

# Single-incision approach for bilateral inguinal hernia repair in children

## A retrospective study

Ren Chongxi, MD\*, Wang Hongqiao, MD, Li Fengying, MD, Wang Xin, MD, Qi Hongxia, MD, Xing Lijun, MD

### Abstract

To introduce the use of a new surgical approach named single-incision bilateral inguinal herniorrhaphy (SBIH) in pediatric surgical population.

This was a STROBE-compliant retrospective cohort study using data from 101 patients who had undergone bilateral inguinal herniorrhaphy in our institution. Children with bilateral inguinal hernias without contraindications for surgery, ranging in age from 6 months to 12 years, were included. Fifty-six children with bilateral inguinal hernias underwent SBIH (SBIH group) and 45 patients underwent laparoscopic bilateral inguinal herniorrhaphy (LBIH) (LBIH group). Differences in operative time, postoperative pain, recurrence, and complications between the 2 groups were analyzed. Patient satisfaction with cosmetic result was also investigated using questionnaires.

There were no statistically significant differences in operative time ( $P=.2257$ ), postoperative pain ( $P=.0607$ ), recurrence ( $P=.8756$ ), and complications ( $P=.7467$ ) between the 2 groups. Interestingly, the operation time of girls in SBIH group was significantly shorter than that of the boys in this group ( $P<.0001$ ), but also shorter than that of girls in LBIH group ( $P=.0038$ ). Postoperative pain for boys was lower in SBIH group than in the LBIH group ( $P=.0340$ ). No ascending testis, testicular atrophy, and hydrocele occurred in either group. According to the questionnaire, both procedures had equally high levels of satisfaction for cosmetic results ( $P=.7531$ ).

Initial results show that SBIH for pediatric patients, regardless of gender, is a safe and feasible procedure compared with LBIH with an equally low recurrence rate, few complication, and satisfactory cosmetic outcomes.

**Abbreviations:** LBIH = laparoscopic bilateral inguinal herniorrhaphy, SBIH = single-incision bilateral inguinal herniorrhaphy.

**Keywords:** laparoscopic bilateral inguinal herniorrhaphy, outcomes, pediatric bilateral inguinal hernia, single-incision bilateral inguinal herniorrhaphy

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*Findings:* Initial results show that SBIH for pediatric patients, regardless of gender, is a safe and feasible procedure compared with the laparoscopic technique with an equally low recurrence rate, few complications, and satisfactory cosmetic outcomes.

*Implications:* We suggest that SBIH procedure should be considered in suitable pediatric patients if surgically available.

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Cangzhou Clinical College of Integrated Traditional Chinese and Western Medicine of Hebei Medical University, China.

\* Correspondence: Ren Chongxi, Department of General Surgery, Cangzhou Clinical College of Integrated Traditional Chinese and Western Medicine of Hebei Medical University, Qian Tong North Street No. 17, Cangzhou City 061000, Hebei Province, China (e-mail: rcxvip@outlook.com).

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### Key Points

- Pediatric patients with bilateral inguinal hernias benefit from the laparoscopic technique while open procedures remain the mainstay of treating these diseases; few studies have reported the use of a single incision method to repair bilateral inguinal hernia in the literature;
- so far there have been rare reports on the use of this technique in boys;
- a new approach named single-incision bilateral inguinal herniorrhaphy (SBIH) in pediatric surgical population is introduced.

### 1. Introduction

Inguinal hernia is one of the most common diseases in infants and children. The reported incidence of inguinal hernia at this age varies from 0.8% to 4.4%, which is more likely to occur in boys. Also, bilateral inguinal hernias are relatively common in children.<sup>[1,2]</sup> Herniorrhaphy (high ligation of the hernia sac for children) has always been the choice and standard treatment for inguinal hernia and is estimated to be used in more than

20 million cases per year worldwide.<sup>[3]</sup> With the development in surgical technology, a number of medical centers adopted laparoscopic hernia repair in children as the best option for herniorrhaphy, replacing the open procedure due to minimal invasiveness and better cosmetic effect. Over the past 2 decades, laparoscopic procedures for pediatric inguinal hernia repair have gained increased popularity. It is commonly believed that laparoscopic surgery is a minimally invasive treatment option and more advantageous for bilateral inguinal hernia repair in children. Undeniably, laparoscopic surgery has obvious advantages over open surgery because of its minimally invasive, cosmetic effects, safety, and less complications, although a variety of surgical methods are available for the treatment of bilateral inguinal hernia in children. Nevertheless, the application of laparoscopy in treating inguinal hernias in children remains controversial. The reported high recurrence rate and long learning curve in literatures are among its disadvantages.<sup>[4–8]</sup> As a result, some surgeons are also in favor of open surgery. A 24-year study by Pogorelić et al<sup>[9]</sup> from Japan found that Marcy hernia repair is a safe and effective procedure for inguinal hernia in children with excellent outcomes and a low incidence of recurrence. Indeed, open repair procedure, as a gold standard for hernia repair, remains the mainstay of treating pediatric bilateral inguinal hernia at present. Although there is variability in the way surgeons perform some of the technical aspects of inguinal herniotomy, we know of no technique that describes a small single transverse suprapubic incision to repair bilateral inguinal hernia in children. Hence, we introduced a new surgical method with minimally invasive effect for the treatment of bilateral inguinal hernia in children. In fact, Uceda<sup>[10]</sup> first described a single transverse suprapubic incision for bilateral inguinal hernia repair in 1994, which was considered simple and practical for bilateral inguinal hernia repair in girls. According to his point of view, this single incision method was not recommended for the repair of bilateral inguinal hernia in boys due to concerns about difficult surgical procedures and inevitable complications. However, in the following decades, few studies have reported the use of a single incision method to repair bilateral inguinal hernia in the literature, and so far there have been rare reports on the use of this technique in boys. With the advancement in laparoscopic surgery, it remains unclear to date if there is any change in the prevalence, including conventional surgery, of bilateral inguinal hernia repairs in children. Currently, there is still the basic question of whether the new procedure can be applied to boys or the fact that it results in spermatic cord injury or surgical failure. To this end, we introduced this approach named single-incision bilateral inguinal herniorrhaphy (SBIH) in pediatric surgical population at our institution as a less invasive and more cosmetically appealing technique.

Recently, many reports in regard to comparisons of open repair procedures and laparoscopic herniorrhaphy in pediatric hernia repair are published confirming the advantages and disadvantages of both and their applicability to children.<sup>[2,11–16]</sup> However, these reports still do not investigate the result of single incision approach for bilateral inguinal hernia repair in children. Here, we introduce a single incision approach for bilateral inguinal herniorrhaphy, aimed at improving therapeutic effect and reducing the incidence of reoccurrence and complications; report our preliminary experience with this procedure in 56 pediatric patients; and retrospectively compare the outcomes with those of 45 pediatric patients who had undergone laparoscopic surgery.

## 2. Materials and methods

From January 2008 to March 2018, 56 consecutive children with bilateral inguinal hernias underwent SBIH in our department. For comparison with these patients, another 45 patients who had undergone laparoscopic bilateral inguinal herniorrhaphy (LBIH) between January 2006 and July 2018 in our center were identified and matched to the SBIH group by age, sex, and body weight. Criteria for enrollment included bilateral inguinal hernia without contraindications for surgery, ranging in age from 6 months to 12 years. Exclusion criteria included patients with ascending testis or cryptorchidism, incarcerated hernia, and strangulated hernia. All patients had undergone ultrasonography and were diagnosed preoperatively. Patients underwent either SBIH or LBIH based on their preferences after providing informed consent. The procedure was performed by the same surgical team at our institution with standard preoperative evaluation, preparation, and postoperative care. Consent for the operations was obtained from the parents prior to the surgery, in which the parents confirmed understanding of the possible complications associated with the new procedure.

Perioperative outcomes from medical records were reviewed, including operative time and 48-hour postoperative pain score. Postoperative pain refers to all pain after the patient's analgesic effect disappears. Pain scores given verbally by children, their parents, and nurses were collected. A numerical rating scale or the Wong-Baker Faces Pain Scale was used.<sup>[17]</sup> The patients and their parents were instructed to use pain medication (non-narcotic) when necessary. In addition, the parent's satisfaction was measured at 3 months after the procedure by use of an ordinal scale with 1 indicating not satisfied at all and 5 indicating very satisfactory. Postoperative recurrence and complications were likewise assessed at 1 week, 3 months, 6 months, and 1 year after the surgical procedure. Patients were followed up regularly in our outpatient clinic by the same surgeon at 1 week, 6 months, and 12 months, and then at regular intervals up to 5 years postoperatively to assess wound healing, incision appearance, in addition to the size and position of the testes in boys. The end of the follow-up period was November 2018, when the questionnaires were returned to us. The study protocol was reviewed and approved by the Institutional Ethics Review Board of Cangzhou Clinical College of Integrated Traditional Chinese and Western Medicine of Hebei Medical University (Approval number: CZ-ASFQ-063). Patient confidentiality was ensured. Guardians of all participants gave written informed consent.

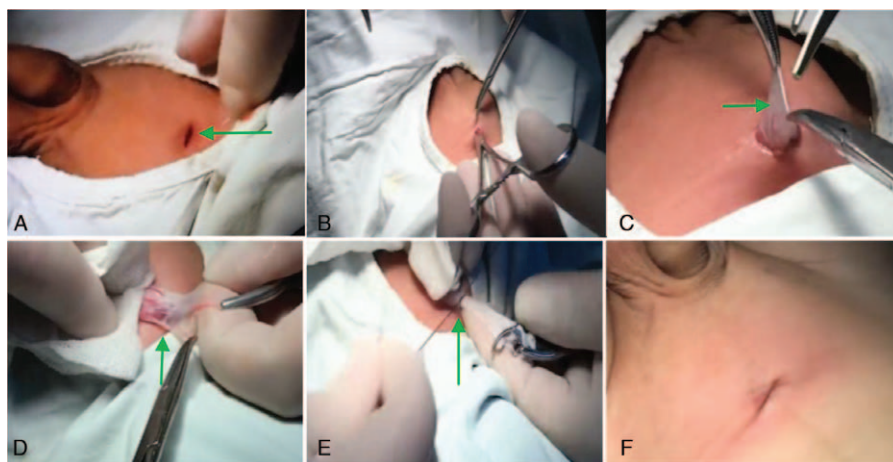
## 3. Statistical analyses

Data are reported as means  $\pm$  standard deviation (SD). Statistical analyses were performed using the  $\chi^2$  test for categorical variables and the Mann–Whitney *U* test for continuous variables. The Chi-Squared test was used for categorical comparisons of data when appropriate. A *P* value of less than .05 was considered to indicate statistical significance; all tests were two-tailed. All statistical analyses were performed with the statistical package IBM SPSS statistics version 22.0 and Graphpad Prism 8 software.

## 4. Surgical procedures

### 4.1. LBIH

Briefly, children who underwent laparoscopic bilateral inguinal hernia repair at our hospital were operated in general anesthesia



**Figure 1.** SBIH procedure presentation. A. A midline transverse suprapubic incision (arrow). B. Gently pull up the skin edge and put hemostatic forceps into the incision. C. Hernia sac with the spermatic cord is exposed outside incision (arrow). D. Hernia sac is separated from the spermatic cord down to the internal ring (arrow). E. Hernia sac is ligated using a high ligation approach (arrow). F. Incision at the completion of the procedure. SBIH = single-incision bilateral inguinal herniorrhaphy.

with tracheal intubation or laryngeal mask airway. For the 30° laparoscope, 1 optical 5 mm port was inserted surgically through an umbilical incision, and two 2 mm or 3 mm ports were placed at the lateral border of the rectus abdominis muscle at the umbilical level or slightly below under laparoscopic observation. All surgical procedures were performed by our team according to the technique described by Schier et al.<sup>[6]</sup> The knots were tied intra- or extracorporeally and checked to ensure proper closure of the internal ring. The intraperitoneal, intracorporal knot technique was used in our study. All abdominal incisions were closed with absorbable sutures.

#### 4.2. SBIH

After general anesthesia, in a supine position, a 0.8 to 1.5 cm midline transverse suprapubic skin incision is made along the skin crease, which is carried down through the dermis to expose the subcutaneous fat (Fig. 1A). With use of a mosquito clamp, the blunt dissection was taken in the subcutaneous fat toward the targeted hernia sac through the Camper fascia and Scarpa fascia down to the plane of external inguinal ring (right), where the tissue layer allows exploration and dissection of hernia sac (Fig. 1B). While being careful not to grasp large pieces of tissue, a mosquito clamp was used to hold gently cremasteric muscle fibers. The hernia sac with the spermatic cord was retracted upward, elevated off the external inguinal ring, and exposed outside incision (Fig. 1C). Then, the hernial sac was separated from the spermatic cord, transected, and ligated as high as possible (Fig. 1D-F). Redundant hernia sac tissue was removed. The spermatic cord on the right was restored and wound was examined. For boys, it is important to note that when dissecting the hernia sac, it is necessary to identify carefully and protect the spermatic arteriovenous vessels and vas deferens. From this point onward, the steps of standard hernia repair with a high ligation are followed according to the surgeons' technique. The neck of the hernia sac (the presence of extraperitoneal adipose tissue) is a key location of high ligation. Subsequently, the same steps were repeated on the contralateral side (left) through the same skin incision. Lastly, the procedure was completed by performing 2 high ligations of the hernia sac with a minimal incision (Fig. 1F).

An accompanying explanation of the procedure:

1. Sometimes, gentle incision retraction was needed laterally to maintain excellent exposure.
2. Gently pulling down the scrotum or testes was necessary to restore the testicles to their original position and avoid iatrogenic cryptorchidism.
3. Electrocautery was available intraoperatively, as a matter of preference.
4. During the entire procedure, we neither cut open the inguinal canal, nor did we incise the spermatic cord.

#### 5. Results

All procedures were successfully performed for 45 patients who underwent LBIH and for 56 patients who underwent SBIH in our institution. Relevant demographic and clinical characteristics of the 2 groups are presented in Table 1. A total of 202 internal inguinal rings (high ligation of hernia sacs) were closed in the 101 patients of the 2 groups. There were no significant differences in the distribution of age, sex, body weight, hospital stay, or follow-up period between the 2 groups (all  $P > .05$ ).

Comparison of the operative time in the 2 groups is listed in Table 2. There was no statistically significant difference in operative time between the LBIH ( $37.9 \pm 8.6$  min) and the SBIH

**Table 1**  
Patients' characteristics (n=101).

| Characteristics       | LBIH (n=45) | SBIH (n=56) | P value |
|-----------------------|-------------|-------------|---------|
| Sex (male, female)    | 38, 7       | 41, 15      | .1741   |
| Age (mo)              | 30.7 ± 18.5 | 24.6 ± 13.7 | .0542   |
| Body weight (kg)      | 12.8 ± 4.3  | 11.4 ± 2.8  | .0747   |
| Hospital stay (d)     | 3.3 ± 0.4   | 3.3 ± 0.4   | .9029   |
| Follow-up period (mo) | 40.2 ± 16.7 | 37.6 ± 15.5 | .3932   |

Data are presented as mean ± standard deviation by Mann-Whitney *U* test and presented as numbers (percentage) by Chi-Squared test.

LBIH = laparoscopic bilateral inguinal herniorrhaphy; SBIH = single-incision bilateral inguinal herniorrhaphy.

**Table 2**  
Comparison of the operative time in the LBIH and SBIH groups.

| Patients (n = 101) | LBIH (min) | SBIH (min) | P value |
|--------------------|------------|------------|---------|
| Male               | 37.8 ± 8.9 | 37.7 ± 6.7 | .5259   |
| Female             | 38.5 ± 6.7 | 28.0 ± 5.2 | .0038   |
| Total              | 37.9 ± 8.6 | 35.1 ± 7.6 | .2257   |

Data are presented as mean ± standard deviation by Mann-Whitney U test. LBIH = laparoscopic bilateral inguinal herniorrhaphy; SBIH = single-incision bilateral inguinal herniorrhaphy.

groups (35.1 ± 7.6 min) (P = .2257). However, the operative time for female patients was significantly shorter in the SBIH group (28.0 ± 5.2 min) than in the LBIH group (38.5 ± 6.7 min) (P = .0038).

Postoperative pain cases requiring treatment in the 2 groups are listed in Table 3. In addition, the incidence of postoperative pain in SBIH group was higher in LBIH group (46.6% vs 28.5%), but there was no statistically significant difference (P = .0607). However, we found that the incidence of male patients with postoperative pain in the SBIH group was significantly lower than that in the LBIH group (26.8% vs 50%, P = .0340).

The recurrence and postoperative complications are listed in Table 4. No difference in short-term adverse events, such as pneumonia, urinary tract infection, urinary retention, and ileus, was found between the 2 groups in our study. Recurrence rate was 2.2% (1/45) in the LBIH group, and 1.7% (1/56) in the SBIH group (P = .8756). One male case of recurrent hernia was in SBIH group and the other female case was in LBIH group. Both recurrences without sliding hernia or intestinal incarceration occurred within a year. During each open reoperation, a knot was found at the distal end of the hernia sac, so high ligation was performed again. Complications were similar in both groups (P = .7467). The incidence of bleeding or hematoma, surgical site infection, and inguinal swelling was 8.8% vs 7.1% in both groups. No hydrocele formation, ascending testis, and testicular atrophy were found in either group.

All SBIH procedures were completed without requiring conversion to traditional 2 skin incision repairs. Comparison of operative time for girls and boys in the SBIH group is presented in Fig. 2 At 28.0 minutes, the mean operative time for girls was significantly shorter than that of the boys (37 minutes). There were statistically significant differences between the sexes (P < .0001).

Questionnaires concerning patients' satisfaction with cosmetic result were sent to 101 parents and all of them were returned. The mean satisfaction index for cosmetic satisfaction on a 5-point scale was 4.4 ± 1.1 in the LBIH group and 4.4 ± 1.0 in the SBIH group (P = .7531) (Fig. 3).

**Table 3**  
Postoperative pain cases requiring treatment in the LBIH and SBIH groups.

| Patients | LBIH (n, %) | SBIH (n, %) | P value |
|----------|-------------|-------------|---------|
| Male     | 19, 50.0    | 11, 26.8    | .0340   |
| Female   | 2, 28.5     | 5, 33.3     | .8233   |
| Total    | 21, 46.6    | 16, 28.5    | .0607   |

Data are presented as numbers (percentage) by Chi-Squared test. LBIH = laparoscopic bilateral inguinal herniorrhaphy; SBIH = single-incision bilateral inguinal herniorrhaphy.

**Table 4**  
Patient demographics are presented with regard to recurrence and complications in both groups.

| Recurrence and complications | LBIH        | SBIH        | P value |
|------------------------------|-------------|-------------|---------|
| Recurrence                   | 1/45 (2.2%) | 1/56 (1.7%) | .8756*  |
| Bleeding or hematoma         | 1/45 (2.2%) | 2/56 (3.5%) | .6914   |
| Surgical site infection      | 2/45 (4.4%) | 1/56 (1.7%) | .4341   |
| Inguinal swelling            | 1/45 (2.2%) | 1/56 (1.7%) | .8756   |
| Hydrocele formation (male)   | 0/38        | 0/41        | –       |
| Ascending testis (male)      | 0/38        | 0/41        | –       |
| Testicular atrophy (male)    | 0/38        | 0/41        | –       |
| Total                        | 4/45 (8.8%) | 4/56 (7.1%) | .7467   |

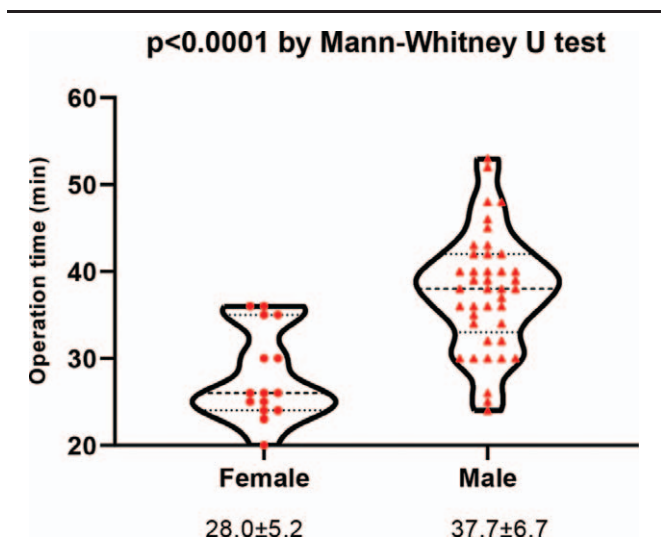
LBIH = laparoscopic bilateral inguinal herniorrhaphy; SBIH = single-incision bilateral inguinal herniorrhaphy.

\*The exclusion of recurrence in complications. Data are presented as numbers (percentage) by Chi-Squared test.

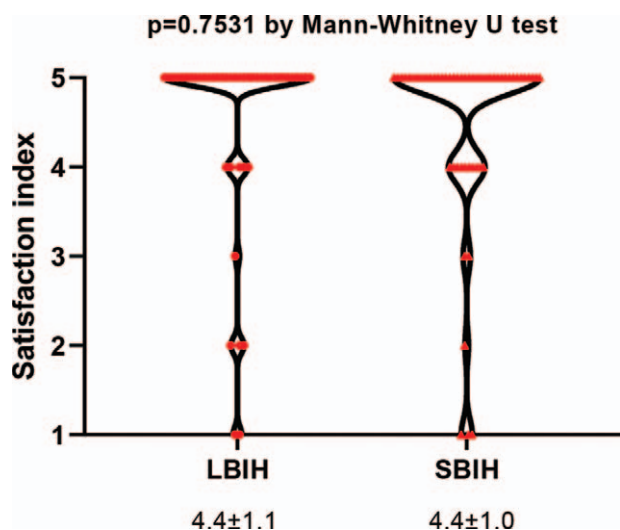
**6. Discussion**

This retrospective study reported our initial experience of bilateral inguinal hernia repair using SBIH in children. Through clinical data survey and follow-up, we demonstrated that the patients who underwent this procedure had an equally low recurrence rate, few complications, and satisfactory cosmetic outcomes compared with those who underwent LBIH.

For a long time, it has been considered impossible to perform open repair of bilateral inguinal hernia with a single surgical incision. To the best of our knowledge, the idea of exposing the bilateral inguinal hernia through a single small incision has rarely been described in the literature. Uceda<sup>[10]</sup> described a single incision method for girls in 1994, and so far there have been few reports on the application of this technique in male children. Concerns regarding this approach may arise from its potential spermatic cord injury in boys, resulting in testicular atrophy. These same concerns also arose when the technique was introduced in girls by Abdalla et al.<sup>[18]</sup> However, our results showed that none of them had this complication. In reality, we have adapted the anthropotomy principles, paying more attention to anatomic structure of the spermatic cord and the



**Figure 2.** A violin plot of operative time for girls and boys in the SBIH group. SBIH = single-incision bilateral inguinal herniorrhaphy.



**Figure 3.** A violin plot of patient satisfaction with cosmetic result through the questionnaires.

exact location of the external inguinal ring. As a result, the spermatic cord vasculature and vas deferens can be prevented from being damaged.

According to an anatomical study by Parnis et al,<sup>[19]</sup> the inguinal canal in infants and younger children is short and straight with a reported median length of 1 cm in children under 2 years of age and 1.1 cm in children over 4 years, and almost vertically from the internal to the external inguinal rings. Obviously, the internal and external inguinal rings in infants almost overlap; therefore, if the retractor exposes the external ring, it is easy to expose the internal ring by retracting a few millimeters more. In addition, the surface projection of the external inguinal ring is usually 1 finger (1.0–1.5 cm) below the transverse ventral stria. According to the characteristics of this disease, the hernia sac is located at the anterior medial side of the spermatic cord or round ligament. Thus, a single transverse incision in the midline of the abdomen is sufficient to expose the bilateral external inguinal rings.

In the light of a systematic review of inguinal canal anatomy in children conducted by Taghavi et al,<sup>[20]</sup> changes in the position of the inguinal rings with respect to the lengthening of the canal remain unclear. As stated in the text, some anatomical studies showed rapid growth of the length of the inguinal canal up to 2 years of age before plateauing, while others suggested no increase in canal length prior to 10 years of age in children. Despite this, the surface anatomy of the pediatric inguinal canal makes sense for the design and selection of surgical methods. Thus, owing to the pliable skin in children, our technique can reasonably ligate the hernia sac at the same level of the internal inguinal ring as the laparoscopic approach. One anatomical basis of our technique over bilateral inguinal herniorrhaphy is that the single transverse incision is closer to the bilateral external inguinal ring and provides better exposure.<sup>[10,19]</sup> Based on it, we speculated that children with bilateral inguinal hernias under 10 years old were the reasonable age for SBIH.

There was no statistically significant difference in operative time between both groups, but the operative time for female patients was significantly shorter in the SBIH group than in the LBIH group ( $P = .0038$ ). The reason it takes less time is because the technical

repair in girls is much easier than male inguinal hernia repair where the vas deferens and testicular vessels need to be spared, whereas there is no need to give too much thought to save the round ligament in girls. In our institution, during the exposure of the hernia sac, intensive and meticulous procedure is performed to avoid or minimize spermatic cord injury. This maneuver might have resulted in a relatively long operative time in clinical practice.

As for the incidence of postoperative pain, most surgeons agree that there is no significant difference between open inguinal hernia repair and laparoscopic surgery in children.<sup>[11,14,15]</sup> In this research, the incidence of postoperative pain was higher but there was also a statistically significant difference of male patients between the 2 groups. Pain cases of boys in the SBIH group accounted for 26.8%, far lower than 50% of the LBIH group. We think that the lower postoperative pain of boys in the SBIH group may be due to a single small incision or another factor.

We observed a recurrence rate of 1.7% in SBIH group. The difference was not statistically significant compared with the LBIH group. This is consistent with the recurrence rate published in the literature, which describes the recurrence rate between 0% and 4.4% after laparoscopic hernia repair.<sup>[11,12,15]</sup> In addition, we note that this recurrence rate is significantly lower than reported in the relevant literature.<sup>[7,21]</sup> According to the findings of reoperation, we speculated that the causes of recurrence seem to be failure to ligate the hernia sac high enough at the internal inguinal rings. Grosfeld et al believe that the factors affecting recurrence appear to be failure to ligate the hernia sac at the internal ring or close the internal ring tightly, operative trauma leading to injury of the inguinal canal, postoperative hematoma, and wound infection.<sup>[22]</sup> We fully agree with this view. In order to prevent recurrence, therefore, ligating the hernia sac high enough at the internal inguinal rings in the procedure is necessary. No difference in short-term adverse events, such as bleeding or hematomas, surgical site infection, inguinal swelling, pneumonia, and urinary retention, was found between open vs laparoscopic hernia repairs in numerous studies focusing on postoperative complications.<sup>[7,8,11–13]</sup> In our study, postoperative problems were observed in 4 of 56 (7.1%) patients and complications were similar in both groups ( $P = .7467$ ). These comprised bleeding or hematomas, surgical site infection, and inguinal swelling. No hydrocele formation, ascending testis, and testicular atrophy were found in either group. Our results are consistent with those reported by Olesen et al.<sup>[11]</sup> This represents an acceptable rate of complications. All these complications were managed without further surgical intervention at the outpatient clinics.

According to patients' cosmetic result score by the questionnaire, both procedures had an equally high level of satisfaction with operative scar. Generally, the cosmetic result is considered to be better in laparoscopic than in open surgery. However, in the open procedure for inguinal hernia, inguinal crease incision is considered to be scarcely visible because it is along the skin crease and usually is concealed under the cloths. More importantly, the procedure is done bilaterally through a single incision. Moreover, in this study, SBIH never caused umbilical deformities like protrusion, which happened more often in LBIH.<sup>[23]</sup> In total, from the perspective of cosmetic result, both procedures produced satisfactory outcomes.

Our initial results show that SBIH has the same efficacy as laparoscopic approach for the treatment of pediatric bilateral inguinal hernias, but is superior in operation time in girls and postoperative pain incidence in boys. Given that complications and recurrence rate with the novel technique were comparable to

those with established operations and cosmetic outcomes after surgery is generally recognized, we suggest that the procedure should be considered in suitable pediatric patients with bilateral inguinal hernias regardless of sex. In fact, since a generally accepted technique suitable for all inguinal hernias does not exist,<sup>[24]</sup> surgeons should provide both an open and a laparoscopic approach option for tailoring of the treatment. Therefore, we have the reason to believe that the procedure provides a new option for the treatment of pediatric patients with bilateral inguinal hernia.

This work has 2 limitations besides bias associated with a single-institution study. First, the parameter body weight rather than BMI of the enrolled patients among the 2 groups might compromise the statistical power. Second, this was a retrospective study with a small sample size and would thus inevitably have been subject to selection bias. We are currently accumulating more cases with younger children and longer surgical outcome follow-up for future publication. We also recommend a future larger-scale and a prospective randomized study to be performed to further investigate the applicability of this novel procedure compared to laparoscopic surgery.

## 7. Conclusion

We here introduce a single-incision approach for the treatment of pediatric bilateral inguinal hernias. We found that this procedure is feasible and safe. Although the procedure was slightly time consuming in boys, it has produced good results in both female and male patients. Therefore, we suggest that SBIH procedure should be considered in suitable pediatric patients if surgically available. However, larger studies and a multicenter prospective randomized controlled trial are required to confirm our results.

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## Author contributions

**Conceptualization:** Ren Chongxi, Wang Hongqiao.

**Data curation:** Wang Hongqiao, Li Fengying.

**Formal analysis:** Wang Xin, Qi Hongxia.

**Investigation:** Ren Chongxi, Wang Xin, Qi Hongxia.

**Methodology:** Ren Chongxi, Li Fengying, Wang Xin.

**Resources:** Li Fengying, Wang Xin and Qi Hongxia.

**Supervision:** Xing Lijun.

**Writing – original draft:** Ren Chongxi, Xing Lijun.

**Writing – review & editing:** Ren Chongxi.

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