



## Comparison between Open and Laparoscopic Appendectomy: A Systematic Review

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### Abstract

Acute appendicitis is the most common intra-abdominal condition which requires emergency surgery in children. Open Appendectomy (OA) and Laparoscopic Appendectomy (LA) can be used for the intervention. This is a retrospective study aiming to compare the two techniques. There is not a significantly greater length of operation in the laparoscopic vs. the open group. Most authors agree that the length of hospital stay is shorter for patients operated with laparoscopy. LA is more expensive but becomes cheaper through time. The overall complication rate seems to be similar in both groups. LA is less painful; it has less wound infections and postoperative ileus. Hospital stay is shorter, return to a normal diet and activity is faster and the cost is decreasing. We recommend LA as a routine surgical approach for acute appendicitis.

**Keywords:** Laparoscopic appendectomy; Open appendectomy; Minimal invasive appendectomy; Pediatric appendectomy; Single incision laparoscopic appendectomy

### Introduction

Acute appendicitis is the most common intra-abdominal condition which requires emergency surgery in children [1,2]. It has a life-time incidence between 7% and 9% [1]. Open Appendectomy (OA) was first described in 1894 and was performed through the right lower quadrant incision [3]. It remained the golden standard until the introduction of Laparoscopic Appendectomy (LA) by Semm in 1983 [4]. There is a lot of discussion among pediatric surgeons over the benefits of each technique [5]. As advantages of LA have been proposed a better wound healing, reduced postoperative pain, faster recovery, earlier resumption of diet, earlier discharge from hospital, and finally, a better cosmetic result [6-10]. Disadvantages of LA compared to OA are considered the increased operative time, the cost of the operation and a higher incidence of intra-abdominal abscesses, especially in case of a perforated appendicitis [11,12]. The aim of our study is to search in the literature in order to find evidence concerning the benefits of each technique in a pediatric population.

### Patients and Methods

We performed a research over Pubmed database in order to extract all studies between 1990 and 2015 concerning open and laparoscopic appendectomies with any potential comparison among them. We used the following keywords: laparoscopic appendectomy, open appendectomy, laparoscopic vs. open appendectomy, pediatric and appendectomy, minimal invasive vs. conventional appendectomy. We also used the related articles function in order to broaden the search.

We used the following inclusion criteria:

1. We included prospective randomized studies, review articles and meta-analysis articles.
2. Comparison between open and laparoscopic techniques.
3. Study of at least one of the outcomes of interest (mentioned below).
4. Studies that used variations of the classical laparoscopic technique (single incision vs. conventional laparoscopic appendectomy).

The outcomes of interest included operative time, hospital stay, cost and complications, more specifically wound infection, intra-abdominal abscess, postoperative ileus, fever, pain and cosmetic result.

### Discussion

There is a lot of discussion over various parameters concerning the two techniques. We will

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examine each one separately.

### Operative time

There are different estimations concerning the duration of the intervention. Some authors find the LA takes much longer to perform [11,13-16]. This was normal in the beginning of the application of the laparoscopic technique. The review and meta-analysis of previous studies demonstrated that there is not a significantly greater length of operation in the laparoscopic vs. the open group [5]. Esposito et al. [17] after comparing 2,332 cases concluded that the median duration of surgery was 40 minutes for LA and 45 minutes for OA. Another meta-analysis shows that the laparoscopic approach takes 12.35 min longer than open surgery, but with a decrease of the difference from 15.14 min to 8.67 min as time passed and LA became more familiar [10]. It is also important to mention that LA offered us new perceptions about the operative process. There is no longer necessary to perform a purse-string suture of the caecum, and the appendiceal stump can be treated only with coagulation of the mucosa and iodization, without invagination into the caecum. LA has a low conversion rate (1.6%) [17].

### Hospital stay

Most authors agree that the length of hospital stay is shorter for patients operated with laparoscopy [5,11,15,18-20]. Median hospital stay for LA varies among authors. Some report a median stay of 3 days in case of simple appendicitis and 5.2 days in case of peritonitis [17]. In other studies it varies from 2.06 to 4.1 days [19,21]. Those differences can be attributed to the experience and skills of the surgeons as well as the different discharge policies. The same studies demonstrated a median hospital stay of 4.3 days for OA in case of simple appendicitis and 8.3 days in case of peritonitis, or a variety from 2.88 to 7.2 days. LA is associated with a quicker return to normal diet (20.2 h) and to normal activity (9.1 d) [21]. This fact can be attributed to the minimal trauma and pain caused by the trocar incisions. Moreover, the minimal manipulation of caecum and ileus decreases the degree of postoperative a dynamic ileus resulting in a faster resumption of a normal diet [10,17].

Of course there are some authors that find no differences in hospital stay between LA and OA [22-24]. At this point we should illustrate an important fact. From 1990 to 2009 the length of hospital stay for LA was reduced by 0.6 days which led to a difference of 0.75 days, in postoperative stay, between LA and OA groups. This could be the result of the surgeons training or the application of a discharge protocol such as the 48-hour discharge policy proposed by Grewal et al. [25].

### Cost

Generally, during the period of most studies the cost of LA was higher than OA from \$600 to \$1,000 [5,23]. The operation cost is higher for LA due to more sophisticated instruments, but the overall cost if we calculate the benefits outside hospital, such as return to normal activity is not that high [18]. Moreover it is interesting to notice that reported hospital cost for LA was \$5,935 in 1992 and \$3,718 in 2004, a reduction of 40%, probably due to the evolution of technology and shortening of hospital stay. We must remind that the mean cost of OA was \$4,734. So, by time, LA becomes cheaper than OA.

### Complications

The overall complication rate seems to be similar in both groups

[14,17]. This rate is 8.2% for LA and 7.9% for OA in children while in adult's raises up to 18.5% vs. 17% respectively. If we examine those complications separately we will observe some important differences. Most authors report that wound infection is significantly lower in patients undergoing LA [5,10,11,16,18,20,21,26,27]. It occurs in 1.5% to 3.81% in the LA group and 5% to 8.41% in the OA group. We can presume that this difference is attributed to the smaller incisions for the trocars compared to the OA incision, as well as the fact that in LA the appendix is delivered with a bag or *via* the port, while in OA it is delivered directly through the wound risking contamination. Postoperative ileus seems to be reduced in LA. (1.3% vs. 2.8% in OA) [5,10,11]. This may be due to reduced manipulation of the small and large bowel and earlier mobilization. The incidence of postoperative fever is not significantly different between LA and OA [5]. Postoperative pain is less after LA [13] while Ignacio et al. [23], find no difference on postoperative days 1 and 7. Intraoperative bleeding has no statistically significant difference [10]. Laparoscopic approach offers some additional advantages. If the appendix is normal the surgeon can search for other anomalies that cause abdominal pain, helped by the accuracy and magnified view of the technique. It can also help with obese patients by offering an easier access [8]. Moreover, there is an easier treatment of an ectopic appendix, while the lavage of the peritoneum is more efficient [28]. The cosmetic result is improved in LA [16,17]. Recently, there is a trend to minimize even further the laparoscopic technique by reducing the abdominal incisions to one (Single Incision Laparoscopic Appendectomy or SILA). Most authors agree that SILA is a feasible and reliable procedure with short-term results similar to the multiport technique [29-33]. It is recommended for uncomplicated appendicitis in order to avoid a potential wound infection caused by the extracorporeal appendectomy [33]. For some it is quicker, cheaper and with a better cosmetic result [31]. For others there are some disadvantages such as the violations of the principles of laparoscopic surgery (lack of pneumoperitoneum, absence of triangulation), and the prolongation of the operative time until the proper training of the surgeon [30]. Generally it has no significant differences in the length of hospital stay, pain scores, or conversion and complication rates [29].

Most supporters of OA are focusing at the increased rate of Intra-Abdominal Abscess (IAA) after LA. In our study we found various reports. Aziz et al. [5], report a similar incidence between the two techniques (3.8% in LA vs. 3.4% in OA). More studies find no difference [10,17,26]. Pedersen et al. [16], found laparoscopy associated with more abscesses but the number of gangrenous and perforated appendices was greater. After adjustment the difference failed to reach statistical significance. On the other side, there are also reports of increased IAA after LA [11,18,20].

### Conclusion

There is still a debate among surgeons concerning the choice of the proper technique for appendectomy. Supporters of the OA find it easy and fast to perform. They use a small incision and consider that they have less IAA. As more retrospective studies and meta-analyses occur it seems that an increasing number of surgeons adopt LA. It becomes more minimal with the one-port technique. Operative time has been reduced after training. It is less painful; it has less wound infections and postoperative ileus. Other complications have the same rate as OA. Hospital stay is shorter, return to a normal diet and activity is faster and the cost is decreasing. We recommend LA as a routine surgical approach for acute appendicitis.

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