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## Research Article

# Glove-Finger Extraction Technique in Laparoscopic Appendectomy: A Cost-Sensible Alternative Approach to Standard Practice

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## ABSTRACT

**Background:** Laparoscopic appendectomy is associated with higher hospital costs due to specialized equipment. This retrospective study evaluates the glove-finger appendix retrieval technique as an alternative to the Endocatch™ bag in laparoscopic appendectomy. The study aims to assess cost-effectiveness, feasibility, operative time, and post-operative complications with the use of a surgical glove. **Methods:** A total of 128 cases of acute uncomplicated appendicitis underwent laparoscopic appendectomy between 2012 and 2015. Forty-nine cases used the glove-finger technique, while 79 used the Endocatch™ bag. Outcome parameters included operative time, postoperative complications, length of stay, and readmission rates. Statistical analysis was conducted using two-tailed t-tests. **Results:** The glove-finger technique had a complication rate of 4.1% (2/49), while the Endocatch™ group had a rate of 7.6% (6/79). Operative time was significantly shorter in the glove-finger group by 7.7 minutes ( $p = 0.009$ ). Length of stay did not significantly differ. The estimated cost reduction per case with the glove-finger technique was \$347. **Conclusion:** While no significant differences were observed in complication rates or length of stay, the glove-finger technique reduced operative time and demonstrated substantial cost savings. This technique offers a cost-sensible alternative to the standard Endocatch™ bag in laparoscopic appendectomy.

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## 1. Background

Nearly 1 in 13 individuals will develop appendicitis in their lifetime, making this disease one of the most common surgical emergencies in the world [1, 2]. Standard of care for the management of appendicitis is laparoscopic appendectomy, with only 20-40% requiring open surgical management instead [3, 4]. When compared to an open approach, laparoscopic procedures result in reduced length of stay, reduced risk of post-operative wound complications, and improvement in pain control [5, 6]. The smaller wounds in laparoscopy result in reduced post-operative pain, risk of infection, and post-operative hernia [5]. Consequently, the greatest disadvantage in laparoscopic surgery is higher hospital costs due to specialized and/or disposable single-use equipment. Laparoscopy has been reported to be nearly 22% more expensive in uncomplicated appendicitis and 9% more expensive in complicated appendicitis [6, 7]. The average cost of single-use disposable equipment in a laparoscopic procedure exceeds thousands of dollars. Minimizing total procedure cost is therefore an area of interest.

The covidien endocatch™ gold 10 mm specimen retrieval bag is commonly used to retrieve the appendix from the abdomen after completion of appendectomy with a cost of approximately \$350. This specialized specimen bag allows for efficiency, convenience and adaptation to the possible different sizes of specimens during an operation [8]. If an alternative and readily available technique were developed to replicate the advantages of the specimen bag without increasing inherent risks or complications, it holds potential to significantly reduce cost associated with laparoscopy. The primary objective of this retrospective study is to incorporate the glove-finger retrieval technique into our standard practice for laparoscopic appendectomy as a safe alternative to the endocatch™ specimen bag. We aim to demonstrate the cost effectiveness, feasibility, reduced operative time, and reduction in post-operative complications with the use of one of the most cost-effective and readily available items in the operating room - a surgical glove.

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## 2. Methods

128 patients who underwent laparoscopic appendectomy for acute appendicitis between 2012 and 2015 by one experienced minimally invasive surgeon in our 500-bed urban teaching hospital were retrospectively reviewed. 49 appendix specimens were collected using the glove-finger extraction technique while 79 utilized the endocatch™ specimen bag. Several outcome parameters were noted, including the duration of the operation, postoperative complications (intra-abdominal abscess, wound infections, post-operative pain), length of hospital stay, and rate of in-hospital readmission. Statistical analysis was completed through two-tailed t tests with p-values of less than .05 considered statistically significant.

## 3. Operative Technique

Every patient involved in this study was prepped in a standard sterile fashion. After administration of general anesthesia, the patient was repositioned in the trendelenburg position. Prior to initiating the procedure, the surgeon cuts the middle finger of a standard size 8.5 sterile surgical glove in an oblique fashion and placed it aside adjacent to the specimen landing zone. A veress needle was inserted through the umbilicus to intra-abdominally insufflate CO<sub>2</sub> and create pneumoperitoneum. A viewing laparoscope was inserted via a 5 mm periumbilical port to allow for complete visualization of intra-abdominal organs including the appendix.

A 5 mm port in the left lower quadrant and 12 mm port in the right upper quadrant were introduced under direct visualization. A non-traumatic grasper was introduced into this port to isolate the appendix. The small bowel was mobilized away from the appendix to achieve adequate exposure. The tinea coli was identified and followed until the base of the appendix was identified. The appendix was then lifted towards the anterior abdominal wall with the left-hand grasper in order to expose the mesoappendix. A maryland grasper was used to create a window through the avascular plane located at the base of the appendix and the base was then divided by a 45 mm stapler. The mesoappendix was then freed using either a 45 mm or 60 mm stapler or with assistance of electrocautery with ligasure or harmonic devices. The appendiceal stump and vasculature were then assessed to ensure hemostasis.

The initially created glove-finger retrieval bag was introduced through the 12 mm port. The edge of the glove-finger bag is secured and the appendix specimen was then carefully placed into the glove-finger bag. The specimen was then retrieved from that same 12 mm port. The 5 mm port was closed with monocryl. The fascia of the 12mm site was closed with a suture passer device using 0 vicryl sutures. The skin was then closed with monocryl and transversus abdominis plane (TAP) block was administered for short-acting post-operative pain control.

## 4. Results

Only two of the 49 glove-finger extraction cases had post-operative complications. One case had a post-operative fever and another had abdominal pain. Both were managed nonoperatively with non-opioid analgesics and antipyretics, yielding a complication rate of 4.1% (2/49). In comparison, the endocatch™ group had six complications of varying

severity for a complication rate of 7.6% (6/79). The total operative time for the glove-finger extraction group ranged from 51 - 58 minutes (mean  $54.4 \pm 0.6$  minutes), compared to 57 - 68 minutes (mean  $62.1 \pm 0.7$  minutes) in the endocatch™ group resulting in shorter operative time in the glove-finger extraction group by 7.7 minutes ( $p = 0.009$ ).

Mean length of stay between both groups was not statistically significant ( $p=0.581$ ). We estimated that a pair of standard size 8.5 sterile surgical gloves costs approximately \$2.06 compared to that of an endocatch™ at \$350. This suggests a potential cost reduction of \$347.94 per case for laparoscopic appendectomy using a glove-finger extraction over the conventional endocatch™ bag. In other words, this inarguably amounts to saving 99.4% of the original cost of endocatch™ bag with the use of the glove-finger extraction method.

## 5. Discussion

Laparoscopic appendectomy is regarded as the gold standard treatment for appendicitis [9, 10]. Even within an estimated 20-40% of cases performed with an open approach, many of these were initially laparoscopic but required conversion to an open approach either due to advanced disease, technical limitations, previous surgeries, or surgical inexperience [4]. Laparoscopic surgery offers reduced post-operative pain, in-hospital length of stay, post-operative infection, and improved cosmesis due to its smaller incision length [6].

One of the most important considerations in performing laparoscopy is the size of the specimen. A glove finger has an inherent limitation in the size of the appendix. Therefore, the surgeon in each case of this study made an appropriate determination of whether using glove-finger extraction was feasible. The use of an endocatch™ bag in several cases was preferred during the operation leading to possible selection bias within our results. The calculated cost reduction with the use of glove-finger is approximately \$347 per case. The cost saved with the use of a glove-finger with each case may represent a small sum, but given the abundance of laparoscopic appendectomies performed in our large-scale urban teaching hospital, the cumulative cost reduction can be reallocated to improve quality of care. Further, glove-finger extraction is not the only cost saving measure being explored in laparoscopic appendectomies and could be combined with other cost reduction methods [11].

While there was no significant difference in complication rates and in-hospital length of stay between the two groups, it was evident that the glove-finger method reduced operative time when compared to endocatch™. Every operative room contains sterile surgical gloves readily available for use. With the large number of laparoscopic appendectomies, this alternative can have profound effects on efficiency and case volume - two commonly evaluated parameters in quality improvement. More studies with a larger sample size and multiple surgeons of varying skillsets are necessary to confirm these findings.

## 6. Conclusion

Laparoscopic appendectomy is the gold standard treatment for acute appendicitis. However, it is associated with higher hospital costs than open appendectomy due to the use of specialized and/or disposable

single-use equipment. Given the important benefits laparoscopy provides, high-volume institutions and centers are focused on cost reduction measures. Identifying innovative and alternative techniques in these common emergency and elective cases such as appendectomies are an efficient way to do so. Using a glove-finger in lieu of an endocatch™ bag retains the benefits of laparoscopic surgery while mitigating costs. Merging multiple techniques with glove-finger extraction can be invaluable in reducing cost while preserving quality of care in patients.

### Competing Interests

None.

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