Review Article

# Laparoscopic vs Open Appendectomy in Children: A Meta-Analysis of Operative Time, Surgical Site Infection, and Recovery

**Meet Sabuwala[1], Abhishek Jaimalani[2]**

[1]Emergency Department, Shalby Hospital, Surat, Gujarat, India, [2]General Surgery Department, Shalby Hospital, Surat, Gujarat, India

## Abstract

**Background:** Appendicitis is one of the most common surgical conditions in children. The appendix, a small pouch attached to the large intestine, may become inflamed or infected, requiring surgical removal. The standard treatment is appendectomy, which can be performed either laparoscopically or by an open technique. The choice of procedure often depends on multiple factors, and ongoing debate exists regarding which approach provides better outcomes. This study focuses on three important parameters: operative time, surgical site infection (SSI), and recovery. **Objective:** The aim of this study is to conduct a comparative analysis between laparoscopic and open appendectomy in children, specifically assessing operative time, SSI, and recovery. The findings are intended to identify the more effective approach for managing paediatric appendicitis. **Method:** A meta-analysis was performed to compare laparoscopic and open appendectomy. An inductive and exploratory research design was followed. Eligible studies published in English between 2019 and 2025 were included if they directly compared the two techniques in children. Review articles were excluded. Databases searched included PubMed, Google Scholar, and Mendeley. The PRISMA methodology guided study selection. Data were summarized in tables and charts, and central tendency analyses were performed using Excel and SPSS statistical tools. **Results:** The analysis showed no significant difference in operative time between the two procedures, although laparoscopic appendectomy tended to take longer. However, laparoscopic surgery demonstrated lower SSI rates and faster recovery compared to open appendectomy. Thus, operative time alone is not a decisive factor, whereas SSI and recovery highlight the advantages of the laparoscopic approach. **Conclusion:** Laparoscopic appendectomy is the more effective approach for paediatric appendicitis as it has significantly lower surgical site infection rates and faster recovery times despite a slightly longer operative duration in the current research.

**Keywords:** Appendectomy, Appendicitis, Laparoscopic Appendectomy, Open appendectomy, Operative time, SSI, Recovery

## Introduction

Appendectomy is a surgical procedure that is very common in children. Appendix is a small pouch that is attached to the large intestine. When this pouch is inflamed or infected due to certain reasons, then, it becomes important to operate it in order to remove the appendix. The possible reasons behind the infection in appendix could be the blockage of appendix by faecal matter, or enlarged lymphoid tissue, or parasites. Other than this, bacterial infection could also be a possible reason behind the blockage. It is important to get the appendix removed to avoid complications in children such as rupture or perforation of appendix which can later cause peritonitis or abscess formation.[1]

The research conducted by Duman 2022, analyzed the incidence of appendicitis in children.[2] The peak incidence of appendicitis in children is observed in the age group of 12 to 17 years. The symptoms of appendicitis can be visible in children within the first 24 hours. The research observed that 4.6% children showed the onset of symptoms within the first 24 hours while 18.6% presented the symptoms between 24 to 48 hours and 60.9% presented the symptoms for more than 48 hours.

The risk of perforation is also found to increase after 24 hours in children. The study also derived the incidence of faecalith in children to be 7.7% which is a major cause of appendicitis in children. Other than this, Pneumoperitoneum is also encountered as a radiographic finding that is associated with appendicitis.

**Address for correspondence:** Meet Sabuwala. Shalby Hospital, Surat, Gujarat, India.
E-mail: meetmsabuwala@gmail.com

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High occurrence of pneumoperitoneum is found in adults while 0.7% incidence is also observed in children. Diagnosing appendicitis in children is more difficult as compared to adults due to certain limitations with tests conducted on children. The most preferred radiologic diagnostic method in children is abdominal ultrasound and plain X-ray. He *et al.*, in their research stated that the management of appendicitis in children is also challenging. The research analyzed the global trends of appendicitis occurrence in children.

The newly diagnosed appendicitis in children was estimated to be 2,193,020 children in 2021 which accounted for 12.93% of all the cases of appendicitis in the general population. Thus, the corresponding incidence rate is estimated to 109 per 100,000. It has also been observed that the incidence of appendicitis has increased by 0.3% annually from 1990 to 2021. This showed a positive association between the incidence rate of appendicitis and its percentage changes in children. According to the research conducted by Jumah in 2022, it is well known that the fastest and the most spontaneous resolution of appendicitis is to operate and remove the appendix which is called appendectomy.[4] However, the research also analysed a non-operative management mechanism of appendicitis. Antibiotic therapy is a non-operative treatment method of acute uncomplicated appendicitis in children. This method has also successfully worked for 92% children with acute appendicitis. A major limitation of non-operative treatment is that its success rate is restricted to uncomplicated appendicitis presentation. In cases of complicated appendicitis, no established non-operative treatment mechanism currently exists.

## Importance of timely surgical intervention

Surgical intervention is the only possible treatment for complicated cases of appendicitis in children. Surgical management of appendicitis is also important to avoid serious complications of perforation and peritonitis. Surgically, there exists two mechanisms to operate on the appendix. One is laparoscopic appendectomy and the other is open appendectomy. However, these techniques are dependent on various factors to conclude which process will be better for the patient. The factors include age, clinical presentation, and time elapsed since the onset of symptoms. Based on these factors, doctors decide the best suited process of appendectomy for the patient.[5] The research conducted by Vacek *et al.* analysed the urgency of surgical treatment to treat appendicitis.[6] According to the research, 78.1% appendectomies were performed on the same day of diagnosing appendicitis while 21.9% were performed on the next day. The appendectomies conducted on the next day of diagnosis were associated with higher costs compared to same day appendectomies. This is mainly because of the longer duration of stay of the patient in the hospital and higher readmission rates on the part of the hospital. However, the surgical complications of appendectomy remain the same in same day surgery and next day surgery. The delay in operating is purely based on the availability of the surgeon and their business hours in the hospital. It does not have any impact on the medical condition of the patient. However, delaying the operation more than this duration could cause the symptoms to worsen in the patients. Supporting this notion, Kovler *et al*. stated that the spontaneous method to treat acute appendicitis is with emergency appendectomy.[7] Recently, hospitals have adopted the practice of urgent appendectomy with acceptable in-hospital delay of up to 24 hours. Any time to appendectomy spent even after 24 hours could lead to worsening of symptoms of appendicitis in children. The patients who received late appendectomy had longer operative time, increased need for postoperative percutaneous drainage, parenteral nutrition, antibiotics at discharge, and an extended length of hospital stay. This shows that the complications could worsen with the delay of a day as well. The exact complications are not yet known to researchers since there are not much literature on the same. However, it is established clearly that if the surgery is not performed, it can lead to perforation which can further cause peritonitis or abscess formation in patients. Thus, the treatment of appendicitis should not be delayed even with one day especially in the case of children.

## Overview of laparoscopic vs open techniques

Acute appendicitis is the most common emergency surgical condition in children. Appendicitis is of two types: complicated appendicitis and uncomplicated appendicitis. Complicated appendicitis is defined as a historically or intraoperatively diagnosed gangrenous or perforated appendicitis, appendicitis with an abscess, or suppurative appendicitis, peri appendicular mass or faecal peritonitis, or phlegmon formation in the appendix of the patient. Such an appendix is complicated and it occurs in around one third of the appendicitis cases. Complicated appendicitis is more commonly visible in children of age group below 5 years. Complicated appendicitis is also associated with higher rates of surgical site infection, intraabdominal abscess formation that leads to more frequent readmissions and delayed return to normal activities.

Laparoscopic appendectomy is a relatively new concept and before its introduction, open appendectomy has been the go-to procedure for removal of appendix. In present times, patients with simple and uncomplicated appendicitis go for laparoscopic appendectomy. A few of the main reasons behind this choice is its minimally invasive nature such as a lower rate of SSI, a shorter length of hospital stay, a reduced incidence of postoperative ileus, and an earlier return to daily living activities. However, the choice of laparoscopic appendectomy over open appendectomy is still dicey since laparoscopic appendectomy is associated with higher rate of intraabdominal abscess formation, longer operative time,

and higher surgical costs.[8] Supporting this notion, the research conducted by Kiblawi *et al*. identified that the most frequently reported advantage of laparoscopic appendectomy is its shorter hospital stay duration which is widely observed in 60.4% of studies.[9] While the most frequently reported disadvantage of laparoscopic appendectomy is its longer operative time which is reported in approximately 52.7% of the studies. Clavien-Dindo grade I to III complications were less frequently observed in laparoscopic appendectomy patients as compared to open appendectomy patients as per 80.3% of studies. Grade IV complications were also less frequently reported after laparoscopic surgery as opposed to open surgery for perforated appendicitis. Thus, the study along with the other supporting study found laparoscopic appendectomy to be better compared to open appendectomy. According to the research conducted by Nikolov *et al.,* laparoscopic appendectomy has been identified as a safe and effective method of treating acute appendicitis across all demographics.[10]

Laparoscopic appendectomy has shown various advantages due to its socioeconomic factors. It is advantageous to patients who belong to low- and middle-income areas because it minimizes challenges secondary to poor sanitation, fewer hospital beds, limited imaging methods, higher rates of haemorrhage, and single income households. Other than these advantages, there also exists a disadvantage of laparoscopic surgery. The non implementation of laparoscopic surgery in lower income regions is due to the lack of specialized equipment and trained personnel. However, open appendectomy proves beneficial for non-white patients and those from low-income background since laparoscopic appendectomy undergoes high cost of installment, unreliable electricity, lack of qualified maintenance personnel, and shortage of consumable items. Laparoscopic appendectomy also costs higher than open appendectomy. The operative time is also longer in laparoscopic appendectomy compared to open appendectomy. Thus, the researcher observed that laparoscopic appendectomy has a shorter hospital stay and postoperative recovery time. It requires less analgesics and results in fewer post-operative complications. It is also cost-effective and is thus, a procedure of choice for many.

### Objectives

The objectives of this study are: to compare laparoscopic appendectomy and open appendectomy in terms of operative time; to compare laparoscopic appendectomy and open appendectomy in terms of SSI; and to compare laparoscopic appendectomy and open appendectomy in terms of recovery (such as length of hospital stay)

## Materials and Methods

To identify the better approach between laparoscopic and open appendectomy in children, meta-analysis has been conducted in the present research. The secondary data has been extracted depending on the inclusion exclusion criteria discussed below. The present research has used inductive approaches. Further exploratory research method has been implemented.

### Inclusion criteria

All papers published between Year 2019 to Year 2025 with English text and the paper must be available in full.

All the papers must be related to laparoscopic and open appendectomy in children only

All the papers must be clinical research or clinical trial on laparoscopic and open appendectomy in children.

### Exclusion criteria

Excluded were studies based only on reviews, studies that also presents presence of co-morbid conditions, studies with only abstract available or incomplete clinical trial, studies incorporating research on complex appendectomy and studies focused on adults

The databases used to extract the research papers are Google Scholar, PubMed and Mendeley.

For the selection of research papers, PRISMA methodology has been used in the present research.

A total of 57 literatures were identified from the databases mentioned above. After screening, a total of nine literatures were reviewed.

The data collected from the studies were presented in tables and charts. Central tendency tests were applied to the collected data. Herein Excel and SPSS statistical tools were used.

## Results

**Objective 1:** To compare laparoscopic appendectomy and open appendectomy in terms of operative time. The hypothesis to be tested are as follows:

H01: There is no significant difference between laparoscopic appendectomy and open appendectomy in terms of operative time.

HA1: There is a significant difference between laparoscopic appendectomy and open appendectomy in terms of operative time.

Comparing laparoscopic appendectomy and open appendectomy in terms of operative time, nine research papers were analyzed. It can be inferred from Table 1 that there exists no significant difference in laparoscopic appendectomy

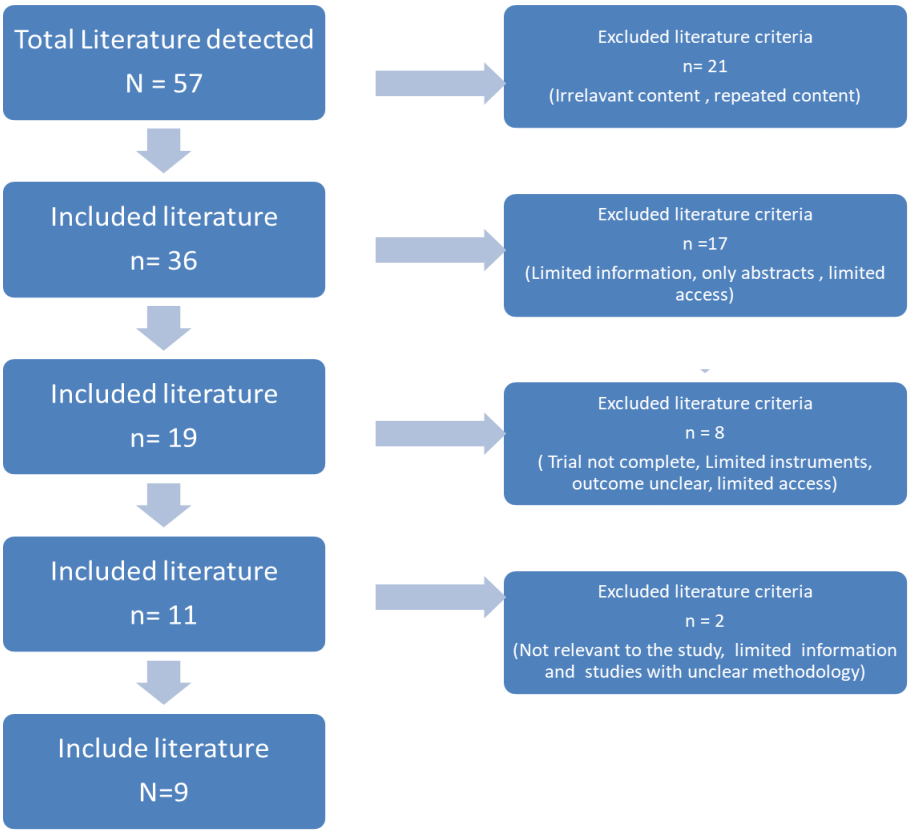



**Figure 1:** PRISMA Flowchart

and open appendectomy in terms of operative time as *p*-value=0.513 (>0.05). Thus, the null hypothesis cannot be rejected and it can be stated that there is no significant difference in laparoscopic appendectomy and open appendectomy in terms of operative time.

A positive mean difference according to most of the studies shows that laparoscopic appendectomy takes more operative time compared to open appendectomy. However, according to a few researchers, laparoscopic appendectomy has taken lesser time than open appendectomy. It can be further inferred that the highest mean difference (43.86) was obtained by Fourie *et al.* stating that laparoscopic appendectomy took the longest time as compared to open appendectomy.[17]

**Objective 2:** To compare laparoscopic appendectomy and open appendectomy in terms of SSI.

The hypothesis to be tested are as follows:

H01: There is no significant difference between laparoscopic appendectomy and open appendectomy in terms of SSI.

HA1: There is a significant difference between laparoscopic appendectomy and open appendectomy in terms of SSI.

Comparing laparoscopic appendectomy and open appendectomy in terms of SSI, nine researches were analysed. It can be inferred from Table 2 that there exists a significant difference in laparoscopic appendectomy and open appendectomy in terms of SSI as *p*-value=0.050 (=0.05). Thus, the null hypothesis can be rejected and it can be stated that there is a significant difference in laparoscopic appendectomy and open appendectomy in terms of SSI.

A negative mean difference as per most of the studies shows that the patients who underwent laparoscopic appendectomy had lower incidence of SSI compared to patients who underwent open appendectomy. However, one study noted a slightly higher case of SSI in laparoscopic group. Specifically, the highest mean difference (0.2) was obtained by Zitouni *et al.,* 2024 stating that laparoscopic appendectomy encountered highest cases of patients affected with SSI compared to open appendectomy. [19]

**Objective 3:** To compare laparoscopic appendectomy and open appendectomy in terms of recovery.

The hypothesis to be tested are as follows:

H01: There is no significant difference between laparoscopic appendectomy and open appendectomy in terms of recovery

HA1: There is a significant difference between laparoscopic appendectomy and open appendectomy in terms of recovery

Comparing laparoscopic appendectomy and open appendectomy in terms of recovery, nine research papers were analyzed. It can be inferred from Table 3 that there exists a significant difference in laparoscopic appendectomy and open appendectomy in terms of recovery as *p*-value=0.006 (<0.05). Thus, the null hypothesis can be rejected and it can be stated that there is a significant difference in laparoscopic appendectomy and open appendectomy in terms of recovery. A negative mean difference as per all the studies shows that the patients who underwent laparoscopic appendectomy had lesser duration of stay in the hospital thereby showcasing faster recovery compared to patients who underwent open appendectomy. According to the study conducted by Zitouni *et al*., there has been no difference in the hospital stay duration in laparoscopic appendectomy and open appendectomy. It can be further inferred that the highest mean difference (0) was obtained by Zitouni *et al.* stating that no difference was encountered between patients of laparoscopic appendectomy and patients of open appendectomy.[19] Furthermore, the research conducted a comparative analysis between the effectiveness of SSI, operative time, and postoperative recovery in laparoscopic appendectomy and open appendectomy through paired sample t-test: It can be inferred from Table 4 that SSI and recovery are significant with *p*-value≤ 0.05 while operative time is insignificant with *p*-value>0.05. This means that in terms of effectiveness, SSI and recovery are significant between laparoscopic appendectomy and open appendectomy while operative time is insignificant. The largest t-value (3.689) was found to be possessed by recovery with a mean difference of (-1.329) between laparoscopic appendectomy and open appendectomy. Thus, recovery has been found to be the most effective parameter that differs between laparoscopic appendectomy and open appendectomy there by showing that the results are not occurring by chance. The overall sequence of effectiveness of the three parameters is as follows:

*Recovery (3.689)>SSI (-2.255)>Operative Time (0.685)*

Further, in order to assess the magnitude of the effectiveness difference, Cohen's d value has been calculated as below- For **paired samples**, Cohen's d is: d= $\frac{t}{\sqrt{n}}$ Where, t = t-value from paired sample t-test table, n = number of pairs

**Pair 1: LA SSI – OA SSI**

t= -2.255, n = 9

d= $\frac{-2.255}{\sqrt{9}}$

=-0.75

This means there is a **Medium-to-large effect.** This indicates that laparoscopic appendectomy tends to reduce SSI compared to open appendectomy.

**Pair 2: LA Operative Time – OA Operative Time**

t = 0.685, n = 9

d= $\frac{-0.685}{\sqrt{9}}$

=0.23

This means there is a **small effect.** This indicates that there is little or no difference in operative time observed between laparoscopic appendectomy and open appendectomy.

**Table 1:** Mean and Standard Deviation of operative time in laparoscopic and open appendectomy

| Reference | Age of the Patients (Mean ±SD) | | Sample Size | | Operative Time (min) (Mean ±SD) | | Mean Difference | P-value |
|---|---|---|---|---|---|---|---|---|
| | LA | OA | LA | OA | LA | OA | | |
| Pogorelic *et al*., 2019[11] | 13 | 13 | 301 | 533 | 30±0.00 | 45±0.00 | -15 | |
| Sreekantamurthy *et al.,* 2020[12] | 10.11±0.86 | 10.54±0.94 | 36 | 37 | 55.83±4.81 | 67.16±4.27 | -11.33 | |
| Seqsaqa *et al.,* 2020[13] | 9.13 ± 1.94 | 8.93 ± 2.12 | 30 | 30 | 85.17±27.02 | 61.33±20.08 | 23.84 | |
| Murali *et al.,* 2020 [14] | 9.69±3.25 | 8.71±3.50 | 102 | 80 | 85.44±7.80 | 72.37±9.41 | 13.07 | |
| Risteski *et al.,* 2022[15] | 9.63±2.7 | 9.16±2.91 | 111 | 73 | 34.19±6.13 | 69.16±22.39 | -34.97 | 0.513 |
| Younes, 2022[16] | 9.56±2.35 | 8.82±3.21 | 47 | 53 | 73.1±25.02 | 63.4±20.15 | 9.7 | |
| Fourie *et al*., 2022 [17] | 8.9±0.00 | 7.7±0.00 | 43 | 90 | 104.5±0.00 | 60.64±0.00 | 43.86 | |
| Ibrahim MM. , Soliman SM, Ahmed YM, 2024 [18] | 10.60±1.96 | 10.15±2.80 | 20 | 20 | 61.2± 0.04 | 61.8± 0.28 | -0.6 | |
| Zitouni *et al.,* 2024[19] | 9.1±0.00 | 9.2±0.00 | 151 | 539 | 77±0.00 | 57±0.00 | 20 | |

LA=laparoscopic appendectomy, OA= open appendectomy

**Table 2:** Mean and Standard Deviation of SSI in laparoscopic and open appendectomy

| | Age of the Patients (Mean ±SD) | | Sample Size | | SSI (%) (Mean ±SD) | | Mean Difference | P-value |
|---|---|---|---|---|---|---|---|---|
| | LA | OA | LA | OA | LA | OA | | |
| Pogorelic *et al.*, 2019[11] | 13 | 13 | 301 | 533 | 1 | 3.94 | -2.94 | |
| Sreekantamurthy *et al.*, 2020[12] | 10.11±0.86 | 10.54±0.94 | 36 | 37 | 5.5 | 18.9 | -13.4 | |
| Seqsaqa *et al.*, 2020[13] | 9.13 ± 1.94 | 8.93 ± 2.12 | 30 | 30 | 20 | 26.7 | -6.7 | |
| Murali *et al.*, 2020[14] | 9.69±3.25 | 8.71±3.50 | 102 | 80 | 4.9 | 17.5 | -12.6 | |
| Risteski *et al.*, 2022[15] | 9.63±2.7 | 9.16±2.91 | 111 | 73 | 2.70 | 5.48 | -2.78 | 0.050 |
| Younes, 2022[16] | 9.56±2.35 | 8.82±3.21 | 47 | 53 | 8.5 | 26.4 | -17.9 | |
| Fourie *et al.*, 2022[17] | 8.9±0.00 | 7.7±0.00 | 43 | 90 | 25.6 | 25.6 | 0 | |
| Ibrahim MM, Soliman SM, Ahmed YM, 2024[18] | 10.60± 1.96 | 10.15±2.80 | 20 | 20 | 15 | 65 | -50 | |
| Zitouni *et al.*, 2024[19] | 9.1±0.00 | 9.2±0.00 | 151 | 539 | 1.3 | 1.1 | 0.2 | |

LA=laparoscopic appendectomy, OA= open appendectomy

**Table 3:** Mean and Standard Deviation of recovery in laparoscopic and open appendectomy

| Reference | Age of the Patients (Mean ±SD) | | Sample Size | | Hospital Stay (days) (Mean ±SD) | | Mean Difference | *P*-value |
|---|---|---|---|---|---|---|---|---|
| | LA | OP | LA | OP | LA | OA | | |
| Pogorelic *et al.*, 2019[11] | 13 | 13 | 301 | 533 | 3±0.00 | 6±0.00 | -3 | |
| Sreekantamurthy *et al.*, 2020[12] | 10.11±0.86 | 10.54±0.94 | 36 | 37 | 5.11±0.55 | 7.92±1.06 | -2.81 | |
| Seqsaqa *et al.*, 2020[13] | 9.13 ± 1.94 | 8.93 ± 2.12 | 30 | 30 | 4.23± 1.57 | 5.13±1.81 | -0.9 | |
| Murali *et al.*, 2020[14] | 9.69±3.25 | 8.71±3.50 | 102 | 80 | 5.72±4.01 | 5.98±3.93 | -0.26 | |
| Risteski *et al.*, 2022[15] | 9.63±2.7 | 9.16±2.91 | 111 | 73 | 4.23±1.49 | 5.18±1.43 | -0.95 | 0.006 |
| Younes, 2022[16] | 9.56±2.35 | 8.82±3.21 | 47 | 53 | 4.51±1.62 | 5.94±1.92 | -1.43 | |
| Fourie *et al.*, 2022[17] | 8.9±0.00 | 7.7±0.00 | 43 | 90 | 5.98±0.00 | 6.54±0.00 | -0.56 | |
| Ibrahim MM, Soliman SM, Ahmed YM, 2024[18] | 10.60±1.96 | 10.15±2.80 | 20 | 20 | 3.15± 2.16 | 5.20±0.83 | -2.05 | |
| Zitouni *et al.*, 2024[19] | 9.1±0.00 | 9.2±0.00 | 151 | 539 | 4±0.00 | 4±0.00 | 0 | |

LA=laparoscopic appendectomy, OA= open appendectomy

**Table 4:** Paired sample tests

| | | Paired Differences | | | | | T | Df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | LA SSI - OA SSI | -11.79111 | 15.68741 | 5.22914 | -23.84952 | .26730 | -2.255 | 8 | .050 |
| Pair 2 | LA Operative Time - OA Operative Time | 5.397 | 23.642 | 7.881 | -12.776 | 23.569 | .685 | 8 | .513 |
| Pair 3 | LA Hospital Stay - OA Hospital Stay | -1.329 | 1.081 | .360 | -2.160 | -.498 | -3.689 | 8 | .006 |

**Pair 3: LA Hospital Stay – OA Hospital Stay**

t = -3.689, n = 9

$d = \frac{-3.689}{\sqrt{9}}$

=-1.23

This means there is a **Very large effect.** This indicates that laparoscopic appendectomy significantly reduces hospital stay as compared to open appendectomy.

## Discussion

Open appendectomy is being performed over the ages while laparoscopic appendectomy is a relatively new but more popular surgical technique these days. Various studies have shown that patients experience less postoperative pain in laparoscopic appendectomy compared to open appendectomy. Laparoscopic appendectomy has also proved to have lower rates of wound infection, smaller scars, and reduced complication rates. It is also observed that after undergoing laparoscopic appendectomy, patients receive an earlier discharge from the hospital and are able to return to their social and professional life sooner than the patients who underwent open appendectomy. Due to all these advantages that patients experience in laparoscopic appendectomy, they feel more confident to go along with laparoscopic appendectomy than open appendectomy. However, both laparoscopic appendectomy and open appendectomy are safe procedures to treat appendicitis. In addition, laparoscopic appendectomy provides the surgeons with an advantage of being able to assess other potential acute intra-abdominal pathologies. All these advantages provide an edge to laparoscopic appendectomy procedure over open appendectomy procedure.[20,21]

Considering the various benefits highlighted in various research, the present research aimed to run a comparative analysis between laparoscopic appendectomy and open appendectomy on three parameters namely operative time, SSI and recovery. The data from the analysis of nine research papers were collated and further analyzed to find out if there exists any difference between laparoscopic appendectomy and open appendectomy in terms of operative time, SSI, and recovery.

In the first objective, no significant difference in laparoscopic appendectomy and open appendectomy in terms of operative time has been observed. The positive mean difference that has been identified from most of the studies showed that laparoscopic appendectomy takes more operative time compared to open appendectomy. The research conducted by Pogorelić *et al.* stated that laparoscopic appendectomy is a highly preferred surgical procedure over open appendectomy due to its significantly shorter operative time.[22] The span of operation time is not dependent on the time of the day at which the operation is being conducted. The time span remained the same in both day and night operations. However, in both scenarios the operative time was significantly lesser compared to open appendectomy and thus, patients prefer this procedure. Previous studies have also confirmed that laparoscopic appendectomy is highly preferred due to its less operative time. This indicates that the literatures analysed in the current research contradict the findings of the present research by presenting a different perspective on the topic. It is also possible that the results of the current research vary based on the inclusion and exclusion criteria of the selected research papers and thus, the results of the research vary significantly.

Furthermore, the study in its second objective analyzed if there exists any difference between laparoscopic appendectomy and open appendectomy in terms of SSI. To explain this, the researcher observed that a significant difference exists in laparoscopic appendectomy and open appendectomy in terms of SSI. The negative mean difference according to most of the studies showed that the patients who underwent laparoscopic appendectomy had lesser SSI compared to patients who underwent open appendectomy. Supporting the findings of the present research, the study conducted by Azmeraw *et al.,* stated that the rate of SSI is significantly lower in laparoscopic appendectomy as compared to open appendectomy.[23] It was observed that the incision made in open appendectomy is more extended compared to laparoscopic appendectomy thereby increasing the risk of SSI incidence in patients. Surgical site infection is identified as one of the most common post-operative complications of appendectomy. Its global prevalence is reported to be 17.9% with the highest prevalence reported in Saudi Arabia as 7.2%. Spain reported a prevalence of 4.7% while Australia reported 1.9%. The lowest prevalence has been reported by Estonia with 1.2%. Occurrence of SSI is also highly associated with the increased morbidity and mortality rates among children. The seriousness of this complication might explain why patients prefer laparoscopic to open appendectomy.

Finally, the study in its third objective analyzed if there exists any difference between laparoscopic appendectomy and open appendectomy in terms of recovery (such as length of hospital stay). To analyze this research problem, hospital stay has been considered as a relevant parameter since the lesser the hospital stay, the higher the postoperative recovery rate and vice versa. Thus, the study observed that a significant difference exists in laparoscopic appendectomy and open appendectomy in terms of postoperative recovery. The negative mean difference as per most of the studies showed that the patients who underwent laparoscopic appendectomy had lesser stay duration in the hospital which indicates lesser recovery time compared to patients who underwent open appendectomy. The research conducted by Zhang *et al.* stated that laparoscopic appendectomy is widely popular due to its various benefits one of which is also faster recovery.[24]

With less operative time, patients get more time to recover as their hospital stay duration is reduced. Thus, the recovery time is lesser in laparoscopic appendectomy compared to open appendectomy. Other than this, lesser complications such as SSI rate is also another reason why patients recover faster in laparoscopic appendectomy than open appendectomy.

Due to these reasons, it has become the go-to procedure for appendicitis. Thus, finding from this study supports the notion that laparoscopic appendectomy has a faster recovery process than open appendectomy.

## Conclusion

The present research aimed to conduct a comparative analysis between laparoscopic appendectomy and open appendectomy on the basis of operative time, SSI, and recovery. To conduct this, a meta-analysis with a dataset of nine research papers were analysed. The results showed that no significant difference is observed between laparoscopic appendectomy and open appendectomy in terms of operative time. While a significant difference exists when compared on the basis of SSI and recovery. The research also analyzed that laparoscopic appendectomy has a higher operative time compared to open appendectomy. However, all the literatures analyzed on the topic stated that laparoscopic appendectomy has a lesser operative time than open appendectomy. Thus, this notion has been found to be contradictory and therefore, holds future scope for further in-depth analysis into this parameter by possibly considering a higher sample size or by varying the inclusion and exclusion criteria to cater to a bigger radius of population.

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### Conflicts of interest

There are no conflicts of interest

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