatic cord was not torn when the testis was inserted into a subdartos pouch. In the event that the suture has slipped, the patient is given an additional 12 weeks following another testis refixation procedure as previously stated. The following day, the boy is sent home.

Laparoscopic Two stage Fowler's Stephens Technique:

First stage:

Two 5 mm ports were inserted into the lower abdomen quadrants as part of the initial surgical procedure. Next, a window is made posteriorly to the testicular vasculature using Kelly's forceps, and the peritoneal reflection lateral to the testicular vessels was separated using scissors at least 3 cm away from the testis (figure 8S. A). The testicular arteries were transected in between after being double cut proximally and single clipped distally at a distance of 1 centimeter (figure 8S. B&C). The patient was scheduled for a second stage at 4-6 months after the operation ended in accordance with laparoscopic norms.

Second stage:

The two ports and the 5 mm instrument are positioned the same way they were for the first stage. The testes were laparoscopically inspected to determine their size and position at the start of the procedure. It is necessary to establish that there has been sufficient neovascularization through the deferential artery. On a broad pedicle of peritoneum covering vas and arteries, the testis was mobilized. Starting in the peritoneum lateral to the testicular arteries and proceeding toward the internal ring, the dissection was performed using scissors proximal to the first stage's clips. The gubernaculum is cut as widely apart as feasible. One centimeter to the left and above the vas, the peritoneal dissection extends medially toward the medial umbilical ligament. It was avoided to utilize cautery near the deferential artery or the vas. To assess the level of mobilization, the testis is clamped down to the opposite internal inguinal ring, starting at the level of the gubernaculum. A subdaortos pouch is produced in the conventional manner after a minor incision is made in the scrotum. In order to generate a new opening medial to inferior epigastric vessels and lateral to medial umbilical ligament, a long-curved forceps was inserted into the abdomen through the scrotum. A fresh internal ring is widened by opening the forceps tips, and the testis is gripped at the gubernaculum and drawn down into the hemiscrotum. The usual orchiopexy procedure secures the testis in the subdaortos pouch.

Follow up:

Regular outpatient follow-up appointments were scheduled for two weeks, one month, and three months following surgery. During these sessions, the size and position of the testes were assessed using ultrasound and clinical examination data. At every follow-up, the data was meticulously recorded in the medical record.

a) A clinical examination to determine the position of the testicles (low, high, or inguinal).

b) In situations of unilateral UDT, ultrasonography and color Doppler evaluation following the second stage to assess testicular size and vascularity (if possible) and compare with the other testis.

c) The scrotal US was used to assess the testicular dimensions and compute the volume using the empirical Lambert formula (volume = length (L) X width (W) X height (H) X 0.71). Testicular volume of the operated testis was compared to the descended contralateral testis in unilateral cases.

The capacity to move the testis to its proper location in the ipsilateral hemiscrotum and the absence of a discernible atrophy or reduction in size were used to determine success.

Determination of Testicular Viability

Based on the clinical examination and ultrasound, a viability status was assigned to each testicle at the most recent follow-up. A nubbin or missing testicle on inspection and/or ultrasound was considered complete atrophy. When compared to the normal contralateral testicle, an ultrasound with a volume difference of more than 20% indicated relative atrophy. 20% or less of the size difference between the normal contralateral testicle and/or the normal size for age was considered normal size. After that, viability was classified as normal or abnormal. Finally, any atrophy or shrinkage in size and upward migration was documented.

STATISTICAL ANALYSIS

SPSS version 20 (Statistical Package for the Social Sciences) was used for data entry, processing, and statistical analysis. The following significance tests were applied: Spearman's correlation, Wilcoxon's, Chi square, logistic regression analysis, and Kruskal-Wallis.

RESULTS

In terms of age or term, there were no statistically significant differences between the groups under investigation (Table 1).

Table (1): Demographic data of the studied groups:

Variable		**Group I (Traction Orchiopexy) (*n*=12 cases)**		**Group II (Fowler-Stephens) (n=12 cases)**		**MW**	**P**
Age: (years)	*Median* *Range*	2 1-3		2.5 0.83 - 5		0.69	0.49 NS
Variable		**No**	**%**	**No**	**%**	**χ^2**	**P**
Term:	*Preterm* *Full term*	8 4	66.7 33.3	9 3	75 25	0.20	0.65 NS

SD: Standard deviation MW: Mann Whitney test χ^2:Chi square test NS: Non significant (P>0.05).

Between the groups under study, there were no statistically significant variations in site, scrotum, or relationship. 2 cases in Group I had bilateral lesion so number of affected testis in Group I was 14 testes (Table 2).

Table (2): Clinical findings between the two groups:

Variable		**Group I (Traction Orchiopexy) (*n*=12 cases)**		**Group II (Fowler-Stephens) (n=12 cases)**		**χ^2**	**P**
		No	**%**	**No**	**%**		
Site:	*Right* *Left* *Bilateral*	4 6 2	33.3 50 16.7	6 6 0	50 50 0	2.4	0.30 NS
Scrotum:	*Well* *Under developed*	5 7	41.7 58.3	8 4	66.7 33.3	1.51	0.22 NS
Association:	*No* *Hypospadias* *Prune belly*	10 1 1	83.3 8.3 8.3	6 3 3	50 25 25	3	0.22 NS

χ^2:Chi square test NS: Non significant (P>0.05)

There was a statistically significant increase in 1st stage and total stages duration and decrease in time between 2 stages among Group I compared to Group II (Table 3).

Table (3): Operative data between the two groups*:*

Variable		**Group I (Traction Orchiopexy) (*n*=12 cases)**	**Group II (Fowler-Stephens) (n=12 cases)**	**Test**	**P**
Operative time of 1st stage: (min)	*Mean ± Sd* *Range*	49.5±8.44 42-60	30.9±5.02 25-45	**t** **6.65**	**0.001***
Duration between two stages: (months)	*Median* *Range*	3 3-3	6 6-6	**MW** **4.8**	**<0.001****
Operativd time of 2nd stage: (min)	*Mean ± Sd* *Range*	35.83±10.85 23-49	34.08±8.68 22-40	t 0.44	0.67 NS
Total Time of two stages: (min)	*Mean ± Sd* *Range*	85.33± 21.29 65-109	64.98±13.7 45-79	**t** **2.78**	**0.01***

SD: Standard deviation t:Independent t test MW: Mann Whitney test χ^2:Chi square test
NS: Non significant (P>0.05) *: Significant (P<0.05) **: Highly Significant (P<0.001)

No cases had surgical site infection or internal herniation in both groups No difference was founded between two groups in slippage of ligature of hydrocele, no difference was founded between two groups in slippage of ligature of hydrocele or testicular atrophy. (Table 4).

Table (4): Postoperative complication between the two groups:

Variable		Group I (Traction Orchiopexy) (*n*=14 testis)		Group II (Fowler-Stephens) (n=12 testis)		χ^2	P
		No	%	No	%		
Testicular atrophy:	*No* *Yes*	13 1	92.8 7.2	9 2	75 25	**4.34**	**0.04***
Surgical site infection:	*No* *Yes*	14 0	100 0	12 0	100 0	--	---
Slippage of ligature:	*No* *Yes*	13 1	92.8 7.2	12 0	100 0	0.98	0.35 NS
Hydrocele:	*No* *Yes*	13 1	92.8 7.2	12 0	100 0	0.98	0.35 NS
Internal herniation:	*No* *Yes*	14 0	100 0	12 0	100 0	--	---

χ^2:Chi square test NS: Non significant (P>0.05) *: Significant (p<0.05)

Regarding testicular volume, there was no statistically significant difference between the two groups at baseline, one month, or two months after surgery; however, at three months after surgery, there was a statistically significant increase in testicular volume among Group I as compared to Group II. Regarding difference between different times in each group, there was no statistical significance differences in testicular volume at 1-, 2- & 3-months post-operative compared to baseline (total percent of increase 4.9%) in Group I while in Group II there was a statistical significance decrease in testicular volume at 3 months post-operative compared to baseline (total percent of decrease 12.5%) (Table 5).

Table (5): Testicular volume of affected testis at the first 3 months of follow up between the two groups:

Variable		Group I (Traction Orchiopexy) (*n*=14 testis)	Group II (Fowler-Stephens) (n=12 testis)	t	P
Pre: (%)	*Mean ± Sd* *Range*	0.41±0.12 0.28-0.56	0.40±0.11 0.30-0.55	0.22	0.83 NS
Post 1 month:	*Mean ± Sd* *Range*	0.42±0.14 0.30-0.56	0.39±0.12 0.26-0.54	0.58	0.57 NS
Post 2 month:	*Mean ± Sd* *Range*	0.41±0.13 0.29-0.58	0.38±0.08 0.26-0.53	0.69	0.49 NS
Post 3 months:	*Mean ± Sd* *Range*	0.43±0.10 0.31-0.60	0.35±0.08 0.25-0.50	**2.23**	**0.04***
P$		0.85 NS[1] 0.97 NS[2] 0.73 NS[3]	0.67 NS[1] 0.09 NS[2] **0.04*[3]**		
% of change		**4.9%**	**-12.5%**		

SD: Standard deviation t: Independent t test $:Paired t test
NS: Non significant (P>0.05) *:Significant (P<0.05)
P1: 1 month versus baseline P2: 2 months versus baseline P3: 3 months versus baseline

During the follow-up period, there was no discernible statistical difference in the contralateral testicular volume between the groups under investigation. In terms of variations between various times within each group, there was no statistically significant difference in testicular volume between the baseline and various follow-up intervals in both groups (Table 6).

Table (6): Testicular volume of contralateral testis at the first 3 months of follow up between the two groups:

Variable		Group I (Traction Orchiopexy) (*n*=10)	Group II (Fowler-Stephens) (n=12)	t	P
Baseline: (ml)	*Mean ± Sd* *Range*	0.52±0.15 0.45-0.60	0.53±0.17 0.48-0.62	0.14	0.89 NS
Post 1 month: (ml)	*Mean ± Sd* *Range*	0.54±0.16 0.48-0.63	0.56±0.18 0.5-0.64	0.27	0.79 NS
Post 2 months: (ml)	*Mean ± Sd* *Range*	0.54±0.12 0.5-0.65	0.54±0.15 0.48-0.65	0.01	0.99 NS
Post 3 months: (ml)	*Mean ± Sd* *Range*	0.55±0.13 0.50-0.68	0.55±0.16 0.52-0.71	0.01	0.99 NS
P$		0.78 NS[1] 0.33 NS[2] 0.53 NS[3]	0.71 NS[1] 0.77 NS[2] 0.51 NS[3]		
% of change		5.77%	3.77%		

significant (P>0.05)

P1: 1month versus baseline P2: 2 months versus baseline P3: 3 months versus baseline

There was an increase in frequency of diminished testicular vascularity at 1, 2 & 3 months in Group II compared to Group I but without statistical significance. This table shows that no cases had testicular retraction in both Groups. Regarding testicular position, No difference was founded between the studied groups in testicular position or frequency of testicular atrophy. There was an increase in frequency of succeed cases in Group I compared to Group II (85.7% versus 75%) but without statistical significance. (Table 7).

Table (7): Testicular vascularity at the first 3 months of follow up and operation outcome between the two groups:

Variable		Group I (Traction Orchiopexy) (*n*=14 testis)		Group II (Fowler-Stephens) (n=12 testis)		χ^2	P
		No	**%**	**No**	**%**		
Testicular vascularity at the first 3 months of follow up							
Post 1 month:	*Normal* *Diminished*	13 1	92.8 7.2	9 3	25 75	1.58	0.21 NS
Post 2 month:	*Normal* *Diminished*	13 1	92.8 7.2	9 3	25 75	1.58	0.21 NS
Post 3 months:	*Normal* *Diminished*	13 1	92.8 7.2	9 3	25 75	1.58	0.21 NS
Operation Outcome							
Position:	*Low scrotal* *Mid scrotal* *High scrotal*	8 5 1	57.2 35.7 7.1	9 2 1	75 16.7 8.3	0.48	0.49 NS
Testicular retraction:	*No* *Yes*	14 0	100 0	12 0	100 0	---	---
Testicular atrophy:	*No* *Yes*	13 1	92.8 7.2	9 3	75 25	**1.58**	**0.21** **NS**
Success rate:	*Failed* *Succeed*	2 12	14.3 85.7	3 9	25 75	0.48	0.49 NS

χ^2:Chi square test NS: Non significant (P>0.05)

DISCUSSION

Undescended testis is one of the most common diseases in pediatric surgery. The risk of testicular malignancy in cryptorchid patients is higher for those with intraabdominal testes (IAT). Given these facts, the goal of surgical management for the impalpable testis is to locate the testis if present and, to bring it to a scrotal position, where any malignant change could be early detected. In addition, the endocrinal function of testis might be improved that offer the best chances of future fertility **[6].**

International guidelines have developed the well-established management of IAT using laparoscopic surgery. The primary impediment to sufficient and tension-free testis insertion into the scrotum is the shortness of the spermatic arteries. Furthermore, testicular atrophy and ischemia may result from excessive stretching of the spermatic arteries. Numerous approaches have been proposed to address this issue, but most surgeons still find it extremely difficult, and agreement is lacking **[7].**

For many years, the two-stage FS orchidopexy has been the gold standard method for high IAT. Despite doubts about the functional impact and fertility outcomes, this procedure has a good projected success rate. Nevertheless, this approach has many drawbacks, including a two-stage waiting period that lasts for six months and requires splitting native testicular capillaries while waiting for the establishment of collateral circulation **[3].**

Data from two stages of FS orchidopexy for cryptorchidism show greater testicular shrinkage and decreased fertility **[8].** Shehata has developed a substitute method for FS that prevents testicular atrophy by maintaining the natural testicular vessels. This method is based on the theory that the testis develops and grows most optimally when its original vascular supply is preserved, and it may also reduce the chance of spermatic germ cell impairment. **[9]**.

The main benefit of spermatic cord traction (ST) is its capacity to gradually lengthen the spermatic cord blood vessels without inducing testicular ischemia. This is accomplished through either continuous breathing movement or gradual traction caused by the weight of the intestine. Shehata's ST results, which show that 84% of the scrotal testis are of normal size and that there is satisfactory doppler evaluation following orchidopexy, are especially encouraging **[1].**

Our study's objective was to evaluate ST in patients treated for IAT at our pediatric surgical center by comparing it to two-stage FS orchiopexy in terms of testicular atrophy and the testis' final scrotal location.

The ideal age for orchiopexy has gradually lowered during the last few decades. Orchiopexy is currently advised for children between the ages of six and eighteen months. The best time to undergo surgery is still up for discussion, though. Several studies shown that boys with undescended testicles (UDT) at the time of operation still tend to be older on average than what is advised **[10].**

According to Varga et al., the initial stage of the procedure had a comparatively high mean age of 2.9 years. According to **Varga et al. [11],** they thought that receiving therapy later could have a negative impact on the results, such as a higher atrophy rate and a comparatively larger mean size difference between the operated testis and the contralateral one.

According to Liu et al., the distance needed to lower the testis in older boys is too great, making testicular traction or descent to the scrotum considerably more difficult for children older than two years old **[3]**.

The majority of the children in the current study are from rural areas, and their parents may not have been aware of or observed cryptorchidism, therefore the mean age was also relatively high—2 years for the ST group and 2.5 years for the FS group—due to delayed referral to the pediatric surgical center.

Although the average age of our patients at the surgery was higher than the suggested age range of 6 to 18 months, the age range was only 1 to 5 years, thus we were unable to assess the influence of the greater age group on the viability of ST and its result.

Twenty percent or so of UDTs are not perceptible; they can either be absent or undescended. When examining boys with NPTs, an imaging study is not necessary. A diagnostic laparoscopy should be performed to determine the size, position, and structure of a testis that has been inspected bimanually while under anesthesia if it is still not perceptible. An IAT (40%), an intra-abdominal blind end cord (15%), and a cord structure entering the internal inguinal ring (45%) are the three main findings of a laparoscopy **[12].**

In our study 60 patients with impalpable testis submitted for diagnostic laparoscopy. Thirty-six cases excluded from the study. In twenty-one of the instances, the testis was absent, and in the other fifteen, the testis was less than two centimeters from the ipsilateral inner ring, indicating a low intraabdominal temperature; the traditional one-stage laparoscopic orchiopexy was successful.. Of the remaining 24 patients, the testis was >2 cm from the ipsilateral inner ring, indicates high IAT. These cases included in our study and was divided randomly into two equal groups, first group underwent 2 stages ST technique and the second group underwent FS Orchidopexy.

The operation times of the first and second stages in the two groups were compared in a retrospective analysis of the two surgical techniques, FS and ST, used to treat children with high IAT. It was found that there was no discernible difference between the two groups (Liu et al 2021). Other research, however, showed that the FS group had a substantially lower first-stage operation time (p 0.0001), whereas the ST group had a significantly shorter second-stage operation time (p = 0.04) **[13].**

In our study, the operation time of the first stage of FS was considerably shorter than the first stage of ST with statistical significance (P=0.001). The first stage of FS is a simple procedure required only a minimal dissection that was done close to the spermatic vessel for double clipping. However, first stage of ST requires dissection, mobilization and testicular fixation to the abdominal wall. The second stage's operating time did not change statistically significantly between the two procedures. The two surgical procedures bear similarities in that they both rely on laparoscopy for assistance. The testicles are lowered to the scrotum and secured by an incision made from the scrotum on the affected side.

In our study, the traction period was planned after 12 weeks as was described in the original publication by Shehata. This gives advantage of ST over FS that requires at least 6 months interval period to achieve adequate collateral circulation **[14].**

Traction orchiopexy should follow the same time intervals as other traction operations, such as long-gap esophageal atresia, according to a recent study by Aljunaibi et al. Furthermore, a shorter interval between the two phases lowers the possibility of testicular adhesion to the abdominal wall and the risk of internal hernia or suture slippage **[15].**

In our opinion, a brief gap traction period is appropriate and long enough to for the testicular vessels to elongate sufficiently and produce positive outcomes.

Although the Shehata procedure has numerous benefits, it also has drawbacks, such as the spermatic cords adhering, the insufficiency of the fixation suture, and the potential for internal herniation **[3].**

In other investigations, fixing suture inadequacy was found in 0–27.3% of patients; Varga et al. stated that it happened in 20% of their cases **[11].** Shehata further stated that this issue was seen in boys older than six years old, and as a result, the success rate of traction dropped to 64% from 90% in boys less than two years old **[14].**

After testicular fixation, Dawood et al. also noticed suture slippage in children older than 7 years old. They attributed this complication to the older age group's shorter testicular arteries' reduced flexibility and stretchability **[5].**

Testicular slippage was observed at the beginning of our trial in one child who was the indicated age, which could be explained by the fact that learning a new method always involves a learning curve. Insufficient vessel elongation resulted from stitch slippage. Retraction was therefore required prior to the second stage in order to prevent improper scrotal placement.

Shehata employed his innovative method for bilateral cases concurrently. This may raise the likelihood of both spermatic cords adhering crosswise at the same time during the second stage of ST. In 14.3% of cases, Varga et al. noted this problem and noted that dividing them later increases the risk of testicular vascular injury, which can lead to testicular atrophy and decreased fertility **[11].**

One infant with bilateral IAT was found to have crossing adhesion in the current investigation. The child's unilateral testicular shrinkage as a result of this adhesion brought up the concern of preventing the two spermatic cords from being pulled during the initial stage of ST.

Internal herniation and/or constriction of the intestines through testicular arteries traversing the abdominal cavity are conceivable risks associated with the Shehata procedure. **[3].**

Because of this, we were concerned that an internal hernia or intestinal blockage may arise during this investigation. All of our present instances did not experience this suggested issue, though, and the traction period went by without incident. These findings align with those of other research projects that did not document this kind of issue **[13].** While our first experience indicates that ST is safe, with the number of cases rising, it is crucial to take into account the likelihood of this complication, which calls for additional research in the future.

The ability to place the testis in the proper scrotal position without compromising its blood supply and without showing any symptoms of testicular shrinkage or retraction during the follow-up period is critical to the success of laparoscopic aided orchiopexy for IAT **[1].**

To optimize fertility and identify cancer early, the testis should be positioned in the scrotal region. The optimal scrotal position of the testes after orchiopexy is not well defined; some research believes the low or mid scrotal testis to be successful, while other studies do not specify the optimum position of the testes in the scrotum. **[11]**.

In this current study, we consider either low or mid scrotal position of testis is adequate scrotal position.

According to a recent meta-analysis study that evaluated the ST and FS techniques, ST performed better than FS in terms of scrotal location **[9].** Nevertheless, according to other research, there was no change in the end testicular scrotal position between the FS and ST groups **[13].**

According to Varga et al., three children had testicular retraction that necessitated a repeat open orchiopexy, and 92% of testes following ST were in an appropriate scrotal position **[11].** According to Shehata, 84% of patients had scrotal testes, while younger patients and testes that were closer to the internal inguinal ring had higher success rates **[14]**. Abouheba et al. studied short term outcome of ST and observed that all 34 testis were in the adequate scrotal location with no any evidence of scrotal ascend **[16]**.

More than 90% of our subjects in both groups had an appropriate scrotal position with no indication of testicular ascent during the available follow-up time, showing that our current investigation had almost identical results for final testicular scrotal position.

When it comes to testicular function result, testicular atrophy is the most serious complication of laparoscopic aided orchiopexy. Testicular volume loss as a percentage of contralateral testis was the primary factor used to diagnose atrophy **[11].**

When a color Doppler ultrasonography revealed no discernible blood flow compared to the normal contralateral side, postoperative testicular atrophy was identified as the existence of a nubbin or a postoperative testicular volume of 25% of the contralateral testis' volume. **[13].**

In contrast to dividing them in FS, the original theory of ST suggested that testicular vascular preservation and eventual extension may result in a decreased rate of testicular atrophy **[14].**

Testicular atrophy following FS is linked to a failure to develop collateral testicular vascularization, while atrophy following ST, though rare, may be caused by a vascular thrombosis associated with high stress in the spermatic arteries. Nonetheless, hypoplasia and structural anomalies of the testis provide a risk for testicular loss **[17].**

According to a study comparing FS with ST, the Shehata group did not experience testicular atrophy. Despite the fact that the FS group contained one instance, there was no discernible difference between the two groups **[3].** According to another study, the rate of testicular atrophy following both procedures was comparable (13.4 percent for FS and 10% for ST) **[17]**.

In this study, the testicular atrophy rate was higher in FS group (25%) compared to ST group (7%) but there was **no statistical significance between two groups.** All atrophied testis in the study demonstrated diminished vascularity on color doppler ultrasound.

Several studies discovered that even while color Doppler ultrasound imaging showed adequate vascularization, the operated testis was consistently smaller than the normal testis. Testicular growth appears to be slower than that of the contralateral normal testis. This could be brought on by either surgical trauma or the prenatal dysgenesis, which is the testis' normal state **[18].**

Shehata described the normal size of the operated testis that has a volume within 75 to 100% of normal contralateral side or to the control by ultrasound examination **[14].**

In their investigation into the effect of testicular vessel division on testicular volume following the two stages of FS, **Abdelhalim et al.** discovered that 83.3% of the operated testes had a volume that was less than the mean for age as determined by US. This finding is primarily the consequence of aberrant development and less frequently the result of blood supply damage sustained during the procedure **[19].**

According to Varga et al., there was a 34.3% mean volume difference following ST between the operated and descended testes. Nevertheless, they do not view the procedures as a failure and attribute the notable volume discrepancy to aberrant testicular development **[11].**

During the follow-up period, the mean volume of the operated testis in both groups was less than the contralateral normal testis, although this difference was not statistically significant. In both ST and FS, the percentage of volume difference between the operated testis and contralateral side was (%).

When the testicles are properly positioned in the scrotum without exhibiting any signs of atrophy or retraction, the orchiopexy procedure was effective. **Varga et al. [11]** stated that the success rate following ST was 82.2%, in accordance with this criterion. This is similar to the previously reported series (65 to 100%).

According to **Roy et al.,** 82 out of 96 testes (85%) that underwent FS had a favorable outcome. These findings are consistent with earlier research that found that the success rate ranged from 67 to 98% **[20].**

In this current study the overall success rate was comparable with other reports. It was higher in ST group (85.7%) than FS group (75 %) but there was no statistical significance.

Finally, the current study still has some limitations. It was a single center study, for this reason the sample size was small. In addition, our follow-up period was not extensive particularly in this preliminary study of ST so, it is impossible to assess the children's future fertility and the problems might not be fully shown. Long-term monitoring, additional research, and observation are therefore required.

CONCLUSION

In terms of testicular size at a short-term follow-up and testicular scrotal location, the preliminary results of the ST and FS procedures revealed comparable outcomes. There was no statistically significant difference, however ST provided a better option than FS in terms of testicular atrophy. The preservation of the testicular arteries in ST allows the testes to circulate appropriately and at a low rate of atrophy, giving the patients the best chance of becoming fertile. When treating children with elevated IAT, the Shehata approach is workable, secure, dependable, and efficient. Thus, in youngsters with high IAT, we advise ST as the first option. To assess the effect on future fertility, long-term monitoring is necessary.

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