

# Outcomes of Open Appendicectomy by Simple Ligation versus Invagination in Acute Appendicitis- A Prospective Observational Study

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## ABSTRACT

**Introduction:** Surgical techniques in open appendicectomy has been evolving with most centres following simple ligation of appendix stump as the most preferred approach including the laparoscopic approach. Invagination of stump of the appendix is also practiced as a traditional approach.

**Aim:** To compare and evaluate the outcomes and postoperative morbidity of simple ligation and invagination appendicectomy techniques.

**Materials and Methods:** This was a prospective observational study conducted from October 2016 to July 2018 and included a total of 100 patients of acute appendicitis undergoing emergency open appendectomy surgery. The method of surgery of simple ligation and invagination appendectomy was allotted alternatively with 50 patients in each category. Both techniques of surgery were compared in terms of operating time, duration

of hospital stay and postsurgical complications. Relevant data was collected and entered in Microsoft excel and p-value was calculated using Chi-square test.

**Results:** A total of 100 patients were included with a mean age of 27 years. Both the groups with 50 patients each, were equivalent with age and gender distribution. It was observed that both the techniques had similar outcomes in respect to mean duration of surgery, duration of hospital stay and morbidities (p-value >0.05) with no statistically significant difference. The morbidity and the rate of postoperative complications were similar in both the groups.

**Conclusion:** Appendicular stump management after appendectomy can be treated either by simple ligation or by invagination method, both techniques being equally effective and safe. Hence, it is surgeons preference to choose among the two techniques.

**Keywords:** Appendix stump, Burial of stump, Postoperative ileus, Wound infection

## INTRODUCTION

Acute appendicitis is the most common surgical cause of acute abdomen presenting with the Murphy's triad of right iliac fossa pain, fever and vomiting. It usually affects younger population with 40% of the cases occurring between the ages of 10 and 29 years [1,2]. Appendectomy is the definitive treatment for acute appendicitis which can be done by both open and laparoscopic approach. During appendectomy, a 3 mm stump is left behind which can be dealt with either by simple ligation or by burial. The practice of burial of appendicular stump dates back to preantibiotic era wherein, the aim of invagination of the stump were to control haemorrhage, reduce adhesion formation and to prevent any peritoneal contamination and subsequent sepsis [2]. Acute appendicitis is a common surgical emergency which is managed by appendectomy. Ligation is simple to do, whereas burial involves use of purse string sutures or the Z technique to bury the appendix stump within the caecum. The advantages of burial include prevention of contamination of the peritoneum by the open end of the stump and therefore, decrease in septic complications and prevention of adhesive complications [3]. Hence, the present study was conducted with the aim of comparing the two methods of appendicular stump management in terms of intraoperative variables and postoperative outcome.

## MATERIALS AND METHODS

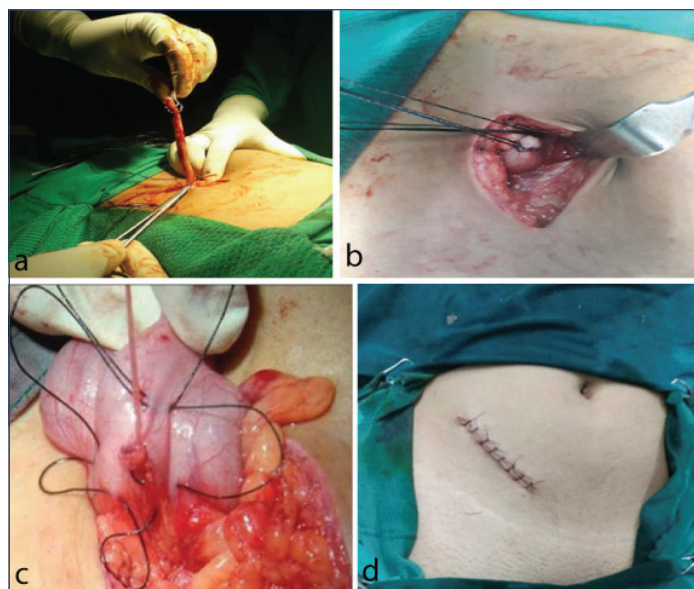
This was a prospective observational study conducted at General Surgery Department, Goa Medical College Hospital, Bambolin, Goa, India, from October 2016 to July 2018 on the patients diagnosed with acute appendicitis as per clinical presentation and imaging features and underwent open appendectomy after obtaining approval from Institutional Ethics Committee [IEC letter dated 14/10/2016].

**Inclusion criteria:** All patients from >12 years to <70 years, who presented to the department during the study time period, diagnosed with acute appendicitis, and managed by surgical intervention were included in the study after taking informed consent from them [2].

**Exclusion criteria:** Patients who were diagnosed to have other pelvic pathology related to uterus, adnexa and other pelvic structures, those with complications of appendicitis such as appendicular mass and appendicular abscess, perforated appendicitis, inflamed caecum, Human Immunodeficiency Virus (HIV) infection, those on immunosuppressive therapy and the patients who were not operated due to other medical associated conditions or refused for surgery were excluded from the study.

## Study Procedure

The patients included in the study were all suffering from acute appendicitis condition [Table/Fig-1(a)] and were managed as per standard treatment protocol. They were evaluated with complete blood counts, renal function tests, prothrombin time. Ultrasonography (USG) abdomen was the initial imaging modality used. Computed Tomography (CT) abdomen was done selectively in patients in whom local complication was suspected. All patients were optimised as their medical condition and co-morbidities demanded. They were randomised to simple ligation group, procedure as in [Table/Fig-1(b)] and stump burial group, as in [Table/Fig-1(c)] by picking lots. Surgery was done by open technique under general or spinal anaesthesia using Mc Burney incision, manner as shown in [Table/Fig-1(d)]. Wound was inspected on day two of surgery and then every two days. Patients were discharged once they were able to take well orally and pain could be managed with oral antibiotics. Sutures were removed on postoperative day eight as per protocol. All patients had a follow-up at one month for clinical evaluation and investigations if warranted.



**[Table/Fig-1]:** Surgical images of the patients a) Acute appendicitis condition; b) Stump ligation procedure; c) Stump burial procedure; d) Mc burneys incision.

Data regarding demographic details and co-morbidities of the patient was collected. Details of relevant biochemical, radiological and histopathological investigations were collected. Intraoperative method of dealing with stump was defined and planned. Time required to perform the surgery was noted. Any postoperative complications specifically wound infection, paralytic ileus and respiratory complications were noted. Details about duration of hospital stay, morbidities and postoperative responses to treatment at one month follow-up were noted.

## STATISTICAL ANALYSIS

The relevant data was collected and entered in Microsoft (MS) excel and the significance was calculated using Chi-square test.

## RESULTS

A total of 100 patients diagnosed as acute appendicitis as per the clinical symptoms and imaging features were included in the study during the study period. They were randomly allocated to stump burial and stump ligation group by picking lots, 50 in each group. Patient characteristics in each group is shown in [Table/Fig-2].

Majority of patients (n=58) belonged to age group of 21-40 years, mean age 27 years. Females constituted majority of the study group (n=69 patients). Age and gender distribution was similar in both the groups. Among the 100 patients, 75 patients were operated within 50-100 minutes, with 39 cases in stump burial group operated between 50-100 minutes and 36 cases in stump ligation group operated between 50-100 minutes. The mean duration of surgery in stump burial group was 89.4 minutes, whereas in stump ligation group, it was 91.2 minutes. The difference was not statistically significant [Table/Fig-2].

Majority of the patients (n=60) were discharged on postoperative day 4, 29 in stump burial group and 31 in stump ligation group. Mean duration of hospital stay was 4.02 days in stump burial group and 3.92 days in stump ligation group. The difference was not statistically significant. Morbidity occurred in 40 patients (40%) with 28 patients having wound infection, 15 in stump burial group and 13 in stump ligation group, all of which were managed with removal of sutures and regular dressing. None of them had dehiscence. [Table/Fig-2].

Among the 12 patients who had postoperative ileus, five were in the stump burial group and seven in the stump ligation group, all of whom responded to conservative management. There was no difference in the incidence of wound infection and postoperative ileus in both the groups. None of the patients of the present

study developed adhesive obstruction, faecal fistula and stump appendicitis [Table/Fig-2].

Data and analysis	Stump burial group N=50	Stump ligation group N=50	p-value
<b>Age distribution</b>			
5-20 years	10	19	0.051
21-40 years	35	23	
41-60 years	5	8	
<b>Gender distribution</b>			
Males	18	13	0.28
Females	32	37	
<b>Duration of surgery (in minutes)</b>			
Less than 50	1	2	0.728
50-100	39	36	
More than 100	10	12	
<b>Duration of hospital stay (in days)</b>			
3	12	13	0.850
4	29	31	
5	8	5	
6	1	1	
<b>Morbidity</b>			
Wound Infection	15	13	0.49
Postoperative Ileus	5	7	

**[Table/Fig-2]:** Demographic data of subjects and clinical parameters along with their analysis; p-values calculated by Chi-square test; no subjects were reported with adhesions, faecal fistula and stump appendicitis in any of the procedures.

## DISCUSSION

Among the total 100 patients included, the mean age of the patients was 27 years with maximum patients in 21-40 years of age group. A total of 69 patients were females and 31 patients were males. In a similar previous study, mean age of occurrence of acute appendicitis was 23.7 years with a range of 14-70 years. Most common age group affected in their study was 20-30 years which is similar to the present study [3]. Around 67% of their patients were males [3]. Similarly, Sayyadinia M et al., in their study found that the mean age of occurrence of acute appendicitis was 26.67 years which is similar to the present study [4]. Appendicular stump management by simple ligation is easy to perform and involves crushing the base with Kocher clamp and simple ligation done at the crushed line and appendix cut above the tie [5]. In burial method, it is buried into the caecum either using purse string suture or using a Z stitch. Since there is additional step in burial, one would expect it to take longer time in comparison to ligation.

To maintain standardisation, all surgeries in the present study were performed by surgeons with minimum three years' experience in surgical department. Steps of the surgery were same in both the groups except the stump management. Majority of the cases took 50-100 minutes. Mean duration of surgery in stump burial group and stump ligation group was 89.4 minutes and 91.2 minutes, respectively. Contrary to other studies, the duration of surgery was longer in stump ligation group compared to stump burial group although it was not statistically significant. The difference could have been due to other factors like body habitus, position of appendix, degree of inflammation which were not taken in account in the study.

Neves LJVA et al., in their study found mean duration of surgery in stump burial group to be 75 minutes 30 seconds whereas in stump ligation group was 69 minutes, 6.30 minutes lesser than in burial group [6]. Gurjit Singh and Apoorva Pandey in their study found that mean duration of surgery in stump burial was 61 minutes whereas mean duration of surgery in stump ligation group was 48 minutes with a difference of 13 minutes [7]. Majority of the patients were discharged on postoperative day four. Mean duration of stay in

stump burial group was 4.02 days and in stump ligation group was 3.92 days. The difference was not statistically significant. Range of hospitalisation was 3-6 days [7]. In the present study as well, the majority of patients post appendectomy were discharged on postoperative day 3 and 4. However, the duration of hospitalisation in few patients extended to 5 and 6 days. Common reason being, postoperative ileus, postoperative pain and wound infection.

Watters DA et al., in their study found that duration of hospitalisation was 2.4 days in burial group and 1.9 days in ligation group. However, there was no statistically significant difference between the two groups in terms of duration of hospitalisation [8]. Similarly Khan N et al., in their study found that mean duration of hospital stay in stump burial group was 2.4 days whereas in stump ligation group, it was 2.06 days. They found that mean range of hospitalisation was between 1-5 days [3].

In the present study, morbidity occurred in 40 patients, among whom 28 had wound infections and 12 had postoperative ileus. Among these 28 patients, 15 (30%) belonged to stump burial group and 13 (26%) belonged to stump ligation group. There was no difference in the occurrence of wound infections in the groups. Neves LJVA et al., found wound infection rate of 9.7% without statistically significant difference in the incidence of wound infection in burial and ligation group [6]. Afridi NG et al., in their study also found that wound infection was the most common postoperative complication. In their study they found 6% incidence of wound infection in stump burial group and 3% in stump ligation group [9]. The difference in the incidence between two groups was statistically significant with higher incidence of wound infection in stump burial group. In the present study, the incidence of wound infection was much higher compared to other groups, inspite of good antibiotic cover. There was no significant difference in the incidence of postoperative ileus between the two groups. All these patients were managed conservatively by keeping them nil by mouth and they resolved within 72 hours. Probable etiology of ileus could be due to handling of inflamed bowel, local infection and longer duration of surgery. Stump management technique did not affect the incidence of ileus.

Gravante G et al., in their study showed that six studies reported data on postoperative ileus. The incidence varied between 0-7.5% in the simple ligation group and 2-27.5% in stump burial group. It

was inferred that simple ligation increases the risk of postoperative ileus four times compared to stump burial. The reason being that in ligation group the infected stump is exposed and is liable to attract adhesions. However other studies have disputed this observation. [10]. None of the patients in this study had any intra-abdominal abscess, faecal fistula or stump appendicitis.

### Limitation(s)

Long term complications are adhesive intestinal obstruction, stump appendicitis and since follow-up time in this study was only one month, hence could not comment on their incidence.

### CONCLUSION(S)

Both the techniques of appendix surgery including stump ligation and invagination were found to have similar results, both are equally effective and safe with similar outcomes. Hence, it becomes surgeons' preference to choose among the two techniques.

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