

# Study to Evaluate the Role of Alvarado Score and Ultrasonography in Diagnosing Acute Appendicitis

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**Abstract:** ***Aim and objective:** To evaluate the role of Alvarado score and ultrasonography in early diagnosis of acute appendicitis. **Study design:** an observational study. **Place and duration of study:** OPD in RIMS, Raipur for 18months. **Methodology:** 90 patients of age group 18 - 60 years who were clinically suspected to be suffering from acute appendicitis were selected from OPD of general surgery of RIMS with the help of a predesigned proforma. Descriptive analysis was conducted to obtain percentages. Categorical variables are expressed in percentages and proportion and chi. sq. test used for association of variables. **Results:** Both Alvarado score and ultrasonography are helpful in early diagnosis of acute appendicitis. Ultrasonography is easily available in peripheral hospital and Alvarado score is both simple to remember and to use.*

**Keywords:** Acute appendicitis, Alvarado score, ultrasonography, early diagnosis, observational study

## 1. Introduction

Appendicitis remains one of the most common diseases faced by the surgeon in practice <sup>[1]</sup>. Although appendectomy is frequently the first “major” case performed by the surgeon, the impact of a timely diagnosis and prompt treatment is as impressive as that of any other major surgical intervention. It is estimated that as much as 6% to 7% of the general population will develop appendicitis during their lifetime, with the incidence peaking in the second decade of life <sup>[2]</sup>.

The first appendectomy was reported in 1735 by a French surgeon, Claudius Amyand, who identified and successfully removed the appendix of an 11 - year old boy.

The first formal description of the disease process, including common clinical features and recommendations for prompt surgical removal, was in 1886 by Reginald Heber Fitz of Harvard University <sup>[3]</sup>. The diagnosis of acute appendicitis is based on the medical history, physical examination, and laboratory analysis and imaging techniques. The ultrasound scan is easy to perform and inexpensive. With its help, however, the number of negative appendectomies can be decreased by 10% <sup>[4]</sup>.

### Etiology and Pathogenesis -

Obstruction of the lumen due to fecaliths or hypertrophy of lymphoid tissue is proposed as the main etiologic factor in acute appendicitis. The frequency of obstruction rises with the severity of the inflammation process. Fecaliths and calculi are found in 40% of cases of simple acute appendicitis <sup>[5]</sup> in 65% of cases of gangrenous appendicitis with rupture <sup>[6]</sup>.

### Clinical presentation -

#### Symptoms:

Appendicitis usually starts with per umbilical and diffuse pain that eventually localizes to the right lower quadrant (sensitivity, 81%; specificity, 53%) <sup>[7]</sup>. Appendicitis is also

associated with gastrointestinal symptoms like, nausea (sensitivity, 58%; specificity, 36%), vomiting (specificity, 51%; specificity, 45%), and anorexia (sensitivity, 68%; specificity, 36%). Gastrointestinal symptoms that develop before the onset of pain suggest a different etiology such as gastroenteritis <sup>[7]</sup>.

#### Signs:

Early in presentation, vital signs may be minimally altered. The body temperature and pulse rate may be normal or slightly elevated <sup>[8]</sup>.

On abdominal palpation, there is tenderness with a maximum at or near McBurney's point <sup>[9]</sup>.

On deep palpation, one can often feel a muscular resistance (guarding) in right iliac fossa, which may be more evident when compared to left side. Indirect tenderness (Rovsing's sign) and indirect rebound tenderness are strong indicators of peritoneal irritation <sup>[9]</sup>.

#### Alvarado Score -

The Alvarado score is the most widespread scoring system. It is especially useful for ruling out appendicitis and selecting patients for further diagnostic workup <sup>[10]</sup>.

The Alvarado score is a 10 - point clinical scoring system for acute appendicitis that has been extensively validated in all population <sup>[11][12]</sup>.

It encompasses the symptoms, signs and laboratory investigations which surgeons take into consideration in the assessment of a patient with suspected appendicitis <sup>[13]</sup>.

If Alvarado score will be <3 or 4 - 6, further investigation like ultrasonography and CECT abdomen will be done for confirmation of acute appendicitis. <sup>[14]</sup>.

ALVARADO SCORE	
Symptoms	Score
Mig RIF pain	1
Anorexia	1
Nausea/ Vomiting	1
Signs	
Tenderness/ RIF	2
Rebound Tenderness RIF	1
Elevated Temperature	1
Laboratory	
Leucocytosis	2
Shift to left of Neutrophils	1
<b>Total Score</b>	<b>10</b>

**Ultrasonography in acute appendicitis -**

Trans abdominal ultrasound is the basic diagnostic method in the case of suspected appendicitis and is the continuation of the clinical examination [15].

The cost - effective examination is immediately and readily available in the emergency situation. It does not require patient preparation, is non invasive and can be repeated at any time. If in some cases acute appendicitis is not ruled out using ultrasonography then CECT abdomen to be done for confirmation. To evaluate the role of Alvarado score and ultrasonography in diagnosing acute appendicitis so that negative appendectomy can be avoided we are conducting the study.

The **Rationale** of this study is that through this study we can early diagnose case of acute appendicitis as delayed diagnosis of acute appendicitis can lead to appendicular perforation leading to perforation peritonitis. Alvarado scoring system is easy, simple, cheap, useful tool in pre operative diagnosis of acute appendicitis and can work effectively in routine practice. Scores more than 7 definitely warrant a virtual confirmed diagnosis of acute appendicitis and early operation is indicated to avoid complications like perforation. Patients within the score range of 7 require admission and need re - evaluation for possible deterioration of clinical condition and earliest possible intervention. The application of Alvarado scoring system definitely improves diagnostic accuracy and possibly reduces the complication rates.

**2. Materials and Methods**

**Study Design:** This is a hospital based observational study. It is undertaken to study role of Alvarado score and ultrasonography in diagnosis of acute appendicitis.

**Study Area:** The study is conducted in the indoor patients of General surgery ward at Raipur Institute of Medical Sciences, Raipur, Chhattisgarh and its associated hospitals and health centres.

**Study Period:** 18 months

**Study Population:** The study is conducted in patients with diagnosis of acute appendicitis (based on Alvarado scoring and ultrasonography reports) from the In - patient ward of general surgery of Raipur Institute of Medical Sciences, Raipur, Chhattisgarh and its associated hospitals and health centres.

**Inclusion Criteria-**

- All Patients clinically suspected to be suffering from acute appendicitis (including both male and female) of age group between 18 - 60 years are selected from the inpatient ward of general surgery of RIMS, Raipur

**Exclusion Criteria-**

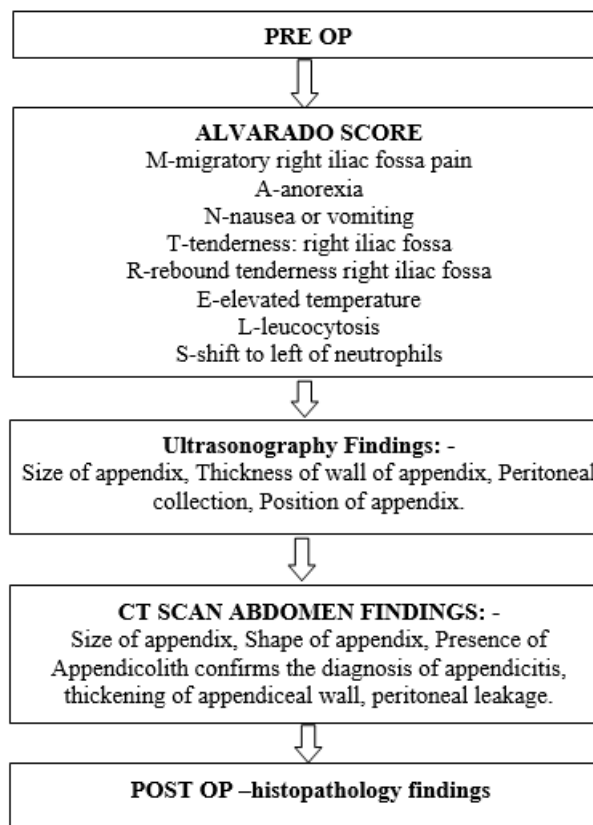
- Patients with other pre existing ileocecal pathology like tuberculosis or malignancy which are the underlying causes of appendicitis.
- All patients with palpable lump in right iliac fossa.
- Patient who are not willing for appendectomy.

**Sample Size:** A total of 90 patients with diagnosis of Acute Appendicitis who fulfilled the inclusion and exclusion criteria during the study period are included in the study. The sample size was calculated to be 90 patients with  $Z=1.96$  at 95% level of confidence, expected percentage of prevalence of correctly diagnosed cases of appendicitis is 95% [14] (p) for Alvarado score and accepted margin of error is 5% (d). [14]

Sample size was calculated using the formula,  $n = Z^2P (1 - P) / d^2 = 86.01$  (approx 90)  
 $Z$ =Value of  $Z$  is 95% of confidence interval  
 $P$ =Expected percentage of parameter of interest is 95%  
 $D$ =allowable error is 5%

**2.1 Methodology**

Patients who fulfill the inclusion criteria are recruited in this study after obtaining informed consent.

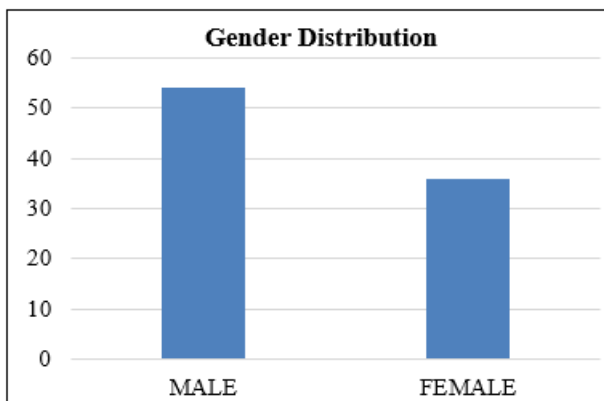


### 3. Observations and Results

This is a hospital based observational study, conducted in the indoor patients of General surgery ward at Raipur institute of medical sciences, Raipur, Chhattisgarh and its associated hospitals and health centres for 18 months. It is undertaken to study role of Alvarado score and ultrasonography in diagnosis of acute appendicitis. From this study these results are found 1. In this study there are 54 (60%) males and 36 (40%) females. Male to female ratio is 1.09. There is male predominancy in this study.

**Table 1: Gender distribution**

Sex	Number	Percentages
Male	54	60%
Female	36	40%
Total	90	100

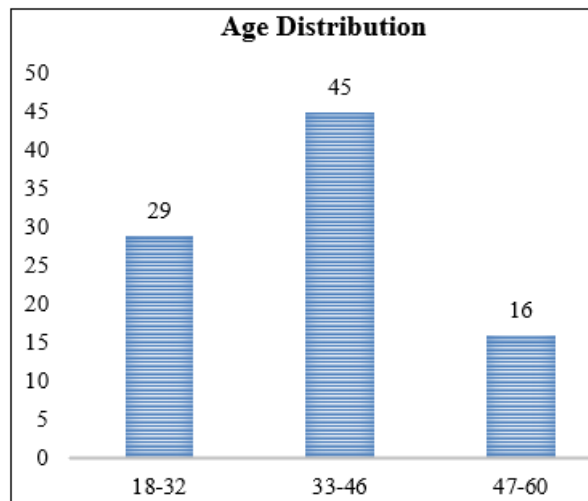


**Graph 1: Gender Distribution**

2. In our study we included age group between 18 - 60 years, in which 50% patients comes between 33 - 46 years age group, 32.22% patients in 18 - 32 years age group and 17.77% patients in 47 - 60 age group.

**Table 2: Age distribution**

Age	Number	Percentages
18 - 32	29	32.22%
33 - 46	45	50%
47 - 60	16	17.77%
Total	90	100%

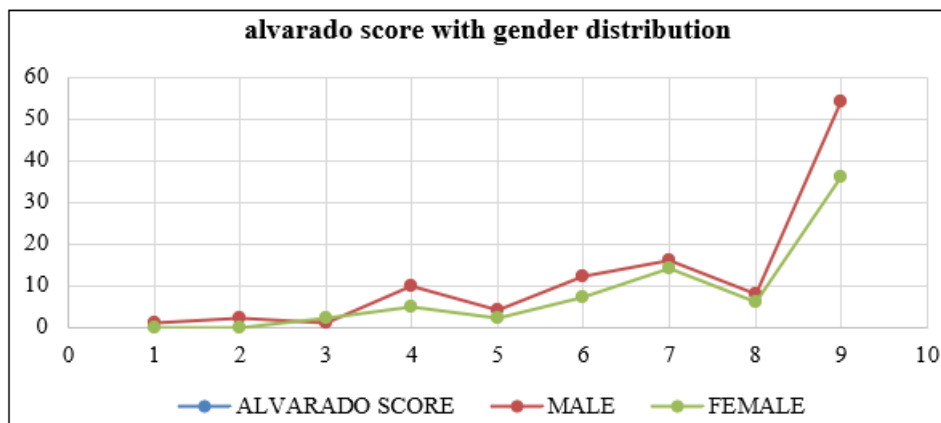


**Graph 2: Distribution of age group**

3. Most of the patients have Alvarado score in between 7 - 8. Both genders demonstrate a peak count at an Alvarado score of 8, males exhibit a more extensive range of scores. Male Alvarado score peaks at score 8 and female also peaked at score 8.

**Table 3: Distribution of Alvarado score by gender**

Alvarado Score	Male	Female
2	1	0
3	2	0
4	1	2
5	10	5
6	4	2
7	12	7
8	16	14
9	8	6
Total	54	36



**Graph 3: Alvarado score with gender**

The line graph illustrates the distribution of Alvarado scores by gender, showcasing the count of scores for each score value. Notably, the plot reveals a broader distribution of Alvarado scores among males compared to females, as evidenced by the wider spread of data points. While both

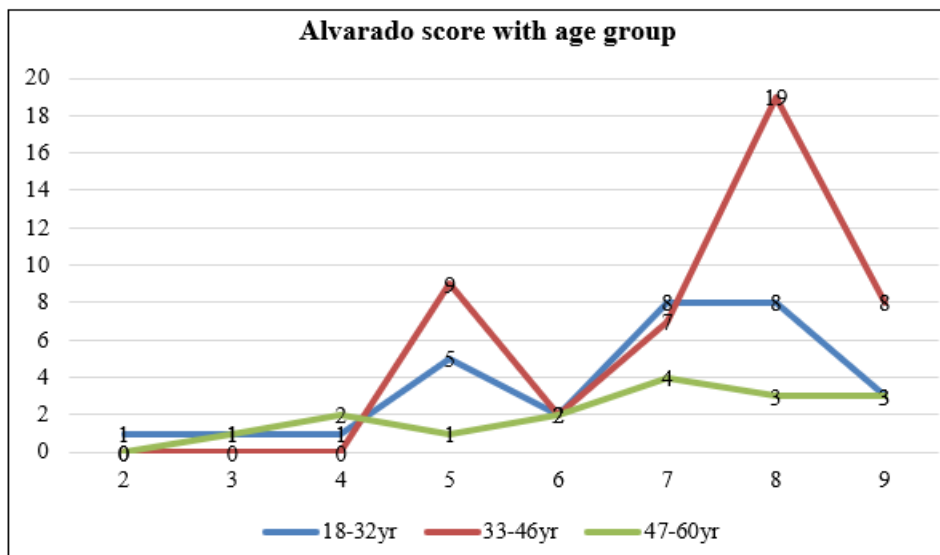
genders demonstrate a peak count at an Alvarado score of 8, males exhibit a more extensive range of scores, with higher counts observed across the spectrum.

4. Most of the patient have Alvarado score in between 7 - 8. Maximum cases of acute appendicitis come under 33 - 46

years (50%) of age group. In 18 - 32 years, 29 cases (32.22%) present, in 47 - 60 years 16 cases (17.77%) present.

**Table 4:** Alvarado score with age group

Alvarado score	18 - 32yr	33 - 46yr	47 - 60yr	Total
2	1	0	0	1
3	1	0	1	2
4	1	0	2	3
5	5	9	1	15
6	2	2	2	6
7	8	7	4	19
8	8	19	3	30
9	3	8	3	14
Total	29	45	16	90



**Graph 4:** Age distribution with Alvarado score

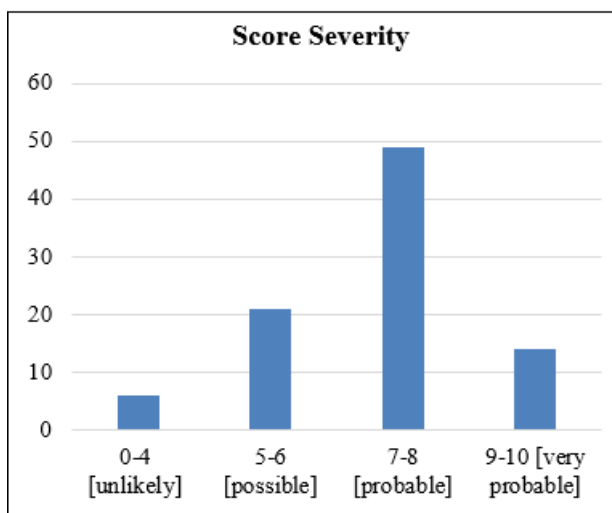
5. Alvarado score 7 - 8 score have maximum (54.44%) patients followed by 5 - 6 score have (23.33%) patients. (15.5%) patient found between score 9 - 10 and (6.66%) found at score 0 - 4.

6. In my study 85 (94.44%) patients ultrasonography finding suggestive of acute appendicitis, while 5 (5.66%) patients ultrasonography findings not suggestive of appendicitis.

**Table 5:** Distribution with score severity

Alvarado score	Number	Percentages
0 - 4 [unlikely]	6	6.66%
5 - 6 [possible]	21	23.33%
7 - 8 [probable]	49	54.44%
9 - 10 [very probable]	14	15.55%
Total	90	100%

Sensitivity of the ultrasonography in the study was 96.39% and specificity came out to be 28.57%. The positive and negative predictive values were 94.10% and 40.06% respectively. Accuracy was 91.10% in the studied population. The negative appendectomy rate was 2.44% with respect to the histopathology findings.



**Graph 5:** Graph with score severity

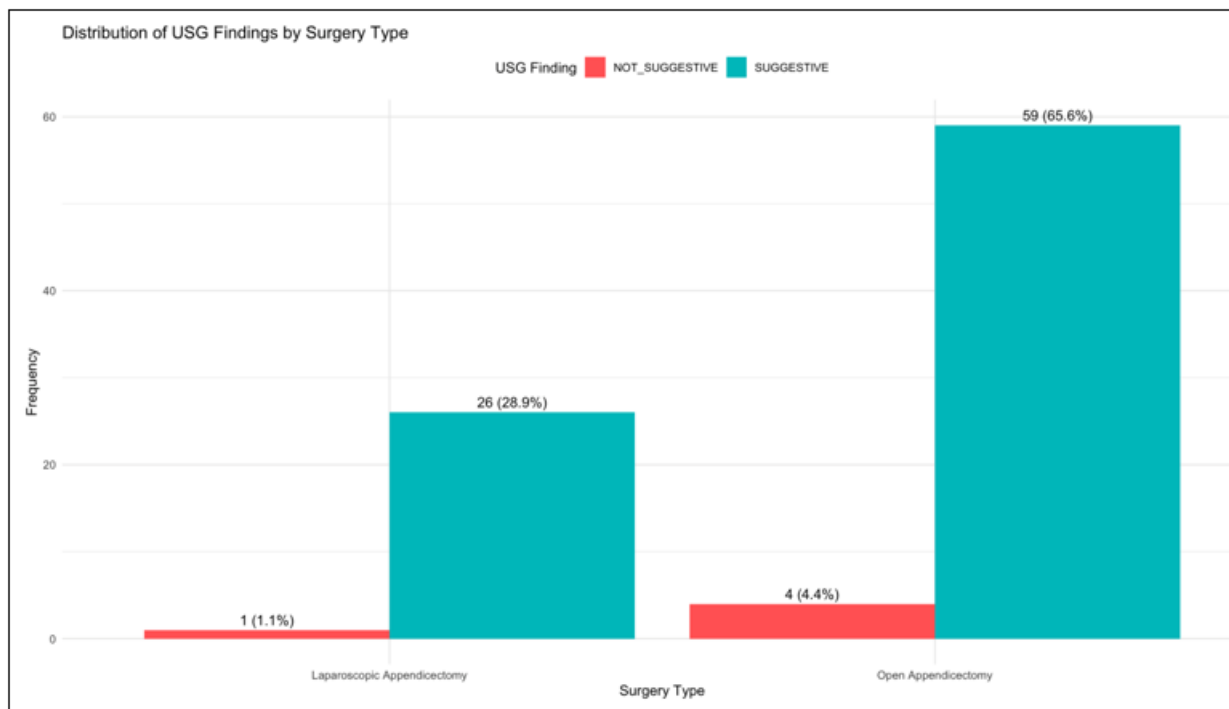
**Table 6:** Ultrasonography findings

Statistic	Value
Sensitivity	96.39%
Specificity	28.57%
PPV	94.10%
NPV	40.06%
Disease prevalence	92.20%
Accuracy	91.10%

7. Among all patients, 5 patients (5.6%) had USG findings not suggestive of appendicitis. Within the open appendicectomy group, (6.3%) was in this category, while in the laparoscopic appendicectomy group, it was (3.7%). The majority of patients (94.4%) had USG findings suggestive of appendicitis. This trend was consistent across both surgical groups, with (94%) in the open appendicectomy group and (96%) in the laparoscopic appendicectomy group.

**Table 7:** Ultrasonography finding in appendicectomy

Characteristic	Overall, N = 90	Open Appendicectomy, N = 63	Laparoscopic Appendicectomy, N = 27	p - value
<b>USG finding</b>				>0.99
<i>Not Suggestive</i>	5 (5.6%)	4 (6.3%)	1 (3.7%)	
<i>Suggestive</i>	85 (94.4%)	59 (94%)	26 (96%)	



**Graph 6:** Ultrasonography finding in appendicectomy

While there is a slight difference in the percentage of patients with USG findings not suggestive of appendicitis between the two surgical groups, this difference is not clinically significant.

8. In this study most of acute appendicitis cases comes between 7 - 8 Alvarado score. Maximum cases of acute appendicitis are coming under score of 8 (33%) followed by score 7 (21%) cases.

**Table 8:** Alvarado score with acute appendicitis cases

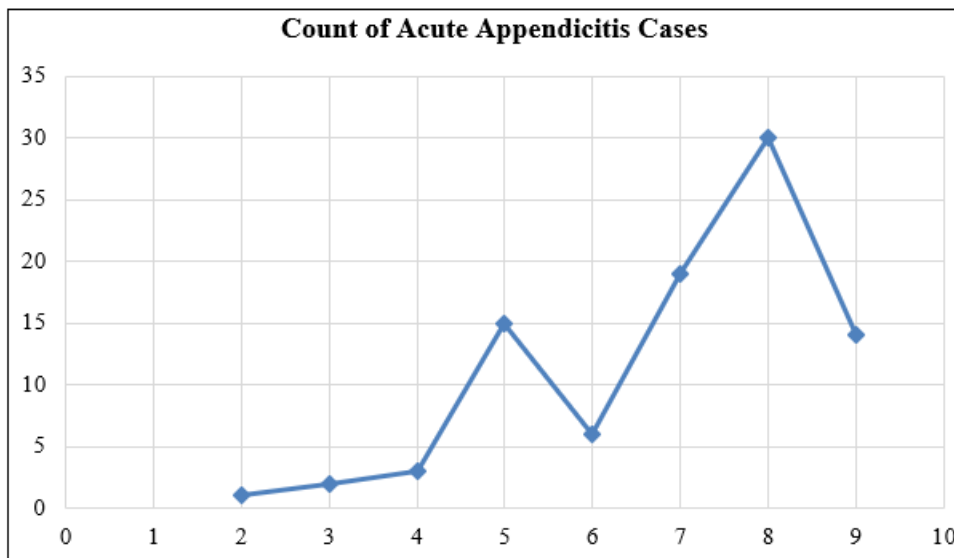
Alvarado Score	Count of Acute Appendicitis Cases	Percentages
2	1	1.1%
3	2	2.2%
4	3	3.3%
5	15	17%
6	6	6.7%
7	19	21%
8	30	33%
9	14	16%
Total	90	100%

In my study 84 (93.33%) patient's Alvarado score suggestive of acute appendicitis, while 6 (6.66%) patients score not suggestive of appendicitis.

Sensitivity of the Alvarado score in the study was (96.39%) and specificity came out to be (28.57%). The positive and negative predictive values were (94.10%) and (40.06%) respectively. Accuracy was (91.10%) in the studied population. The negative appendectomy rate was 2.44% with respect to the histopathology findings.

**Table 9:** Alvarado score

Statistic	Value
Sensitivity	93.98%
Specificity	14.29%
PPV	92.84%
NPV	16.71%
Disease prevalence	92.20%
Accuracy	87.76%

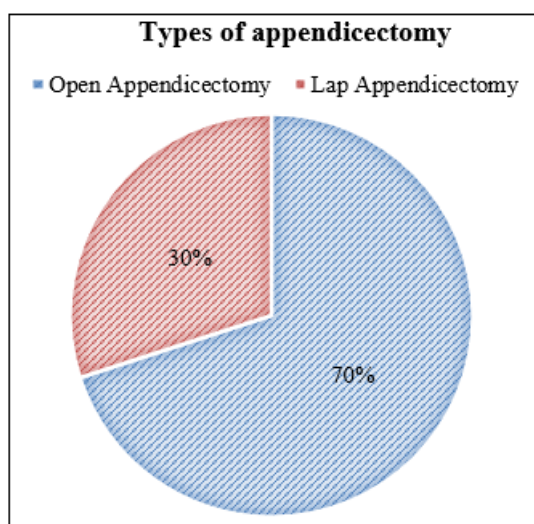


Graph 7

9. Table showing the distribution of different types of appendicectomy procedures. Graph represents different types of appendicectomy: Open Appendicectomy and Lap Appendicectomy. Most common procedure is open appendicectomy 70% and lap appendicectomy in (30%).

Table 10: Types of appendicectomy

Treatment	Present	Percentages
Open Appendicectomy	63	70%
Lap Appendicectomy	27	30%
Total	90	100%



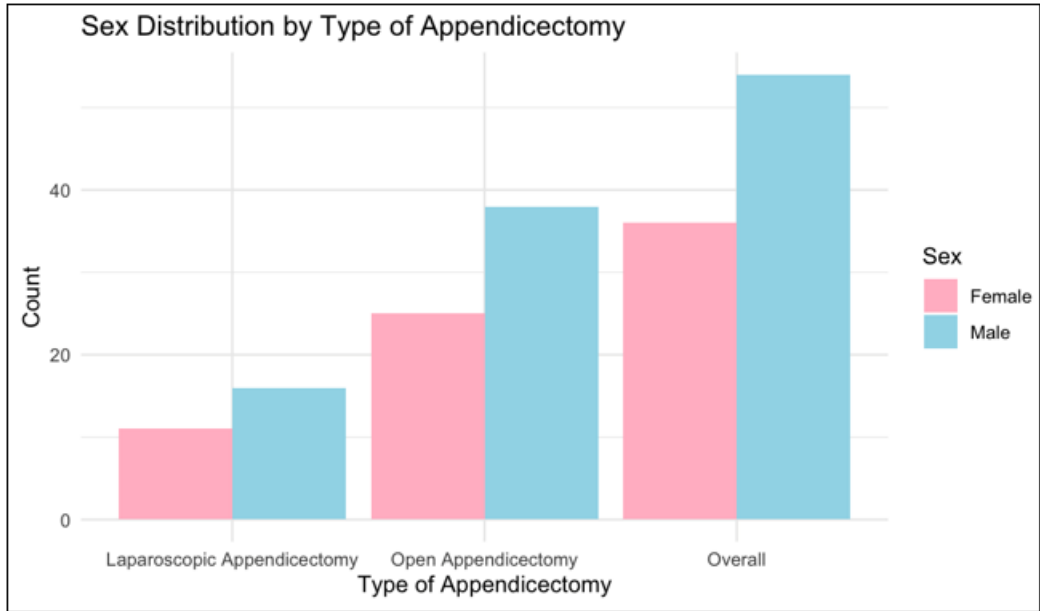
Graph 8: Types of appendicectomy

10. The proportion of female patients is (39%), and the proportion of male patients is (61%). Open Appendicectomy: The proportion of female patients is slightly lower at (38%), and the proportion of male patients is slightly higher at (62%). Laparoscopic Appendicectomy: The proportion of female patients is slightly higher at (41%), and the proportion of male patients is slightly lower at (59%).

Table 11: Gender wise appendicectomy distribution

Characteristic	Overall, N = 90	Open Appendicectomy, N = 63	Laparoscopic Appendicectomy, N = 27	p - value
SEX				0.93
Female	36 (40%)	25 (40%)	11 (41%)	
Male	54 (60%)	38 (60%)	16 (59%)	





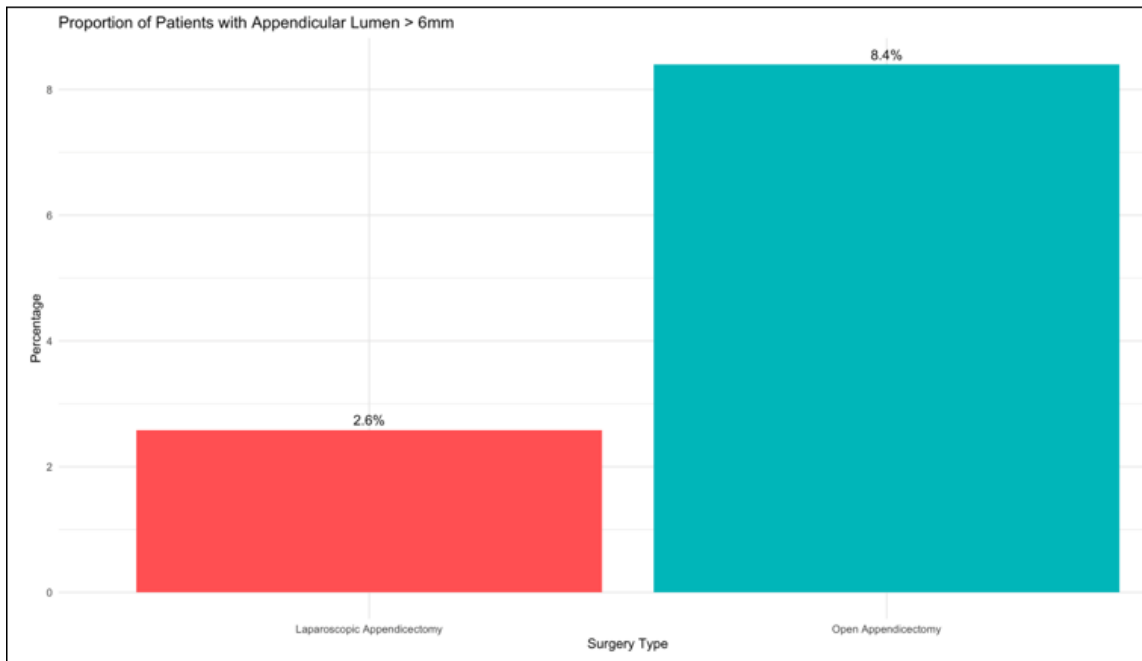
Graph 9: Gender wise appendicectomy distribution

p - value: The p - value for the comparison of sex distribution across the two surgical procedures is 0.81. This value is significantly higher than the conventional threshold of 0.05, indicating that there is no statistically significant difference in the sex distribution between patients undergoing Open Appendicectomy and those undergoing Laparoscopic Appendicectomy.

11. The distribution of surgical interventions among participants with a lumen size greater than 6mm, the majority of these surgeries were Open Appendicectomies, constituting (84%) of the cases and lap appendicectomy in (27%) cases. while lumen size less than 6mm, surgeries were Open Appendicectomies, constituting (16%) of the cases and lap appendicectomy in (73%) cases.

Table 12: Distribution of surgery with lumen size

Characteristic	Overall, N = 90	Open Appendicectomy, N = 63	Laparoscopic Appendicectomy, N = 27	p - value
Appendicular lumen > 6 mm	60 (67%)	53 (84%)	7 (26%)	<0.001



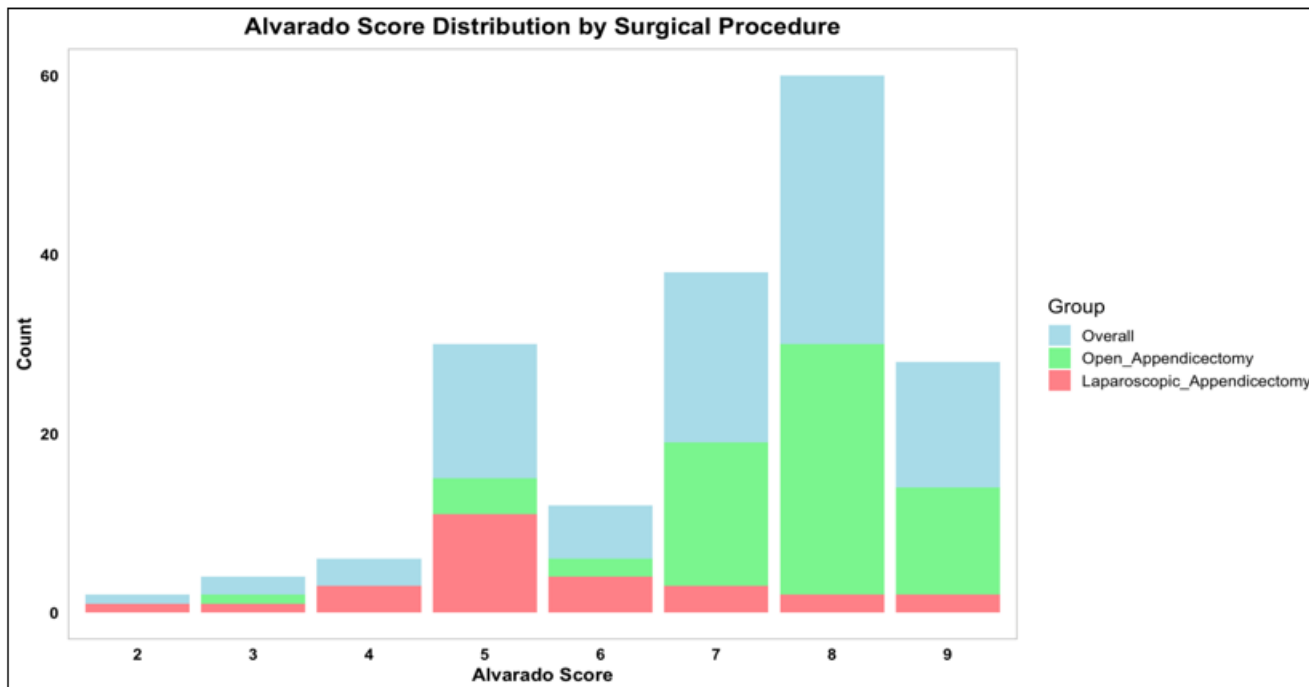
Graph 10: Distribution of surgery with lumen size

The p - value being less than 0.001 indicates a statistically significant difference in the distribution of appendicular lumen sizes between acute appendicitis cases.

12. The number of surgeries of different types (Open Appendectomy and Lap Appendectomy) varies across different Alvarado scores. Most open appendicectomy done in score 7 - 8 score while lap appendicectomy maximum done in 5 score.

**Table 13:** Surgeries with Alvarado score

Characteristic	Overall, N = 90	Open Appendicectomy, N = 63	Laparoscopic Appendicectomy, N = 27	p - value
<b>Alvarado score</b>				<b>&lt;0.001</b>
2	1 (1.1%)	0 (0%)	1 (3.7%)	
3	2 (2.2%)	1 (1.6%)	1 (3.7%)	
4	3 (3.3%)	0 (0%)	3 (11%)	
5	15 (17%)	4 (6.3%)	11 (41%)	
6	6 (6.7%)	2 (3.2%)	4 (15%)	
7	19 (21%)	16 (25%)	3 (11%)	
8	30 (33%)	28 (44%)	2 (7.4%)	
9	14 (16%)	12 (19%)	2 (7.4%)	



**Graph 11:** Surgeries with Alvarado score

The Alvarado score ranges from 2 to 9 in this dataset. The p - value, which is <0.001, suggests that there is a statistically significant difference between the distribution of Alvarado scores among patients who underwent open appendicectomy and those who underwent laparoscopic appendicectomy.

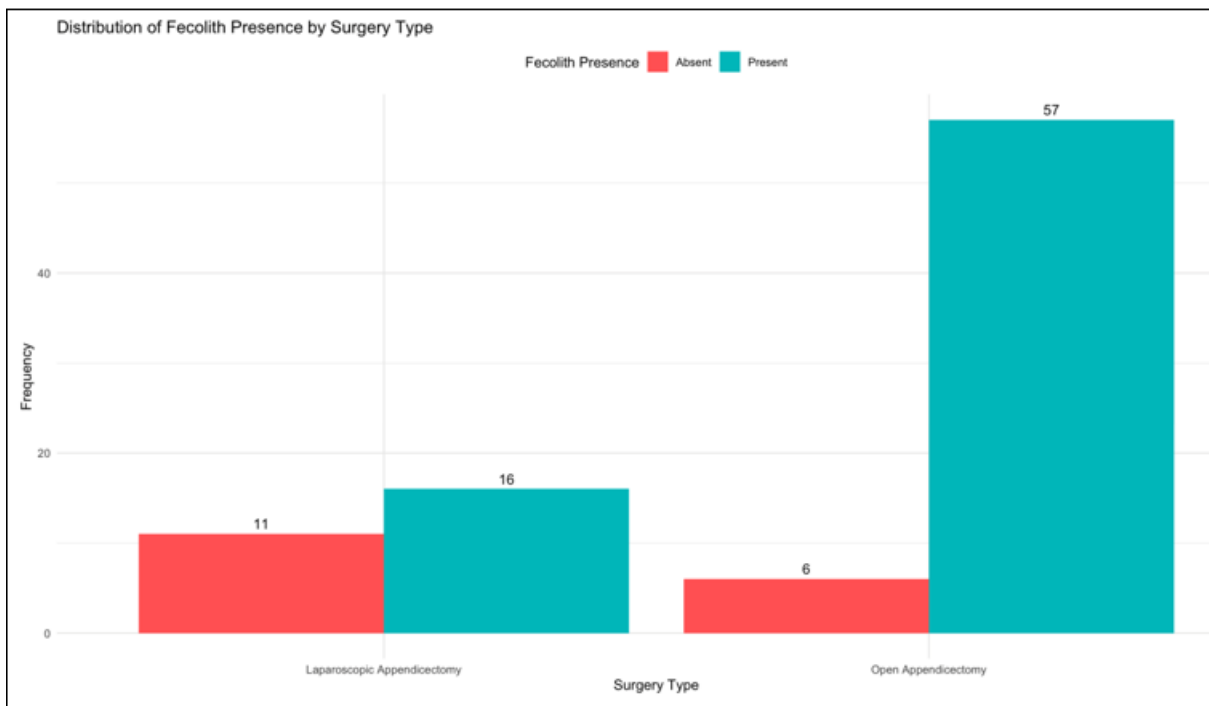
13. The distribution of fecolith presence among different types of appendicectomy treatments. It indicates that in most

cases, fecoliths are present regardless of the type of appendicectomy treatment administered. A higher percentage of patients who underwent open appendicectomy (90%) had fecolith present compared to those who underwent laparoscopic appendicectomy (59%). Conversely, the absence of fecolith was more common among patients who underwent laparoscopic appendicectomy (41%) compared to those who underwent open appendicectomy (9.5%).

**Table 14:** Presence of Fecolith

Characteristic	Overall, N = 90	Open Appendicectomy, N = 63	Laparoscopic Appendicectomy, N = 27	p - value
<b>Fecolith</b>				<b>&lt;0.001</b>
<i>ABSENT</i>	17 (19%)	6 (9.5%)	11 (41%)	
<i>PRESENT</i>	73 (81%)	57 (90%)	16 (59%)	





Graph 12: Fecolith in various surgeries

The p - value being less than 0.001 indicates a statistically significant difference in fecolith presence between patients who underwent open appendectomy and those who underwent laparoscopic appendectomy.

14. In our study appendix is found inflamed in 83 (92.22%) cases and 7 (7.88%) cases found normal histopathology report. Sensitivity of the Alvarado scoring system with ultrasonography in the study was 89.29% and specificity came out to be 16.63%. The positive and negative predictive values were 92.64% and 11.63% respectively. Accuracy of the Alvarado scoring system with ultrasonography was 83.63% in the studied population. There are 5 patients having normal histopathology findings.

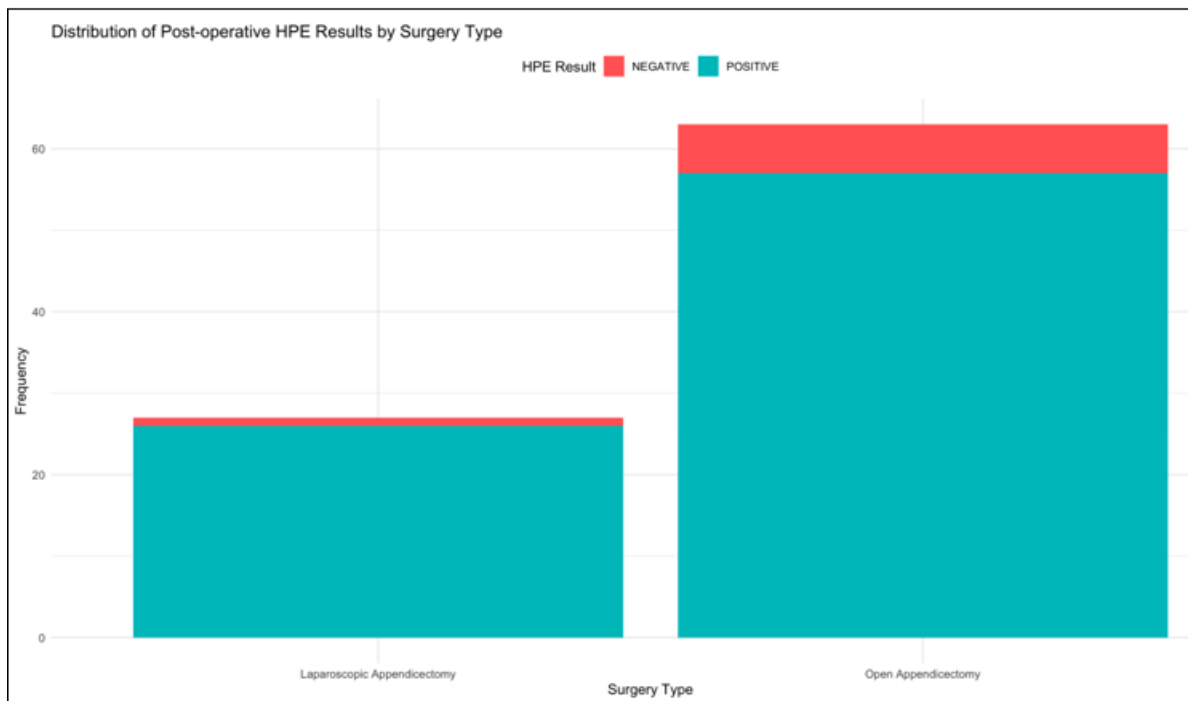
Table 15: Alvarado score with ultrasonography

Statistic	Value
Sensitivity	89.29%
Specificity	16.63%
PPV	92.64%
NPV	11.63%
Disease prevalence	92.20%
Accuracy	83.63%

16. The majority of patients who underwent either open or laparoscopic appendectomy had positive post - operative HPE findings, indicating the presence of histopathological changes consistent with appendicitis.

Table 16: Histopathology report in various surgery

Post - operative HPE				0.67
Negative	7 (7.8%)	6 (9.5%)	1 (3.7%)	
Positive	83 (92%)	57 (90%)	26 (96%)	



**Graph 13:** Histopathology report in surgeries

The p - value being 0.67 indicates that there is no significant difference in the distribution of post - operative HPE findings between patients who underwent open appendectomy and those who underwent laparoscopic appendectomy. This suggests that both surgical approaches are equally effective in achieving similar histopathological outcomes.

#### 4. Discussion

This is a hospital based observational study, conducted in the indoor patients of General surgery ward at Raipur institute of medical sciences, Raipur, Chhattisgarh and its associated hospitals and health centres for 18 months. It is undertaken to study role of Alvarado score and ultrasonography in diagnosis of acute appendicitis.

In this study there are 54 (60%) males and 36 (40%) females. Male to female ratio is 1.09 found. There is male predominancy in this study. While in Mounir Bouali, Yassine, azizmoufakkir conducted a prospective study of 208 patients presenting with symptoms and signs of acute appendicitis, which included 142 males and 66 females. [16]

In our study we included age group between 18 - 60 years, in which 50% patients comes between 33 - 46 years age group, 32.22% patients in 18 - 32 years age group and 17.77% patients in 47 - 60 age group.

Most of the patients have Alvarado score in between 7 - 8. both genders demonstrate a peak count at an Alvarado score of 8, males exhibit a more extensive range of scores. Male Alvarado score peaks at score 8 and female also peaked at score 8.

Most of the patient have Alvarado score in between 7 - 8. Maximum cases of acute appendicitis come under 33 - 46

years (50%) of age group. In 18 - 32 years, 29 cases [32.22%] present, 47 - 60 years 16 cases (17.77%) present.

Alvarado score 7 - 8 score have maximum 54.44% patients have followed by 5 - 6 score 23.33% patients found. 15.5% patient found between score 9 - 10 and 6.66% found at score 0 - 4. Kanumba et al., This study, conducted at Bugando Medical Centre over a six - month period from November 2008 to April 2009, aimed to assess the diagnostic accuracy of the Modified Alvarado Scoring System (MASS) in patients suspected of having acute appendicitis. A total of 127 patients, with ages ranging from eight to 76 years.

In my study 85 [94.44%] patient's ultrasonography finding suggestive of acute appendicitis, while 5 [5.66%] patients ultrasonography findings not suggestive of appendicitis.

Sensitivity of the Alvarado score in the study was 96.39% and specificity came out to be 28.57%. The positive and negative predictive values were 94.10% and 40.06% respectively. Accuracy of was 91.10% in the studied population. The negative appendectomy rate was 2.44% with respect to the histopathology findings.

Alvarado score 7 - 8 score have maximum 54.44% patients followed by 5 - 6, score 23.33% patients found 15.5% patient found between score 9 - 10 and 6.66% found at score 0 - 4. Mounir Bouali, Yassine, azizmou fakkir conducted a prospective study of 208 patients presenting with symptoms and signs of acute appendicitis, which included 142 males and 66 females at score of 7 or more, appendicitis was confirmed in 187/190 patients, while at score < 7 appendicitis was confirmed in 10/18 patients. They concluded that Alvarado score is a simple, easy scoring system at both end of scale [16].

Kundiona et al., study conducted at Parirenyatwa Group of Hospitals and Harare Central Hospital in Zimbabwe between

June 2012 and May 2013, the researchers aimed to determine the negative appendectomy rate and assess the accuracy of the Alvarado score and ultrasound scan in diagnosing acute appendicitis. With a total of 206 patients undergoing appendectomy, the overall negative appendectomy rate was found to be 16.5%, higher than contemporary standards. The Alvarado score exhibited high sensitivity (95.3%) and positive predictive value (90.3%), while ultrasound scan showed a sensitivity of 89.5% and a positive predictive value of 77.2%.

Jalil et al., This analytical study conducted at the Department of Surgery, Pakistan Institute of Medical Sciences (PIMS), Islamabad, aimed to assess the diagnostic accuracy of the Alvarado score in predicting acute appendicitis. Patients underwent emergency appendectomy with histological examination of resected specimens, and their Alvarado scores were compared with histopathology. The results indicated an overall sensitivity of 66%, specificity of 81%, positive predictive value of 96%, and negative predictive value of 29% for the Alvarado score in diagnosing acute appendicitis.

The study suggested that a high Alvarado score in adult males strongly predicted acute appendicitis, but in women of childbearing age, the score exhibited lower diagnostic accuracy due to other causes with similar clinical presentations. [17]

Alvarado score 7 - 8 score have maximum (54.44%) patients followed by 5 - 6, score (23.33%) patients found (15.5%) patient found between score 9 - 10 and (6.66%) found at score 0 - 4.

Most of the patient have Alvarado score in between 7 - 8. Maximum cases of acute appendicitis come under 33 - 46 years (50%) of age group. In 18 - 32 years, 29 cases (32.22% present, 47 - 60 years 16 cases (17.77% present). Study done by Subhajeet Dey, Pradip k. mohanta, anil k Baruah, Bikram kharga, varun k singh conducted a retrospective study of consecutive patients admitted with suspected acute appendicitis. Out of 155 patients, 92 underwent appendectomy with the intention to treat appendicitis and diagnosis was confirmed in 80 patients. They concluded that Alvarado scoring system is easy, simple, cheap, useful tool in pre operative diagnosis of acute appendicitis and can work effectively in routine practice (18).

Another study done by U K Shrivastava, Aman Gupta, Dinesh Sharma conducted a study on 100 patients operated with a presumptive diagnosis of acute appendicitis on the basis of clinical grounds. Alvarado scoring was done in all patients. The positive and negative predictive values of the Alvarado score were (77.6%) and (52.4%) respectively. The sensitivity of Alvarado score increased from (69.2%) to (92%). They concluded that Alvarado scoring system can be used to diagnose acute appendicitis [19].

In my study 85 (94.44%) patient's ultrasonography finding suggestive of acute appendicitis, while 5 (5.66%) patients ultrasonography findings not suggestive of appendicitis. Sensitivity of the ultrasonography in the study was (96.39%)

and specificity came out to be (28.57%). The positive and negative predictive values were (94.10%) and (40.06%) respectively. Accuracy of was (91.10%) in the studied population. The negative appendectomy rate was (2.44%) with respect to the histopathology findings. Among all patients, 5 patients (5.6%) had USG findings not suggestive of appendicitis. Within the open appendectomy group, (6.3%) fell into this category, while in the laparoscopic appendectomy group, it was (3.7%). The majority of patients (94.4%) had USG findings suggestive of appendicitis. This trend was consistent across both surgical groups, with (94%) in the open appendectomy group and (96%) in the laparoscopic appendectomy group.

Canbak et al., This study aimed to assess the correlation between Alvarado scoring and ultrasonographic findings in diagnosing acute appendicitis and its impact on reducing the rate of negative appendectomy. A retrospective analysis of 2772 patients (operated between January 2010 and September 2016) with suspected acute appendicitis was conducted. The rate of negative appendectomy was found to be 5.3%. Ultrasonography (USG) results correlated with histopathologic findings, with a high possibility of correct diagnosis in patients with an Alvarado score  $\geq 7$ . However, the study suggests that a low Alvarado score should not rule out the diagnosis. Combining Alvarado scoring and ultrasonography can potentially reduce the rate of negative appendectomy and enhance specificity in diagnosing acute appendicitis. [20]

Ultrasound findings were highly sensitive and specific for appendicitis and it significantly improved when combined with Alvarado score. Study done by Swathi B Reddy, Michael Kelleher, S A Jamal Bokhari, Kimberly A Davis, Kevin M Schuster conducted a retrospective review of all patients who presented with suspected appendicitis and underwent ultrasonography. 300 patients who underwent ultrasonography as initial imaging were identified. They concluded that ultrasound findings was highly sensitive and specific for appendicitis and it significantly improved when combined with Alvarado score [21].

In our study appendix is found inflamed in 83 (92.22%) cases and 7 (7.88%) cases found normal histopathology report. Sensitivity of the Alvarado scoring system with ultrasonography in the study was 89.29% and specificity came out to be 16.63%. The positive and negative predictive values were 92.64% and 11.63% respectively. Accuracy of the Alvarado scoring system with ultrasonography was 83.63% in the studied population. There are 5 patients have normal histopathology findings.

Another study done by Shaneel Bappayya, Fionachen, megan alderuccio conducted a case control study of 1194 patients. Histopathological identification of acute appendicitis was interpreted as the gold standard. They concluded that Alvarado score in combination with ultrasonography is useful to diagnose acute appendicitis [22]

Most common procedure is open appendectomy 70% and lap appendectomy in 30%. The proportion of female patients is 39%, and the proportion of male patients is 61%.

In Open Appendectomy the proportion of female patients is slightly lower at 38%, and the proportion of male patients is slightly higher at 62%. And in Laparoscopic Appendectomy the proportion of female patients is slightly higher at 41%, and the proportion of male patients is slightly lower at 59%.

The p - value for the comparison of sex distribution across the two surgical procedures is 0.81. This value is significantly higher than the conventional threshold of 0.05, indicating that there is no statistically significant difference in the sex distribution between patients undergoing Open Appendectomy and those undergoing Laparoscopic Appendectomy.

Subhajeet Dey, Pradip k. mohanta, anil k Baruah, Bikram kharga, varun k singh conducted a retrospective study of consecutive patients admitted with suspected acute appendicitis. Out of 155 patients, 92 underwent appendectomy with the intention to treat appendicitis and diagnosis was confirmed in 80 patients.

The distribution of surgical interventions among participants with a lumen size greater than 6mm, the majority of these surgeries were Open Appendectomies, constituting 84% of the cases and lap appendectomy in 27% cases. while lumen size less than 6mm, surgeries were Open Appendectomies, constituting 16% of the cases and lap appendectomy in 73% cases.

The p - value being less than 0.001 indicates a statistically significant difference in the distribution of appendicular lumen sizes between acute appendicitis cases. This suggests that the choice of surgical approach significantly impacts the likelihood of encountering an appendicular lumen size greater than 6 mm.

The number of surgeries of different types (Open Appendectomy and Lap Appendectomy) varies across different Alvarado scores. Most open appendectomy done in score 7 - 8 score while lap appendectomy maximum done in 5 score.

Fente et al., This prospective study aimed to evaluate the effectiveness of the Bengezi and Al - Fallouji modified Alvarado score in the presumptive diagnosis of acute appendicitis (AA) at the University of Port Harcourt Teaching Hospital, particularly in the absence of advanced radiological investigations common in developing countries. A retrospective analysis of the negative appendectomy rate (NAR) between June 2000 and May 2002 was conducted, and a scoring system was applied to 128 consecutive patients presenting with a presumptive diagnosis of AA between June 2003 and May 2004. Patients with low scores were observed and discharged without surgery, while those with higher scores underwent appendectomies. The study found a high sensitivity and specificity of 92.93% for the scoring system, significantly reducing the NAR to 9.09%, compared to 26.4% in the retrospective study and 19.05% in the control group operated without scoring [23]

The distribution of fecolith presence among different types of appendectomy treatments. It indicates that in most cases,

fecoliths are present regardless of the type of appendectomy treatment administered. A higher percentage of patients who underwent open appendectomy (90%) had fecolith present compared to those who underwent laparoscopic appendectomy (59%). Conversely, the absence of fecolith was more common among patients who underwent laparoscopic appendectomy (41%) compared to those who underwent open appendectomy (9.5%). The p - value being less than 0.001 indicates a statistically significant difference in fecolith presence between patients who underwent open appendectomy and those who underwent laparoscopic appendectomy.

In our study appendix is found inflamed in 83 (92.22%) cases and 7 (7.88%) cases found normal histopathology report. Sensitivity of the Alvarado scoring system with ultrasonography in the study was 89.29% and specificity came out to be 16.63%. The positive and negative predictive values were 92.64% and 11.63% respectively. Accuracy of the Alvarado scoring system with ultrasonography was 83.63% in the studied population. There are 5 patients have normal histopathology findings.

Kanumba et al., This study, conducted at Bugando Medical Centre over a six - month period from November 2008 to April 2009, in patients suspected of having acute appendicitis. The study found a perforation rate of 9.4%, and histopathological examination confirmed appendicitis in 66.9% of cases, with a notable negative appendectomy rate of 33.1%. [24]

## 5. Conclusion

Alvarado scoring system is ideal for the diagnosis of acute appendicitis because it is non invasive, requires no special equipment and can be easily used by a junior resident in clinical routine in a peripheral hospital. Ultrasonography is more sensitive investigation. Hence Alvarado score along with ultrasonography proves to be evident in diagnosis of acute appendicitis and thereby reducing the rate of negative appendectomy.

In this study there are 54 (60%) males and 36 (40%) females. Male to female ratio is 1.09. There is male predominancy in this study. Age group between 18 - 60 years, in which (50%) patients comes between 33 - 46 years age group, (32.22%) patients in 18 - 32 years age group and (17.77%) patients in 47 - 60 age group. Most of the patients have Alvarado score is between 7 - 8 Male Alvarado score peaks at score 8 and female also peaked at score 8. Alvarado score 7 - 8 score have maximum (54.44%) patients have followed by 5 - 6 score (23.33%) patients found. (15.5%) patient found between score 9 - 10 and (6.66%) found at score 0 - 4.

In this study 85 (94.44%) patient's ultrasonography finding suggestive of acute appendicitis, while 5 (5.66%) patients not suggestive. Sensitivity was 96.39% and specificity came out to be (28.57%). The positive and negative predictive values were (94.10%) and (40.06%) respectively. Accuracy of was 91.10% in the studied population. The majority of patients (94.4%) had USG findings suggestive of appendicitis. This trend was consistent across both surgical



groups, with (94%) in the open appendectomy group and (96%) in the laparoscopic appendectomy group.

In my study 84 (93.33%) patient's Alvarado score suggestive of acute appendicitis, while 6 (6.66%) patients score not suggestive of appendicitis. Sensitivity of the Alvarado score in the study was (96.39%) and specificity came out to be (28.57%). The positive and negative predictive values were (94.10%) and (40.06%) respectively. Accuracy of was (91.10%) in the studied population. The negative appendectomy rate was (2.44%) with respect to the histopathology findings. Most common procedure is open appendectomy (70%) and lap appendectomy in (30%). The proportion of female patients is (39%), and the proportion of male patients is (61%).

Lumen size greater than 6mm, Open Appendectomies constituting (84%) of the cases and lap appendectomy in (27%) cases. while lumen size less than 6mm, surgeries were Open Appendectomies, constituting (16%) of the cases and lap appendectomy in (73%) cases. Most open appendectomy done in score 7 - 8 score while lap appendectomy maximum done in 5 score.

A higher percentage of patients who underwent open appendectomy (90%) had fecolith present compared to those who underwent laparoscopic appendectomy (59%). Appendix is found inflamed in 83 [92.22%] cases and 7 [7.88%] cases found normal histopathology report.

Sensitivity of the Alvarado scoring system with ultrasonography in the study was 89.29% and specificity came out to be 16.63%. The positive and negative predictive values were 92.64% and 11.63% respectively. Accuracy of the Alvarado scoring system with ultrasonography was 83.63% in the studied population. There are 5 patients have normal histopathology findings.

The majority of patients who underwent either open or laparoscopic appendectomy had positive post-operative HPE findings, indicating the presence of histopathological changes consistent with appendicitis. The p-value being 0.67 indicates that there is no significant difference in the distribution of post-operative HPE findings between patients who underwent open appendectomy and those who underwent laparoscopic appendectomy. This suggests that both surgical approaches are equally effective in achieving similar histopathological outcomes.

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