

# A Comparative Study on Removal of Appendectomy Specimen during Laparoscopy

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## ABSTRACT

This study included 151 patients and compared four techniques for appendectomy specimen removal during laparoscopy in a tertiary health centre. An endo bag was the most common removal technique which is preferred in the elderly, whereas, direct removal is preferred in younger patients ( $p=0.045$ ). A lower median CRP level was observed in the powdered glove group ( $p=0.025$ ), and median values of hospital stay were longer in powder-free and powdered glove groups ( $p<0.001$ ). In comparing the powder-free glove group and powdered glove group, there was only a difference in median hospital stays, and the median level was higher in the powdered glove group.

The present study's results show direct removal is the best method because of the reduced need for catheters during surgery and the short hospital stay. However, powdered gloves technique is preferred method in cases with less inflammation, though, it prolongs the need for drainage catheter use and length of hospital stay. Therefore, we emphasise that removal *via* powdered gloves is the worst technique among the four techniques.

**Key Words:** Appendectomy, Appendicitis, Laparoscopy, Morbidity, Readmission.

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One of the main steps of laparoscopic appendectomy is the extra-abdominal removal of the *appendix vermiformis* (AV). Using an endo bag, removal with surgical gloves, and direct removal are the commonly used techniques for AV removal. Surgical gloves can be powdered or powder-free due to their production. Previously, few studies compared the powder-free glove and endo bag during AV removal. However, no study compared powdered and powder-free gloves during specimen removal.<sup>1</sup> To complete the deficiency in the literature, the superiority of four different techniques (endo bag, powdered gloves, powder-free gloves, and direct removal) over each other was investigated.

Patients who were operated on due to acute appendicitis (AA) between January 2019 and July 2020 in a tertiary health centre were selected for this retrospective study. Hospital records, consultation and operation notes, and clinical charts of the patients were searched to gather data. Patients in the paediatric age group (0-18 years), pregnant patients, and patients treated at external centres and then admitted to our centre were included in the study.

Patients' age and gender, times from home to hospital, preoperative symptoms, signs and laboratory parameters on admission, the imaging tools used for diagnosis, operation room time, length of hospital stay, specimen removal technique, use of drainage catheter, and postoperative outcomes were checked. Alvarado's score was calculated for all patients. In addition, postoperative outcomes (complication, mortality, and readmission) occurring in the first 30 days postoperatively were investigated. The differences in the studied parameters in the four-specimen removal techniques were evaluated statistically. In addition, a statistical comparison of the glove groups according to clinical parameters was performed.

Statistical analyses were performed using SPSS v22.0 (IBM, Armonk, NY, USA). Quantitative variables were expressed as mean  $\pm$  standard deviation (SD), median, minimum-maximum, interquartile range and interval. Qualitative variables were reported as numbers and percentages. The Kruskal Wallis, Mann-Whitney U-test and chi-square tests (Pearson chi-square, Fisher's exact test, and Likelihood ratio tests) were used. A  $p$ -value below 0.05 was considered statistically significant.

This comparative study included 151 patients (92 were males, and 59 were females). The mean age of the patients was  $33.08 \pm 14.25$  (18-79) years. Most patients (88.7%) were admitted to the hospital in the first 12 hours. The most common admission symptom was migratory pain with 78.1%, and the sign was right iliac fossa tenderness with 97.4%. An endo bag was the most common removal technique with 62 (41.1%).

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Table I: Comparison of the specimen removal techniques.

Parameters	Comparison of all specimen removal techniques				p-value	Powder-free glove vs powdered glove		p-value
	Endo bag (n=62)	Powdered glove (n=46)	Powder-free glove (n=30)	Direct (n=13)		Powder-free glove (n=30)	Powdered glove (n=46)	
<b>Preoperative parameters</b>								
<b>Gender<sup>a</sup></b>					0.163*			0.811*
Female	35 (56.5)	31 (67.4)	21 (70)	5 (38.5)		9 (37.5)	15 (62.5)	
Male	27 (43.5)	15 (32.6)	9 (30)	8 (61.5)		21 (40.4)	31 (59.6)	
<b>Age<sup>b</sup></b>	34.00 (22.50)	25.50 (25.25)	29.00 (24.50)	21.00 (8.00)	<b>0.045**</b>	29 (24.5)	25.50 (25.25)	0.267***
<b>Time home to hospital<sup>a</sup></b>					0.907****			1.000****
First 12 hours	6 (9.7)	6 (13)	3 (10)	2 (15.4)		27 (90)	40 (87)	
>12 hours	56 (90.3)	40 (87)	27 (90)	11 (84.6)		3 (30)	6 (13)	
<b>Symptom and signs</b>								
<b>Migratory pain<sup>a</sup></b>					0.564*			0.774*
Yes	45 (72.6)	38 (82.6)	24 (80)	11 (84.6)		24 (80)	38 (82.6)	
No	17 (27.4)	8 (17.4)	6 (20)	2 (15.4)		6 (20)	8 (17.4)	
<b>Vomiting and nausea<sup>a</sup></b>					0.075*			0.260*
Yes	30 (48.4)	29 (63)	15 (50)	3 (23.1)		15 (50)	29 (63)	
No	32 (51.6)	17 (37)	15 (50)	10 (76.9)		15 (50)	17 (37)	
<b>Lack of appetite<sup>a</sup></b>					0.506*			0.457*
Yes	45 (72.6)	30 (65.2)	22 (73.3)	7 (53.8)		22 (73.3)	30 (65.2)	
No	17 (27.4)	16 (34.8)	8 (26.7)	6 (46.2)		8 (26.7)	16 (34.8)	
<b>RIF tenderness<sup>a</sup></b>					0.421*****			0.516****
Yes	60 (96.8)	44 (95.7)	30 (100)	13 (100)		30 (100)	44 (95.7)	
No	2 (3.2)	2 (4.3)	0 (0)	0 (0)		0 (0)	2 (4.3)	
<b>Rebound<sup>a</sup></b>					0.132*****			0.149****
Yes	60 (96.8)	42 (91.3)	30 (100)	13 (100)		30 (100)	42 (91.3)	
No	2 (3.2)	4 (8.7)	0 (0)	0 (0)		0 (0)	4 (8.7)	
<b>Fever<sup>a</sup></b>					0.760*			0.285*
Yes	25 (40.3)	21 (45.7)	10 (33.3)	5 (38.5)		10 (33.3)	21 (45.7)	
No	37 (59.7)	25 (54.3)	20 (66.7)	8 (61.5)		20 (66.7)	25 (54.3)	
<b>Alvarado score<sup>a</sup></b>					0.342*			0.150*
5-6	15 (24.2)	10 (21.7)	3 (10)	3 (23.1)		3 (10)	10 (21.7)	
7-8	32 (51.6)	22 (47.8)	21 (70)	9 (69.2)		21 (70)	22 (47.8)	
>8	15 (24.2)	14 (30.4)	6 (20)	1 (7.7)		6 (20)	14 (30.4)	
<b>Laboratory parameters</b>								
WBC <sup>b</sup>	12.60 (6.27) <sup>b</sup>	13.85 (7.60) <sup>b</sup>	13.85 (5.90) <sup>b</sup>	13.70 (5.19) <sup>b</sup>	0.485**	14.26±3.39 <sup>c</sup>	14.51±5.25 <sup>c</sup>	0.803*****
Haemoglobin	14.00 (3.00) <sup>b</sup>	14.00 (1.90) <sup>b</sup>	14.00 (2.68) <sup>b</sup>	15.10 (2.65) <sup>b</sup>	0.920**	14 (2.68) <sup>b</sup>	14.00 (1.90) <sup>b</sup>	0.974***
Platelet count	251.00 (108.00) <sup>b</sup>	260.00 (119.75) <sup>b</sup>	247.00 (139.25) <sup>b</sup>	251.00 (129.00) <sup>b</sup>	0.905**	247.00 (139.25) <sup>b</sup>	260.00 (119.75) <sup>b</sup>	0.734***
Neutrophil count	9.70 (5.53) <sup>b</sup>	10.01 (6.79) <sup>b</sup>	10.05 (3.74) <sup>b</sup>	9.31 (6.44) <sup>b</sup>	0.531**	10.97±3.31 <sup>c</sup>	10.81±4.55 <sup>c</sup>	0.865*****
Lymphocyte count	2.13 (2.27) <sup>b</sup>	2.52 (2.27) <sup>b</sup>	2.59 (2.53) <sup>b</sup>	1.69 (1.52) <sup>b</sup>	0.601**	2.59 (2.53) <sup>b</sup>	2.52 (2.57) <sup>b</sup>	0.644***
Neutrophil rate	74.00 (16.10) <sup>b</sup>	74.00 (13.67) <sup>b</sup>	74.50 (21.25) <sup>b</sup>	82.00 (19.55) <sup>b</sup>	0.511**	74.50 (21.25) <sup>b</sup>	74.00 (13.67) <sup>b</sup>	0.246***
Lymphocyte rate	18.00 (19.30) <sup>b</sup>	17.60 (9.40) <sup>b</sup>	18.60 (18.68) <sup>b</sup>	14.00 (13.10) <sup>b</sup>	0.609**	18.60 (18.68) <sup>b</sup>	17.60 (9.40) <sup>b</sup>	0.647***
Albumin level	3.40 (0.50) <sup>b</sup>	3.40 (0.63) <sup>b</sup>	3.40 (1.05) <sup>b</sup>	3.50 (0.90) <sup>b</sup>	0.325**	3.40 (1.05) <sup>b</sup>	3.40 (0.63) <sup>b</sup>	0.568***
CRP	5.91 (10.97) <sup>b</sup>	2.00 (11.56) <sup>b</sup>	5.35 (13.63) <sup>b</sup>	7.00 (31.02) <sup>b</sup>	<b>0.025**</b>	5.35 (13.63) <sup>b</sup>	2.00 (11.56) <sup>b</sup>	0.128***
<b>Imaging tPool<sup>a</sup></b>					0.435*****			0.772*
Only USG	20 (32.3)	21 (45.7)	13 (43.3)	3 (23.1)		13 (43.3)	21 (45.7)	
Only CT	23 (20.5)	13 (28.3)	7 (23.3)	7 (53.8)		7 (23.3)	13 (28.3)	
Both USG and CT	19 (30.6)	12 (26.1)	10 (33.3)	3 (23.1)		10 (33.3)	12 (26.1)	
<b>Operative parameters</b>								
<b>Drainage catheter<sup>a</sup></b>					<b>&lt;0.001*</b>			0.776*
Yes	11 (17.7)	23 (50)	16 (53.3)	0 (0)		16 (53.3)	23 (50)	
No	51 (82.3)	23 (50)	14 (46.7)	13 (100)		14 (46.7)	23 (50)	
<b>Operation room time</b>	55 (26.25) <sup>b</sup>	45.00 (26.25) <sup>b</sup>	45.00 (27.50) <sup>b</sup>	45.00 (26.50) <sup>b</sup>	0.109**	45.00 (27.5) <sup>b</sup>	45.00 (26.25) <sup>b</sup>	0.802***
<b>Postoperative parameters</b>								
<b>Readmission<sup>a</sup></b>					0.170*****			0.516****
Yes	3 (4.8%)	2 (4.3%)	0 (0%)	2 (15.4%)		0 (0)	2 (4.3)	
No	59 (95.2%)	44 (95.7%)	30 (100%)	11 (84.6%)		30 (100)	44 (95.7)	
<b>Morbidity<sup>a</sup></b>					0.510*****			1.000****
Yes	3 (4.8%)	4 (8.7%)	2 (6.7%)	0 (0%)		2 (6.7)	4 (8.7)	
No	59 (95.2%)	42 (91.3%)	28 (93.3%)	13 (100%)		28 (93.3)	42 (91.3)	
<b>Hospital stays</b>	1.00 (1.00) <sup>b</sup>	4.00 (4.25) <sup>b</sup>	2.00 (1.00) <sup>b</sup>	1.00 (0.50) <sup>b</sup>	<b>&lt;0.001**</b>	2.00 (1.00) <sup>b</sup>	4.00 (4.25) <sup>b</sup>	<b>0.004***</b>
<b>Pathology<sup>a</sup></b>					0.434*			0.416*
Non-complicated AA	46 (74.2)	33 (71.7)	24 (80)	12 (92.3)		24 (80)	33 (71.7)	
Complicated AA	16 (25.8)	13 (28.3)	6 (20)	1 (7.7)		6 (20)	13 (28.3)	
<b>Pathology subgroup<sup>a</sup></b>					0.704*****			0.683*****
Suppurative	18 (29)	17 (37)	12 (40)	7 (53.8)		12 (40)	17 (37)	
Catarrhal	21 (33.9)	10 (21.7)	10 (33.3)	4 (30.8)		10 (33.3)	10 (21.7)	
Phlegmonous	7 (11.3)	6 (13)	2 (6.7)	1 (7.7)		2 (6.7)	6 (13)	
Gangrenous	7 (11.3)	7 (15.2)	4 (13.3)	0 (0)		4 (13.3)	7 (15.2)	
Perforated	6 (9.7)	5 (10.9)	2 (6.7)	1 (7.7)		2 (6.7)	5 (10.9)	
Plastron	3 (4.8)	1 (2.2)	0 (0)	0 (0)		0 (0)	1 (2.2)	

RIF: Right iliac fossa, WBC: White blood cell count, CRP: C-reactive protein, USG: Ultrasonography, CT: Computed tomography, AA: Acute appendicitis; <sup>a</sup> n (%), <sup>b</sup> median (interquartile range), <sup>c</sup> mean±sd, \*Pearson chi-square test, \*\*Kruskal wallis test, \*\*\*Mann whitney U test, \*\*\*\*Fisher's exact test, \*\*\*\*\*Likelihood ratio test, \*\*\*\*\*Independent sample t-test.

The number of patients in the other groups was 46 (30.5%) in the powdered surgical glove group, 30 (19.9%) in the powder-free surgical glove group, and 13 (8.6%) in the direct removal group. Postoperative complications were seen in 9 (6%) patients with no mortality, and 7 (4.6%) patients required readmission. The most common pathological diagnosis was uncomplicated appendicitis with 76.2%, and the most common subtype in this group was acute suppurative appendicitis.

According to the statistical analysis, an endo bag is preferred in the elderly, whereas direct removal is preferred in younger patients ( $p=0.045$ ). Only median c-reactive protein levels were statistically different among the evaluated laboratory parameters among the groups. A higher median c-reactive protein (CRP) level was observed in the endo bag group, while a lower median CRP level was observed in the powdered glove group ( $p=0.025$ ). There was no need for a catheter in the group from which the sample was directly removed, and the most frequent need for a drainage catheter was in the powdered glove group. Median values of hospital stay were longer powder-free and powdered glove groups ( $p<0.001$ ). In comparing the powder-free glove group and powdered glove group, there was only a difference in median hospital stays, and the median level was higher in the powdered glove group. However, these two groups' other evaluated parameters were similar. A comparison of all removal techniques and between powdered gloves and powder-free gloves groups are shown in Table I.

The crucial surgical step in appendectomies is the reliable removal of the specimen from the abdomen. During laparoscopic surgery, surgical gloves and an endo bag may remove the AV from outside the abdomen.<sup>2</sup> On the other hand, direct removal of the AV is an option for specimen removal where appropriate. However, no one method is superior to another. But, in past studies, the comparison of the techniques was limited. Based on this deficiency in the literature, four different methods used for appendectomy specimen removal were compared in this study. Therefore, this study is an original and first study on this subject.

Among the removal techniques, high costs and often-required wide incisions are the two most common disadvantages associated with retrieval bag use (endo bag).<sup>3</sup> However, endo bag access is not always possible. Surgical gloves can be powdered or powder-free due to their production. Surgical gloves are readily available materials in every operating room. Eliminating the use of glove powder can help eliminate several adverse health effects that may result from its use, such as postoperative adhesions, granulomas, wound contamination, and delayed wound healing. If the diameter of the appendix has enough diameter to pass through a trocar, the direct removal method can be preferred. In the present study, powder usage during spec-

imen removal did not increase wound-specific complications and early period outcomes.

Age is not a known parameter in selecting the removal material, but the authors chose to use endo bags in elderly patients and direct removal in younger patients. In addition, the use of powdered gloves in patients with lower CRP values and the use of endo bags in cases with higher CRP values were preferred.

The primary outcomes of appendectomy are morbidity, mortality, and hospital readmission.<sup>4,5</sup> The overall morbidity, mortality, and readmission rate of the present study were 6%, 0%, and 4.6%, respectively. The morbidity rate of surgical glove groups (powdered glove group was 8.7%, and the powder-free group was 6.7%) was higher than both groups, and overall morbidity was without statistical significance. On the other hand, the mortality rate of the present study was 0%, which is lower than the literature average. The group with the highest readmission rate was in the direct removal group with 15.4%. However, there was no significant difference in readmission rates between the groups.

The most important limitations of this study were that it was a retrospective study, and the number of patients was relatively small. Chronic adverse effects of powder are a well-known fact during open surgery, and studies with long-term outcomes are needed to determine its usability as a removal technique during laparoscopic appendectomy.

In conclusion, all four techniques are reliable since the morbidity, mortality, and readmission rates are similar. Direct removal is the best method because of the reduced need for catheters during surgery and the short hospital stay. However, powdered gloves technique is a preferred method in cases with less inflammation, though, it prolongs the need for drainage catheter use and length of hospital stay. Therefore, removal *via* powdered gloves is the least preferable technique among the four techniques.

#### **ETHICAL APPROVAL:**

This study was started after receiving the Non-invasive Clinical Research Ethics Committee of Erzurum Regional Education and Research Hospital, Erzurum, Turkey (Decision No. 2021/13-223).

#### **PATIENTS' CONSENT:**

Patients' consent was waived as the study was retrospective.

#### **COMPETING INTEREST:**

The authors declared no competing interest.

#### **AUTHORS' CONTRIBUTION:**

TK: Conception and study design, literature review, data collection, image analysis, statistical analysis, results, writing of the manuscript, and critical review.

ST: Study design, data collection, image analysis, critical review of the manuscript.

All the authors have approved the final version of the manuscript to be published.

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