

Surgical Techniques of Laparoscopic Inguinal Hernia Repair in Childhood: A Critical Appraisal

Christopher S. Lukong

Department of Surgery, Paediatric Surgery Unit, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria

INTRODUCTION

Inguinal hernia is a common condition in children. The treatment for this condition is high ligation of patent processus vaginalis at the level of the internal inguinal ring. This can be achieved either by conventional open method or by laparoscopic technique.^[1]

There have been conflicting reports regarding the place of laparoscopy in the treatment of inguinal hernia in children.^[2] At the moment, laparoscopic inguinal hernia repair is not only possible in children, but also is gaining ground as a safe, feasible, and popular method.^[3-15] There are, however, several reports comparing the conventional open method and laparoscopic inguinal hernia repair in children, but the current trend is toward laparoscopic method.^[16-20]

With increasing interest in laparoscopic inguinal hernia repair, several treatment techniques have developed over the past two decades, aimed at improving the outcome.^[21] The various techniques differ in their approach to the inguinal internal ring, suturing and knotting techniques, number of ports used in the procedure, endoscopic instruments used, mode of dissection of the hernia sac, and gender of the patient as well. The emerging techniques show a tendency for simple extracorporeal

ABSTRACT

Laparoscopic inguinal hernia repair started over two decades ago. It has been gaining ground as a mode of treatment for inguinal hernia in children. Several surgical techniques have emerged since its inception. The aim of this article is to review the role of laparoscopy in inguinal hernia repair in children, the various emerging laparoscopic surgical techniques, and their current trend in pediatric surgical practice. In this study, extensive review and analysis of recent articles on laparoscopic inguinal hernia repair in children revealed that laparoscopy plays a great role in the treatment of inguinal hernia in children. There were several emerging laparoscopic techniques, with trends toward extracorporeal suturing and knotting technique and single-port access technique as well. The recent advance is toward the use of tissue adhesives in laparoscopic inguinal hernia repair in children.

Key words: Children, hernia, inguinal, laparoscopic, repair, technique

suturing and knotting technique, and diminished use of endoscopic ports and instruments.

The aim of this article is to review the role of laparoscopy in inguinal hernia repair in children, the various emerging laparoscopic surgical techniques, and their current trend in pediatric surgical practice.

MATERIALS AND METHODS

Literature search was performed using search engines like Google, PubMed, SpringerLink, and journals. Search for English language articles on laparoscopic inguinal hernia in children was done. Citations found in selected articles were screened and used for further references. The articles were selected based on appropriateness to the subject matter, year of publication (articles beyond 1990 were excluded), operative procedure, and institutions where the studies were conducted.

The various techniques were evaluated based: approach to the inguinal internal ring (intraperitoneal or extraperitoneal), suturing and knotting techniques (intracorporeal or extracorporeal), number of ports used (three, two, or one), instruments used, and outcome of procedure (safety, feasibility, and reproducibility).

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Address for correspondence: Dr. Christopher S. Lukong, Department of Surgery, Paediatric Surgery Unit, Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria. E-mail: lukongchris@yahoo.com

RESULTS

There have been a lot of publications on laparoscopic inguinal hernia repair over the past two decades, based on PubMed citations on this topic. Laparoscopic inguinal hernia repair is currently employed in developed countries and developing countries as well.

The papers reviewed show that laparoscopy has a role in the treatment of inguinal hernia in children. The advantages, disadvantages, and limitations of this procedure are well highlighted in the articles.

The various laparoscopic surgical techniques for inguinal hernia repair in children cited in the review include: intracorporeal or extracorporeal, three- or single-port procedure, sac inversion and ligation in female children, resection and no ligation technique, flip-flap technique, and finally use of tissue adhesives – a current concept.

DISCUSSION

Laparoscopic inguinal hernia repair in children started over two decades ago. Initially it was doubtful whether this mode of treatment could be employed in children. This controversy lingered on until several reports established that this procedure was feasible and safe in children.^[3-15] Then came the controversy between laparoscopic and conventional open surgery for inguinal hernia repair in children.^[16-20]

Role of laparoscopy

The above controversies have been overtaken by events. This review establishes the fact that more and more laparoscopic inguinal hernia repairs are being carried out in children with satisfactory outcome.^[22-24] Laparoscopic inguinal hernia repair has an established role in the management of this condition in children in trained hands. Indeed, it is fast becoming the gold standard for the treatment of inguinal hernia in children. The laparoscopic technique has the advantage that it is simple, feasible, and safe. Also, the contralateral internal inguinal ring and other hernia sites such as femoral, obturator, or internal hernia can be diagnosed and treated at same sitting and other occult pathologies may be diagnosed. The risk of injury to the vas deferens and cord structures in this procedure is lesser when compared to the conventional open technique.^[16-19] The general advantages of laparoscopic technique such as cosmesis, low wound infection, less pain, and short hospital stay, all apply here. The disadvantages of laparoscopic technique in inguinal hernia repair in

children are: it is expensive, longer duration of surgery, higher recurrence rates, and longer learning curve when compared to the conventional open method. The technique is highly limited if there is no training, and there is lack of expertise and equipment.

The issue of injury to the vas deferens and affectation of testicular vascular supply following laparoscopic surgery has been addressed. Indeed, studies by Schier and Parelkar *et al.* have shown that laparoscopic inguinal hernia repair in children does not affect testicular perfusion or growth.^[6,13] None of the studies reviewed recorded any incidence of injury to the vas deferens.

Laparoscopic techniques

With increasing interest, there has been a proliferation of various techniques in the laparoscopic repair of inguinal hernia in children. This proliferation has been orchestrated by refinements in methods of ligation of the patent processus vaginalis at the internal inguinal ring in order to improve results and the outcome of treatment. The various techniques are: extracorporeal or intracorporeal suturing and knotting, three- or single-port procedure, sac inversion and ligation technique in girls, flip-flap technique, and use of tissue adhesives. Some studies have been highlighted in order compare the various techniques *vis-à-vis* the authors and their complication rates [Tables 1–3].

Extracorporeal suturing and knotting technique

The review shows that extracorporeal technique is currently being adopted by many pediatric surgeons.^[25-29] The two-port technique using nonabsorbable suture material is employed. The trend is shifting toward this technique because it is simple, safe, feasible, and reproducible. This method particularly has low recurrence rates (0–2.0%), and more importantly, knotting does not require any special skill because it is done externally in the subcutaneous tissue in the conventional manner [Table 1]. The low recurrence rate in this technique is attributed to the fact that in this procedure the sac is wholly ligated without

Table 1: Comparison between extracorporeal and intracorporeal techniques

Technique	No. of ports	Sutures	Duration (min)	Recurrence	Remarks
Extracorporeal	2 or 1	Nonabsorbable	23.8–40.2 23.8: Unilateral 40.2: Bilateral	0–2.0%	Does not require laparoscopic suturing skills
Intracorporeal	3 or 1	Nonabsorbable	48.5+4: Unilateral 61.0+13.8: Bilateral	0–5.7%	Requires good laparoscopic suturing skills

Table 2: Various techniques by different authors and recurrence rates

Technique	Author	Sample size	Recurrence (%)
Inversion herniotomy (intracorporeal)	Guner <i>et al.</i> (2010) ^[33]	79	2 (2.5)
Intracorporeal	Giseke <i>et al.</i> (2010) ^[22]	385	3 (1.0)
Extracorporeal	Tam <i>et al.</i> (2009)	433	2 (0.35)
Resection, no ligation	Riquelme <i>et al.</i> (2010) ^[35]	91	None
Extracorporeal	Ozgediz <i>et al.</i> (2007) ^[23]	300	13 (4.3)
		100	2 (2.0)
Inversion and ligation (intracorporeal)	Lipskar <i>et al.</i> (2010) ^[30]	173	2 (0.83)
Extracorporeal	Uchida <i>et al.</i> (2010) ^[27]	117	None
Extracorporeal	Choi <i>et al.</i> (2011)	498	None
Resection and ligation (intracorporeal)	Montupet <i>et al.</i> (2011)	569	11 (1.5)
Resection and ligation (intracorporeal)	Esposito <i>et al.</i> (2010) ^[34]	73	1 (1.3)
Extracorporeal	Patkowski <i>et al.</i> (2006) ^[29]	106	3 (2.8)
Intracorporeal	Becmeur <i>et al.</i> (2004) ^[34]	82	None
Intracorporeal	Yip <i>et al.</i> (2004) ^[36]	43	None
Extracorporeal	Prasad <i>et al.</i>	12	None

Table 3: Comparison between three and single port (Bharathi *et al.* J Laparoendosc Adv Surg Tech A, 2008)^[40]

Port	Sample size	Operation time (min)	Cosmetic outcome	Recurrence rate	Limitation
Three	51	15–25	Good	2.98%, $P=0.49$	Suturing and knotting
Single	112	25–40	Better	4.8%, $P=0.49$	Wide ring >10 mm

leaving skip portions. The skip portions, especially at the medial aspect of internal inguinal ring, account for some of the recurrences in some reports.^[22,28] The limitation of this technique is that special needles and introducers are required. In the review, spinal needle, special 19-gauge needle, hook, and host of other instruments are currently being used with good outcome.^[28]

Intracorporeal suturing and knotting technique

This was the initial method adopted at the inception of laparoscopic inguinal hernia repair in children. The technique employs three ports and uses nonabsorbable suture materials. In this method, intraperitoneal knotting is performed to close the internal inguinal ring. The closure is achieved by applying a suturing in purse-string fashion and knotting tight the internal inguinal ring. Sometimes interrupted suturing is done to close the ring.^[10] This method has a high recurrence rate (0–5.7%) and is not as simple and easy as the extracorporeal technique. Here, good intracorporeal laparoscopic knotting skill is required [Table 1].

Inversion and ligation technique

This method of laparoscopic inguinal repair is widely used in female children. This is a modification of the intracorporeal technique, using three ports and nonabsorbable sutures. It is thought that inversion and

ligation of sac at the internal inguinal ring would reduce the risk of recurrence (0.8–2.5%).^[30–32] The problems faced in the intracorporeal technique may also apply here. In a similar manner, the selective sac extraction method for inguinal hernia repair in children by minimally invasive procedure has been described with satisfactory surgical and cosmetic outcome by Ikeda *et al.*^[33] In the sac extraction method, the sac is extracted and ligated openly. In the inversion and ligation technique, the sac is isolated, inverted, and ligated laparoscopically.

Resection and ligation technique

This is another modification of the intracorporeal technique, with three ports and nonabsorbable sutures employed. In this technique, the hernia sac is resected and closed with a purse-string suture at the level of the internal inguinal ring. Becmeur *et al.* recorded no recurrence with this method.^[34] This was done in an attempt to reduce the recurrence.

Resection and no ligation technique

Here, the hernia sac is resected at the level of the internal inguinal and allowed to close spontaneously. This novel technique has been reported in literature with preliminary results showing satisfactory outcome and no recurrence.^[35] The method uses three ports and no sutures are employed.

Flip-flap technique

In this procedure, a flip-flap is raised in the internal inguinal ring and used to close the defect. This is a three-port technique that uses absorbable sutures. Yip *et al.* did not record any recurrence with this technique.^[36] Satisfactory results have been noticed by Hassan *et al.* in a comparative study of this flip-flap technique with the conventional open technique.^[37]

Three-port or single-port technique

The pioneer procedures for inguinal hernia repair in children by laparoscopy used the three-port method. Recently, with refinements in technology, the single procedure is currently attracting attention. In their experience with modified single-port laparoscopic procedures in children, Rothenberg *et al.* found very encouraging outcome.^[38] This report corroborates with a study by Chang on technical refinements in single-port laparoscopic surgery of inguinal hernia in infants and children.^[39] In a comparison study by Bharathi *et al.*, single-port technique was preferred to the three port due to better outcome.^[40] The technical difficulties encountered with the single port are a major limitation [Table 3].

Use of tissue adhesives

Initial animal experimental studies showed that tissue

adhesives could be used in tissue approximation.^[41] Further, experimental animal models have continued to establish the role of tissue adhesives in inguinal hernia repair.^[42,43] Cusheiri in a study had earlier published an article forecasting the promising role of tissue adhesives in endosurgery.^[44] Today tissue adhesive is being employed in a host of pediatric endoscopic surgeries, including inguinal hernia repair.^[45]

Current trend

This review shows preference for extracorporeal technique because it is simple, safe, reproducible, and has low recurrent rates.^[21] The other trend is toward the single-port technique because it results in virtually scarless abdomen as the surgical incision is hidden within the umbilicus.^[38,39]

CONCLUSION

Laparoscopy plays a great role in the treatment of inguinal hernia in children. There are several emerging laparoscopic techniques in the repair of inguinal hernia in children, geared toward improving results and outcome. The current trend is toward extracorporeal suturing and knotting technique and single-port access technique as well. The future or recent advancement is the use of tissue adhesives in laparoscopic inguinal hernia repair in children.

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