Effect of internal ring narrowing on the rate of recurrence of large inguinoscrotal hernias in the pediatric age group

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Introduction and purpose
Risk factors and causes of recurrence following inguinal hernia repair in the pediatric age group are not well understood. In this work, we aimed to describe a cutoff value of internal ring diameter in male children who presented with large inguinoscrotal hernia above which internal ring narrowing (plication of inguinal canal floor) may affect the rate of hernia recurrence.
Patients and methods
A prospective study was conducted on male children who presented clinically with large unilateral or bilateral inguinoscrotal hernias. Preoperative ultrasound was performed for all of them to assess the diameter of the internal inguinal ring. Cases were categorized into two groups: group 1, internal ring diameter less than 12 mm, and group 2, internal ring diameter 12 mm and more.
Patients in either group were blindly selected to be operated upon by one of the two operative techniques, either just high ligation of the sac or high ligation of the sac followed by plication of the floor of the inguinal canal (narrowing of the internal ring).
The recurrence rate was compared between the two operative techniques, and the results were statistically analyzed.
Results
This study included 204 inguinoscrotal hernias divided into two groups: group 1 included 142 cases in which the internal ring diameter was below 12 mm. Half of them were operated upon by just high ligation of the sac, and the other half were operated upon by high ligation of the sac and internal ring narrowing. We encountered no recurrence in either group.
Group 2 included 62 cases in which the internal ring diameter was 12 mm or more. A total of 31 patients were operated upon by high ligation of the sac only, and we encountered three (10%) recurrent cases. The other 31 cases were operated upon by high ligation of the sac and narrowing of the internal ring, with no recurrence.
Conclusion
Narrowing of the internal ring if dilated above 12 mm or more may decrease the recurrence rate in such cases.

Keywords:
huge hernia, inguinal, internal ring, narrowing of internal ring

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Introduction

Pediatric inguinal hernia is one of the most common surgical diseases in children. It is estimated that more than 20 million hernia repairs are performed each year worldwide. The estimated incidence of pediatric inguinal hernia ranges from 0.8 to 4% in children and is highest in infants, especially in premature children, with an incidence of about 10–30%. More than 99% of inguinal hernias in children are indirect [1–3].

There has been a wide range of reported estimates of hernia recurrence in children, which varies from as low as 0.3% up to 10.9% in different series [4].

Many things related to inguinal hernias in pediatrics are still debatable including the optimal time for repair, role of laparoscopy, need to explore the clinically negative contralateral side, importance of preoperative inguinoscrotal ultrasound (US), and the need to repair or narrow the internal ring in selected cases. The use of US as a diagnostic tool has made it possible to accurately measure the size of internal ring [5,6].

Although many surgical procedures were described for the repair of adult inguinal hernia, only one of three surgical procedures were available for surgical repair of inguinal hernia in children:

(1) High ligation of the hernia sac.
(2) Plication of the floor of inguinal canal if the internal ring excessively dilated after high ligation of the sac.
(3) High ligation of the sac and then reconstruction of the floor of the canal [7,8].

Some surgeons consider narrowing of the internal ring should not be performed, which may cause entrapment of the cord structures and injury to the inferior epigastric vessels, and they believe that simple high ligation of the hernia sac should allow the internal ring to close down to its normal width, whereas others believe that repair of the posterior inguinal wall in selected cases with very wide internal ring will reduce the recurrence rate in such cases. It is not yet clear when to choose to narrow the internal ring after high ligation of the sac [2–9].

Aim

The aim was to evaluate if narrowing of the dilated internal ring was mandatory after high ligation of the hernia sac in huge or giant inguinoscrotal hernia in pediatric age group, and we tried to detect the cutoff value of internal ring diameter above which the recurrence was likely to occur if not narrowed.

Patients and methods

The study was carried out as a prospective study on selected patients who presented with inguinoscrotal hernias between April 2018 and May 2021. Only male children were included in this study. All operations were done by the authors of this study who had at least 15 years of experience in inguinal hernia management in the pediatric age group. All US assessment were done by the same senior physician.

We included 204 inguinal hernias in 190 male children (14 bilateral cases) who presented to us in the outpatient clinic of Fayoum University Surgery Hospital. They had large or huge inguinoscrotal unilateral or bilateral hernias (inguinal bulge that reach the scrotum either filling or not filling it during rest or crying).

Preoperative inguinoscrotal US was performed for all patients included in this study to confirm the diagnosis first, determine the content of the hernia sac, and finally to measure the diameter of the internal ring. US examinations were carried out with one of the two machines Toshiba Xario XG (California, USA) utilizing linear transducer 9.2–4-MHz or logic S7 expert utilizing 12–3-MHz transducer. All examinations were carried out without sedation and with straining conditions such as crying and coughing. The examination started from the scrotum and continued proximally toward the peritoneal cavity in both groins.

Inclusion criteria

The following were the inclusion criteria:

(1) Male patients with large or huge inguinoscrotal hernia reaching the scrotal compartment clinically.
(2) Age from 1 day to 12 years.

Exclusion criteria

The following were the exclusion criteria:

(1) Female patients.
(2) Male patients who presented with small inguinal hernia not reaching the scrotum (bubonocele).
(3) Recurrent hernias.
(4) Incarcerated hernias.
(5) Concomitant pathology that can affect the outcome such as hydrocephalus.
(6) Patients missed during the follow-up period.

Cases included in this study were separated into two groups depending on the diameter of the internal ring that was previously measured by US.

Group 1 included 142 cases in which the internal ring diameter was less than 11.9 mm.

Group 2 included 62 cases in which the internal ring diameter by US ranged from 12–20 mm.

Patients in either group were blindly selected by an envelops method to be operated upon by one of two operative techniques (1 and 2).

The first operative technique was done for half of the cases of the two groups (A and C), which is high ligation of the sac and then narrowing of the internal ring (plication of the inguinal canal floor) by one or two absorbable sutures (vicryl 4–0) through a small inguinal crease incision.

The second operative technique was done to the second half of both groups (B and D) by only high ligation and excision of the hernia sac without narrowing of internal ring.

Table 1 shows the division of patients into four groups.

Data collection: all data were collected in a master sheet and presented anonymously, and no personal data were disclosed.

Follow-up: the mean follow-up time for all patients was 17.7 ± 5.6 months. In each follow-up, we asked the parents carefully about any recurrence of the inguinoscrotal bulge, and any expected recurrence was sent again to US for confirmation. Moreover, we followed up the occurrence and the outcome of any complication noticed after the operation rather than the recurrence like scrotal edema or bruising, wound infection, iatrogenic testicular atrophy, or iatrogenic postoperative cryptorchidism.

Statistical analysis

χ^2 test and Fisher's exact test were used to compare the outcome of all groups. IBM SPSS 28 (Armonk, NY, United States) for windows software were used for the analysis, and a *P* value of less than 0.05 was considered statistically significant.

Ethical consideration: the present study was carried out on the basis of the code of ethics of the World Medical Association according to the principles of the Declaration of Helsinki [3]. This study has been approved by the local Ethics Committee of Faculty of Medicine, Fayoum University Hospitals. A written informed consent was provided by all parents after explaining to them the nature of the study before their children were included in the study. Informed consent was obtained from all study participants.

Results

All 190 patients included in this study were males. Their age ranged from 1 month to 10 years, with a median of 18 months.

Table 2 represents the incidence of occurrence of the inguinal hernia in the presented study on each side.

No recurrence occurred in groups A, B, and C after the whole follow-up period, whereas we encountered three recurrences in group D (Table 3).

Comparison of the occurrence of recurrence in the four groups showed a statistically significant difference using exact test, with *P* value of 0.006. Recurrence was higher in group D, as there were three cases of recurrence in this group, whereas no cases of recurrence were observed in the other groups.

If we statistically compare group 1 with group 2, making the internal ring diameter was the only affecting factor whatever the surgical procedure that was performed. We found a statistically significant difference between both groups regarding the recurrence rate, with a *P* value of 0.027 using χ^2 test and Fisher's exact test.

This means that there is a direct proportional relationship between the internal ring diameter and the recurrence rate.

For postoperative scrotal swilling (edema or hematoma) and postoperative wound infection, χ^2 test and Fisher's exact test were used to compare the outcome of the four groups. There was a statistically significant difference between the four groups regarding postoperative scrotal swilling (edema or hematoma). The percentages of mild and severe cases were higher in groups C and D ($P<0.001$). Overall, 31% of groups C and D had mild postoperative swelling as compared with 10% in groups A and B.

Overall, 11% of groups C and D had severe postoperative swelling as compared with 3% in groups A and B.

There was no statistically significant difference between the four groups regarding wound infection.

Table 4 summarizes and compares these mentioned results. Regarding wound infection, we encountered six (2.9%) cases of postoperative wound infection, and all of them resolved within 14 days by oral antibiotics.

Table 1 Blind separation of the cases into four groups; to make it easier to refer to the category group, we had named them as A, B, C, and D

	Group 1 (142) – internal ring diameter less than 12 mm	Group 2 (62) – internal ring diameter 12–20 mm
First operative technique	(A) 71 inguinal hernias (high ligation and narrowing of the internal ring)	(C) 31 inguinal hernias (high ligation and narrowing of the internal ring)
Second operative technique	(B) 71 inguinal hernias (high ligation of the sac	(D) 31 inguinal hernias (high ligation of the sac)

Table 2 Incidence of right versus left versus bilateral hernias

	Group 1 (142) [*n* (%)]	Group 2 (62) [*n* (%)]	Total [*n* (%)]
Right	71 (55)	42 (69)	113 (59.5)
Left	45 (35)	18 (29.5)	63 (33)
Bilateral	13 (26 hernias) (10)	1 (2 hernias) (1.5)	14 (7.5)

Table 3 Recurrence in each group

	(A) 0/71 (high ligation and internal ring narrowing)	(C) 0/31 (high ligation and ring narrowing narrowing)
	(B) 0/71 (high ligation of the sac)	(D) 3/31 (high ligation of the sac) (10%), with *P* value 0.006
Total	0/142	3/62 (5%) with *P* value 0.027

Discussion

The incidence of inguinal hernia in full-term children ranges from 0.8 to 4% and in preterm infant may reach up to 30% [1].

Hernia recurrence in children has been reported to be as low as 0.3 up to 10.9% in different studies. Risk factors and causes of recurrence are still not clearly understood and may include one or more of the following factors: failure to ligate the sac high enough, infant and premature cases, male patient, incarcerated cases, and very wide internal ring that is not repaired during the operation [4].

The primary outcome of this work was the recurrence rate, and we aimed to assess a single risk factor, which was the internal ring diameter, and if narrowing it after high ligation of the hernia sac affects the rate of the recurrence. Moreover, we also tried to find a cutoff value of internal ring diameter above which recurrence was more likely if the internal ring was not narrowed.

To minimize the effect of other recurrence risk factors, we excluded incarcerated cases, recurrent cases, and premature infants.

Only male children were included in this study as recurrence was reported to be higher in male than female patients.

Preoperative inguinoscrotal US was done for all cases included in this study to accurately measure the internal ring diameter. Inguinal US is a safe, cheap and noninvasive method for the evaluation of the diameter of the internal inguinal ring. We have performed routine US for all cases presented to us with inguinal hernia since 10 years for many reasons, such as detecting contralateral hernias in patients presented with unilateral one, accurately detecting the site and size of both testicles, and measure the internal ring [5,6].

A total of 190 male children were included in this study. Overall, 60% of them presented with right-side hernia, 33% of hernias were at the left side, and 7% were bilateral. This reported incidence was in agreement with that reported by Rowe and Clatworthy [10], as they reported 60% at the right, 30% at the left, and 10% bilateral.

The overall recurrence rate in the present study was 1.4%. A retrospective single-surgeon study including 6361 inguinal hernia repairs reported a hernia recurrence rate of 1.2%, which is comparable to our study (1.4%) [4].

We found no studies addressing the presence of possible relationship between the preoperative internal ring diameter and the rate of recurrence. In the present study, the recurrence rate was higher in group 2, which had a wider internal ring, compared with group 1. This difference was statistically significant, with a *P* value of 0.027 using χ^2 test and Fisher's exact test.

Repairing of the posterior wall in selected cases of pediatric large inguinoscrotal hernias has been reported in different studies. Hill and Durham [11] specified that they used a biological mesh for a neonatal case with giant hernia and stated that using a mesh strengthened the muscle layer and thus prevented recurrence. Anadolulu *et al.* [12] reported that recurrence rates were lower in patients who underwent hernioplasty using Zig maneuver and internal ring narrowing, but they used this technique for giant inguinoscrotal hernias with an internal ring diameter above 2 cm.

In the present study, all male patients who presented clinically with inguinoscrotal hernia were included and categorized into four groups according to the internal ring diameter and the surgical procedure that was performed. According to our aforementioned results, we found a statistically significant difference in the recurrence rate in group D compared with the other groups, with a *P* value 0.006.

Postoperative scrotal bruising or edema is considered by some authors as a normal finding owing to its widespread occurrence [2,9]. In our study, the incidence of mild edema that resolved within 2 weeks was 31–10% in the different groups, and also the incidence of severe postoperative scrotal edema that resolved after about 3 weeks was 11–3% in different groups. We found a direct proportional relationship between the internal ring diameter and in turn the size of the hernia and the postoperative scrotal swelling in both severity

Table 4 Comparison of the surgical outcome of the two groups

	Groups A and B [*n* (%)]	Groups C and D [*n* (%)]	*P* value
Postoperative scrotal swilling (edema or hematoma)			
None	124 (87)	36 (58)	<0.001
Mild (resolved within 10 days)	14 (10)	19 (31)	
Severe (resolved after 3 weeks)	4 (3)	7 (11)	

and the time needed to be resolved. This may be owing to the fact that the larger the size of hernia, the more the tissue edema and the more difficult to find the hernia sac, which leads to excessive tissue trauma and more postoperative edema and hematoma.

Our reported incidence of scrotal edema was much higher than that reported by Taqvi *et al*. [13] et al, as they reported scrotal edema in about 3% and hematoma in 0.49%.

In the present study, the overall incidence of wound infection was 2.9%, and this reported incidence of infection was larger than that reported by Bhattacharyya and Kosloske [14], which was less than 1%, and we can assume this difference in the incidence between our series and the report by Bhattacharyya owing to the selection criteria in our study, as we only included inguinoscrotal hernias.

Conclusion

Plication of the floor of the inguinal canal in children presented with large inguinoscrotal hernia and narrowing of the internal ring may decrease the recurrence rate in such cases. We found a cutoff value of internal ring diameter of about 11.9 mm above which repairing of the internal ring will affect the recurrence rate.

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Conflicts of interest
There are no conflicts of interest.

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