



## Inguinal versus Scrotal Approach for Hydrocelectomy in Adults with Idiopathic Hydrocele

Wissam Al-Quraishy<sup>1</sup>, Mohanned Al-Saadi<sup>2</sup>

### ABSTRACT:

#### BACKGROUND:

Hydrocele is a common benign condition in adult males caused by fluid accumulation within the tunica vaginalis, leading to painless scrotal swelling.

#### OBJECTIVE:

To compare the outcomes of hydrocelectomy using the inguinal versus scrotal approach in adult patients with idiopathic hydrocele.

#### PATIENTS AND METHODS:

This prospective, non-randomized comparative clinical trial was conducted from June 2020 to October 2021 and included 44 adult males (20–65 years) with unilateral idiopathic hydrocele. Patients were allocated into two equal groups (n=22) using a structured allocation method to balance baseline variables. Group I underwent hydrocelectomy via an inguinal approach, whereas Group II underwent a scrotal approach. Primary outcomes included hydrocele sac volume, operative time, hospital stay, postoperative complications, and time to resume normal activities.

#### RESULTS:

Mean hydrocele sac volume was  $205.18 \pm 36.2$  mL in Group I and  $207.23 \pm 34.26$  mL in Group II ( $p = 0.849$ ). Mean operative time was  $28.27 \pm 4.55$  minutes (Group I) and  $26.77 \pm 3.61$  minutes (Group II) ( $p = 0.232$ ). Postoperative hospital stay was  $15.2 \pm 5$  hours (Group I) vs.  $18.7 \pm 5.5$  hours (Group II) ( $p = 0.032$ ). Postoperative complications occurred in 4.55% of Group I and 27.27% of Group II (difference = 22.72%; 95% CI: 2.35% to 43.09%;  $p = 0.039$ ). Time to return to normal activities was shorter in Group I ( $11.31 \pm 2.0$  days) than Group II ( $15.09 \pm 3.17$  days) (mean difference = 3.78 days; 95% CI: 2.25–5.31;  $p < 0.001$ ).

#### CONCLUSION:

The inguinal approach is a potential favorable option for idiopathic unilateral hydrocele surgery in adults, associated with fewer postoperative complications, shorter hospital stay, faster recovery, and earlier return to normal activities compared to the scrotal approach. It also allows evaluation and treatment of concurrent inguinal pathologies.

**KEYWORDS:** Adult; Hydrocelectomy; Idiopathic Hydrocele; Inguinal Approach; Scrotal Approach.

<sup>1</sup> MD Department of Neurophysiology, Baghdad Teaching Hospital, Medical City, .

<sup>2</sup> PhD Department of Medical Physiology, College of Medicine, Al-Nahrain University, Baghdad, Iraq.

<sup>3</sup> MD/PhD National Diabetes Center, Al-Mustansiriyah University, Baghdad, Iraq.



### INTRODUCTION:

A hydrocele is a common benign condition in adult males, caused by fluid accumulation within the tunica vaginalis, leading to painless scrotal swelling<sup>(1)</sup>. Under normal physiological conditions, a small amount of serous fluid, typically between 1 and 2 mL, exists within the cavity of the tunica vaginalis. This has been confirmed through ultrasonographic evaluation in healthy adults and is believed to reduce friction during testicular mobility<sup>(2,3)</sup>.

Hydrocele can be broadly divided into two main types: congenital hydrocele, which occurs in children due to a patent processus vaginalis<sup>(4)</sup>, and acquired hydrocele in adults, which is

typically categorized into idiopathic-accounting for the majority of cases-and secondary types linked to other medical conditions such as prior inguinal surgeries (e.g., hernia repair, varicocelectomy), testicular torsion, neoplasms, infections (e.g., tuberculosis, filariasis), and radiotherapy<sup>(5,6,7)</sup>.

The prevalence of hydrocele in adult males is approximately 1%, with a higher incidence in individuals over 40 years of age. Around 7–10% of hydrocele cases present bilaterally<sup>(8,9)</sup>. While the precise etiology of idiopathic hydrocele is not fully understood, it is hypothesized to result from factors such as enhanced secretion of serous fluid

by the mesothelial cells, compromised lymphatic drainage, and reduced fluid reabsorption<sup>(5,10)</sup>.

The conventional treatment for idiopathic hydrocele is hydrocelectomy, which is most commonly performed using a scrotal approach<sup>(11)</sup>. The procedure is generally effective, but one of the most common and bothersome postoperative complications is scrotal edema<sup>(12)</sup>. The mechanism of scrotal edema is multifactorial and primarily involves an exaggerated inflammatory response, accumulation of serosanguinous fluid, and the dependent position of the scrotum which facilitates gravitational pooling. Additionally, the rich vascular and lymphatic supply of the scrotal skin contributes to the extent of postoperative edema<sup>(13)</sup>.

In some cases, the swelling may even exceed the original size of the hydrocele and can persist for several weeks, sometimes lasting up to a month, which may cause distress or lead the patient to perceive the surgery as unsuccessful<sup>(12)</sup>. Although rare, this complication can progress to serious infections such as Fournier's gangrene, particularly in cases of poor postoperative compliance or in patients with comorbidities like diabetes or immunosuppression<sup>(14)</sup>.

### **Clinical importance:**

Alternative approaches, such as the inguinal route, have been suggested to reduce postoperative scrotal complications and allow for the simultaneous assessment of inguinal canal pathology. However, comparative evidence is limited, making it clinically important to evaluate which approach provides better outcomes.

### **AIM OF THE STUDY:**

This study aimed to:

1. Compare the outcomes of hydrocelectomy using the inguinal versus scrotal approach in adult patients with idiopathic hydrocele.
2. Assess postoperative complications associated with each technique.
3. Determine the recovery time and return to normal activity for both approaches.

### **PATIENTS AND METHODS:**

#### **Study Design and Setting**

This was an interventional, non-randomized, prospective comparative clinical trial conducted between June 2020 and October 2021. A total of 44 adult male patients aged 20–65 years with unilateral idiopathic hydrocele were enrolled and allocated into two equal groups (n = 22 each) using a structured non-randomized allocation method that balanced clinical variables such as age, BMI, smoking status, comorbidities, prior surgical history, hydrocele laterality, and size to

minimize confounding. Hydrocelectomy was performed via the inguinal approach in Group I and via the scrotal approach in Group II. The groups were compared regarding hydrocele sac volume, operative time, postoperative hospital stay, complications, and time to resume normal activities.

#### **Sample Size Justification**

An a priori power analysis was performed based on the primary outcome (time to return to normal activity) using effect sizes reported in previous studies. Lasheen et al. reported a very large effect size (Cohen's  $d \approx 1.83$ ), requiring a minimum of approximately 9 patients per group. Agnihotri et al. reported a large effect size (Cohen's  $d \approx 1.0$ ), requiring approximately 17 patients per group. To ensure adequate statistical power and account for variability, the present study included 22 patients in each group, exceeding the minimum required sample size.

#### **Patient Selection**

**Inclusion criteria:** adult male patients with unilateral, idiopathic, primary vaginal hydrocele.

**Exclusion criteria:** bilateral, multilocular, recurrent, or post-traumatic hydroceles; hydrocele secondary to infections, neoplasms, or filariasis; testicular atrophy; prior ipsilateral inguinal surgery or radiotherapy; hypoalbuminemia; non-transilluminating (thick-walled) sacs; and giant hydroceles were excluded.

#### **Preoperative Evaluation**

All patients underwent detailed medical history, physical and genital examinations, and laboratory investigations including complete blood count, renal function tests, blood glucose, HbA1c (for diabetic patients), coagulation profile, serum albumin, urinalysis, and viral screening (hepatitis, HIV, COVID-19). Additional assessments such as chest X-ray, electrocardiography, echocardiography (when indicated), and scrotal ultrasonography were performed. After obtaining informed consent, surgeries were carried out under general or spinal anesthesia. Prophylactic antibiotics were administered preoperatively. The surgical field—including the scrotal and inguinal regions—was shaved, cleaned, and disinfected with povidone-iodine (Betadine™).

#### **Operative Technique**

##### **Group I: Inguinal Approach**

Hydrocelectomy was performed via a transverse inguinal incision over the external inguinal ring (Fig. 1A, 1B). Dissection proceeded until the external inguinal ring was reached, where the external oblique aponeurosis was carefully divided. Special attention was given to

## Surgical Approaches for Adult Hydrocelectomy

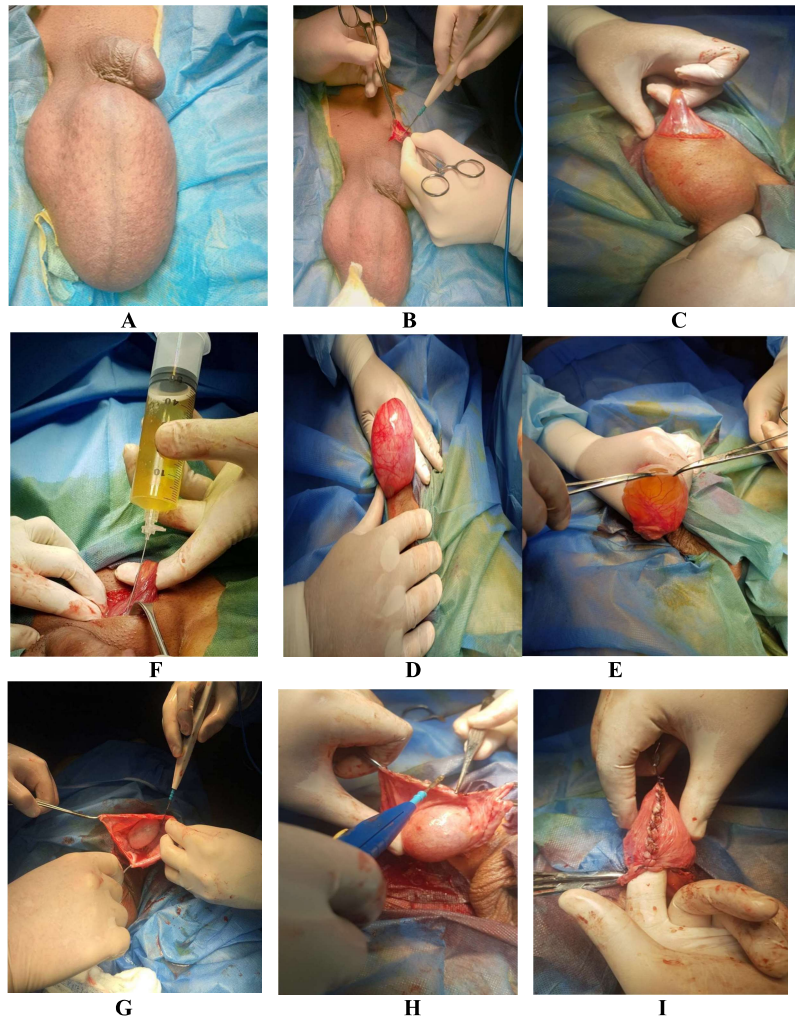
preserving the ilioinguinal nerve to reduce the risk of postoperative pain and sensory disturbances. The spermatic cord was mobilized and gently displaced laterally and superiorly.

The hemiscrotum containing the hydrocele sac was then pushed upward toward the inguinal wound (Fig. 1C). Hydrocele fluid was aspirated using a 50 mL syringe (Fig. 1D) to reduce sac size and facilitate delivery through the inguinal incision (Fig. 1E). A small incision was made in the sac to allow drainage while preventing contamination of the wound by hydrocele fluid (Fig. 1F). Complete opening of the sac was performed using electrocautery (Fig. 1G). The testis and surrounding structures were examined for malignancy or other lesions.

Most of the hydrocele sac was excised with electrocautery, leaving a cuff at the testicular

margins. Electrocautery was also used along the tunica vaginalis edges for hemostasis (Fig. 1H). Both sides of the tunica were everted and lightly sutured behind the testis using Vicryl 3/0 round-bodied sutures, following Jaboulay's procedure (Fig. 1I). The testis was repositioned into the hemiscrotum (Fig. 1J).

The inguinal wound was closed in layers: the external oblique aponeurosis and subcutaneous tissues were sutured with Vicryl 2/0 round-bodied sutures, while the skin was closed in a subcuticular fashion using 2/0 polypropylene cutting-bodied sutures, without drain insertion (Fig. 1K). A sterile compressive dressing was applied to maintain scrotal elevation, and patients were advised to wear a supportive athletic garment during the recovery period. Sutures were removed after 10 days.



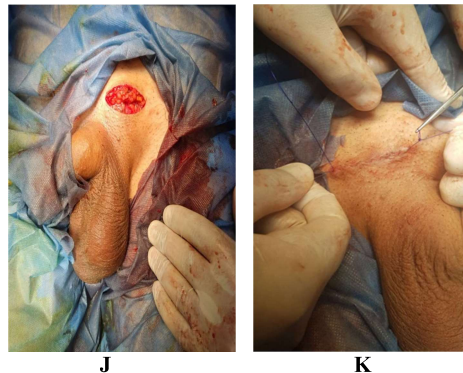


Figure 1: Operative steps of hydrocelectomy using the inguinal approach.

### Group II: Scrotal Approach

Hydrocelectomy was performed through a transverse incision on the scrotum, with layered dissection of the skin, dartos fascia, and thin cremasteric muscle. The tunica vaginalis was everted using the same method as in the inguinal approach. The testis was subsequently repositioned into the hemiscrotum after ensuring complete hemostasis. Closure was done in two layers: the dartos fascia was sutured with a continuous 2/0 Vicryl (round-bodied) suture, and the skin was closed using interrupted 2/0 Vicryl (cutting-bodied) sutures, without insertion of a drain. Scrotal support was applied. No sutures were removed postoperatively.

### Outcome Measurements

- Operative time: measured in minutes using a stopwatch, starting from skin incision to the last skin suture.
- Hydrocele volume: calculated preoperatively by ultrasonography using three orthogonal dimensions (length  $\times$  width  $\times$  depth) and applying the ellipsoid formula:  $Volume = length \times width \times depth \times 0.52$ .
- Time to return to normal activity: recorded based on patient self-report during follow-up visits.
- Length of hospital stay: measured in days from surgery to discharge.
- Postoperative complications: including wound infection, hematoma, edema, and recurrence.

### Blinding and Bias Control

Blinding of surgeons, patients, and outcome assessors was not feasible due to the nature of the surgical interventions. All operations and postoperative follow-up assessments were performed by the same surgeon to maintain consistency and reduce performance and assessment bias.

### Postoperative Care and Follow-up

All patients received the same postoperative management, including prophylactic antibiotics, analgesics, and instructions to minimize pain, swelling, and infection risk. Postoperative assessments were conducted at consistent intervals: at 1 and 2 weeks, and subsequently at 1, 2, and 3 months after surgery.

### Statistical Analysis

Data were analyzed using SPSS version 25 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean  $\pm$  standard deviation (SD) and compared using independent t-tests. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test. A p-value  $<0.05$  was considered statistically significant.

### Ethical Approval and Trial Registration

This study was conducted under the ethical oversight of the Arab Board of Health Specializations as part of the requirements for board certification. The research protocol was reviewed and approved prior to initiation, and the study was carried out under the supervision of a certified academic supervisor. A formal supervision certificate and signed approval form from the discussion committee were obtained.

The study adhered to the principles of the Declaration of Helsinki and applicable local regulatory guidelines. Written informed consent was obtained from all participants before enrollment. All collected data were kept confidential and used solely for research purposes, ensuring the privacy and anonymity of participants throughout the study.

The study was also registered with the Medical Education Council of Iraq (MECIQ) under the researcher's account, with the research title and acceptance date documented as January 23, 2022.

**RESULTS:****I. Demographic and Clinical Characteristics of the Patients**

The mean age of patients in the inguinal group was  $45.5 \pm 14.79$  years, compared to  $44.64 \pm 14.65$  years in the scrotal group; the difference was not statistically significant ( $p = 0.791$ ). Similarly, body mass index (BMI) was comparable between the two groups ( $27.47 \pm 2.16$  kg/m<sup>2</sup> vs.  $26.51 \pm 2.06$  kg/m<sup>2</sup>;  $p = 0.139$ ), showing no significant difference.

Regarding smoking status, 31.82% of patients in the inguinal group were current or former smokers, compared to 27.27% in the scrotal

group; this difference was also not statistically significant ( $p = 0.741$ ). Comorbidities, including well-controlled hypertension and diabetes mellitus, were similarly distributed, with no significant differences between groups ( $p = 0.709$  and  $p = 0.680$ , respectively).

History of prior surgeries unrelated to hydrocele was reported by 13.64% of patients in the inguinal group and 9.09% in the scrotal group; this difference was not statistically significant ( $p = 0.634$ ).

These demographic and clinical characteristics are summarized in Table 1.

**Table 1: Demographic and Clinical Characteristics of the Patients.**

Variables	group I (n=22)	group II (n=22)	p-value
<b>Age, years</b>			
Mean±SD	45.5±10.79	44.64±10.65	0.791
Range	23-65	20-63	
<b>BMI, kg/m<sup>2</sup></b>			
Mean±SD	27.47±2.16	26.51±2.06	0.139
Range	23.4-31.5	23.5-30.5	
<b>Smoking</b>			
Never	15(68.18%)	16(72.73%)	0.741
Ex/current	7(31.82%)	6(27.27%)	
<b>Comorbidities</b>			
No comorbidity	15(68.18%)	17(77.27%)	0.498
HTN	5(22.73%)	4(18.18%)	0.709
DM	4(18.18%)	3(13.64%)	0.680
<b>Past surgical history</b>			
No	19(86.36%)	20(90.91%)	0.634
Yes	3(13.64%)	2(9.09%)	

**II. Perioperative Characteristics**

All surgical procedures in both groups were completed successfully without any intraoperative surgical or anesthetic complications. In Group I, aspiration of hydrocele fluid was carried out efficiently without technical challenges. The hydrocele sacs were subsequently delivered with ease through the inguinal incision. No identifiable underlying causes for the hydroceles were found in any of the patients in either group.

Regarding the laterality of the hydrocele, in Group I, 10 patients (45.45%) had right-sided hydrocele and 12 patients (54.55%) had left-sided involvement. In Group II, right-sided hydrocele was observed in 9 patients (40.91%) and left-sided in 13 patients (59.09%). Although

the distribution of hydrocele sides differed slightly between the two groups, the variation was not statistically significant ( $p = 0.761$ ).

The mean volume of the hydrocele sac was  $205.18 \pm 36.20$  ml (range: 150–275 ml) in Group I, and  $207.23 \pm 34.26$  ml (range: 155–265 ml) in Group II. Hydrocele sac volumes were comparable between the two groups, with no statistically significant difference noted ( $p = 0.849$ ).

The inguinal group had a slightly longer mean operative duration ( $28.27 \pm 4.55$  minutes; range: 23–38 minutes) than the scrotal group ( $26.77 \pm 3.61$  minutes; range: 22–35 minutes), but this difference did not reach statistical significance ( $p = 0.232$ ). These perioperative findings are summarized in Table 2.

**Table 2: Perioperative characteristics of patients undergoing hydrocelectomy.**

Variables	Group I (n=22)	Group II (n=22)	p-value
<b>Side of hydrocele</b>			
Right	10(45.45%)	9(40.91%)	0.761
Left	12(54.55%)	13(59.09%)	
<b>Volume of hydrocele sac, MI</b>			
Mean±SD	205.18±36.2	207.23±34.26	0.849
Range	150-275	155-265	
<b>Operative time, minuts</b>			
Mean±SD	28.27±4.55	26.77±3.61	0.232
Range	23-38	22-35	

### III. Postoperative Characteristics

The mean postoperative hospital stay was shorter in group I compared to group II ( $15.2 \pm 5$  hours; range: 8–25 hours vs.  $18.7 \pm 5.5$  hours; range: 10–30 hours), and this difference was statistically significant ( $p$ -value = 0.03).

The follow-up duration was comparable between the two groups, with a mean of  $2.011 \pm 0.508$

months (range: 1.25–3 months) in group I and  $2.136 \pm 0.486$  months (range: 1.5–3 months) in group II ( $p$ -value = 0.409), with no statistically significant difference. Notably, neither group demonstrated any recurrence of hydrocele throughout the follow-up duration, as shown in Table 3.

**Table 3: Postoperative hospital stay and follow up of patients.**

Variables	Group I (n=22)	Group II (n=22)	p-value
<b>Post-operative hospital stay in hours</b>			
Mean±SD	15.2±5	18.7±5.5	<b>0.032</b>
Range	8-25	10-30	
<b>Follow up in months</b>			
Mean±SD	2.011±0.508	2.136±0.486	0.409
Range	1.25-3	1.5-3	

During the follow-up period, postoperative complications occurred significantly more frequently in the scrotal approach group (Group II) compared to the inguinal approach group (Group I), with complication rates of 27.27% and 4.55%, respectively. The difference of 22.72% was statistically significant (95% confidence interval [CI]: 2.35% to 43.09%;  $p = 0.039$ ).

In Group I, the only complication observed was a hematoma in one patient (4.55%). In contrast, Group II experienced multiple complications: mild to moderate scrotal edema in all six patients, with three cases (13.64%) persisting for more than one month; hematoma in two patients (9.09%); and wound infection in one patient (4.55%) (Table 4).

**Table 4: Postoperative complications observed in both groups.**

Complications	Group I (n=22)	Group II (n=22)	p-value
<b>Overall complications</b>	1(4.55%)	6(27.27%)	<b>0.039</b>
<b>scrotal edema</b>	0(0%)	3(13.64%)	<b>0.073</b>
<b>Hematoma</b>	1(4.55%)	2(9.09%)	0.550
<b>Wound infection</b>	0(0%)	1(4.55%)	0.312

There was a highly significant difference in the meantime to resume normal daily activities between the two groups. Patients in Group I returned to normal activities earlier (mean =

$11.31 \pm 2.0$  days; range: 8–17) than Group II (mean =  $15.09 \pm 3.17$  days; range: 12–22), with a mean difference of 3.78 days (95% CI: 2.25–5.31,  $p < 0.001$ ), (Figure 2).

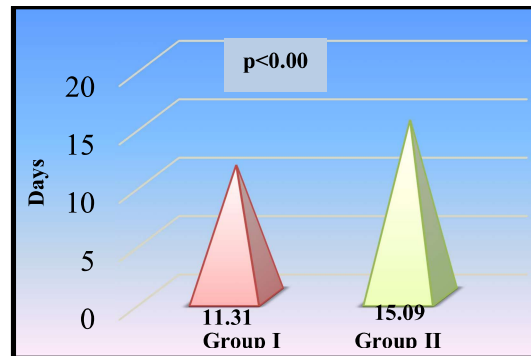


Figure 2: Comparison of the mean time to resume normal daily activities between both groups following hydrocelectomy.

## DISCUSSION:

### Clinical Implications

This study highlights that the inguinal approach for idiopathic hydrocele repair offers key clinical advantages compared to the scrotal approach, including shorter hospital stay, fewer postoperative complications, and faster return to normal daily activities. These findings can help optimize patient recovery and reduce healthcare burden. Importantly, these benefits apply specifically to adult patients with unilateral, idiopathic, transilluminating hydroceles. Such outcomes are particularly relevant in resource-limited settings where minimizing hospitalization and complications can significantly reduce costs and improve patient satisfaction.

### Comparison with Existing Literature

Ceylan et al. (2006) compared inguinal and scrotal approaches in 32 adult patients and found complications were more frequent with the scrotal technique. Hematoma occurred in 26.66% of scrotal cases versus 5.88% in the inguinal group, and edema was also more common with the scrotal approach<sup>(15)</sup>. Our findings align with these results, reinforcing the higher complication risk associated with the scrotal technique.

Nweze et al. (2009) managed 11 hydrocele cases using an inguinal incision parallel to the inguinal ligament, reporting minimal postoperative discomfort and rapid wound healing<sup>(16)</sup>. We observed similar outcomes, notably the absence of persistent scrotal edema. However, we used a transverse skin-crease incision to enhance exposure and reduce the risk of blind aspiration-related complications, such as testicular trauma or hematoma.

Lasheen et al. (2012) studied 40 patients and found no significant difference in operative time between the two approaches. However, the scrotal technique was associated with

significantly longer hospital stays and a higher incidence of postoperative complications (25%), including infection (5%), wound dehiscence (5%), persistent edema (10%), and testicular adhesion (5%). Recovery was also faster in the inguinal group<sup>(17)</sup>. These observations are consistent with our results: operative time did not differ significantly, while the inguinal approach demonstrated advantages in hospitalization, complication rates, and return to daily activities.

Agnihotri et al. (2018) evaluated 100 patients and reported a significantly longer operative time for the inguinal approach but superior postoperative outcomes, including shorter hospital stay and lower complication rates (10% vs. 68% in the scrotal group). Common scrotal approach complications included pain (26%), edema (14%), hematoma (10%), fever (8%), and infection (2%), whereas the inguinal group experienced only minor issues, such as localized pain (6%) and fever (4%). Patients undergoing the inguinal approach resumed activities sooner<sup>(18)</sup>. Our findings partially differ—while operative time was slightly longer with the inguinal approach, the difference was not statistically significant. However, postoperative advantages mirrored Agnihotri's results.

Two recent studies published after our data collection further support our conclusions. Orban et al. (2022) reported scrotal edema in 31.25% of scrotal cases and none in inguinal cases but did not assess hospital stay or recovery<sup>(19)</sup>. Sankarlingam et al. (2024) found the inguinal group had shorter hospital stays and earlier return to normal activities, despite reporting shorter operative time with the scrotal technique<sup>(20)</sup>. These studies confirm the

advantages of the inguinal approach regarding complications and recovery.

One area of difference compared to some studies was operative time, which requires further interpretation.

### **Interpretation of Operative Time Findings**

In our study, the inguinal approach showed a slightly longer operative time than the scrotal approach; however, this difference was not statistically significant. This finding aligns with Lasheen et al., but contrasts with Agnihotri et al. and Sankarlingam et al., who observed shorter times with the scrotal technique. The variation may be explained by procedural differences and surgeon experience. All operations in our study were performed by a single experienced surgeon using standardized steps, minimizing variability. Additionally, there were no intraoperative complications or additional pathologies requiring extended dissection, factors that could otherwise affect operative time.

### **Limitations**

This study has certain limitations. Randomization was not applied, as structured allocation was used to maintain comparable baseline characteristics between groups. Although the sample size was relatively small, an a priori power analysis confirmed adequacy for detecting clinically meaningful differences. The follow-up period (mean ~2 months) was sufficient for identifying early complications, which were the primary outcomes, and no recurrences were observed, consistent with prior reports using similar techniques. All surgeries and follow-up assessments were performed by a single experienced surgeon, ensuring procedural consistency but limiting variability in technique. The study exclusively included patients with idiopathic, unilateral, transilluminating hydroceles. Cases involving previous ipsilateral inguinal surgery or irradiation, recurrent hydroceles with adhesions, non-transilluminating (thick-walled) hydroceles, or giant hydroceles difficult to extract through the inguinal incision after aspiration were excluded by design. These strict inclusion and exclusion criteria improved internal validity, but results should be interpreted within this defined clinical scope.

However, these limitations do not diminish the significance of our findings; rather, they restrict their generalizability beyond the well-defined study population.

### **CONCLUSIONS AND RECOMMENDATIONS:**

Based on the present findings, the inguinal approach may represent a potentially favorable option for the surgical management of idiopathic

unilateral hydroceles in adults. It was associated with a lower incidence of postoperative complications, shorter hospital stay, quicker recovery, and earlier return to normal activities compared to the scrotal approach. Furthermore, this technique provides the added advantage of enabling evaluation and treatment of associated inguinal pathologies during the same procedure.

### **Recommendations**

- The inguinal approach can be considered as an alternative to the scrotal technique in carefully selected cases of adult idiopathic hydrocele.
- Preoperative assessment should include confirmation of transillumination and exclusion of complex or recurrent cases to ensure safe application of this approach.
- Training and experience in inguinal surgery remain essential to optimize outcomes and minimize complications.
- **Future research** should include:
  - Multicenter or randomized controlled trials with larger and more diverse patient populations.
  - Studies assessing the impact of hydrocele size and sac characteristics on the technical feasibility and outcomes of the inguinal approach.
  - Long-term follow-up to evaluate recurrence and late complications. While these findings are promising, further studies are required to validate their generalizability across different clinical settings.

### **Conflict of Interest Statement:**

The authors declare no conflict of interest.

### **Authors' Contributions:**

Author A contributed to the study design, data collection, surgical procedures, and manuscript drafting.

Author B contributed to critical revision of all manuscript sections and provided scientific input during the preparation process.

All authors have thoroughly reviewed and approved the final version of the manuscript.

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