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Research Article

A COMPARATIVE STUDY BETWEEN TZANAKIS SCORING SYSTEM AND ALVARADO SCORING SYSTEM IN DIAGNOSIS OF ACUTE APPENDICITIS

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ABSTRACT

Background: Acute appendicitis is one of the most common surgical emergency, and its accurate diagnosis is crucial to prevent complications and reduce negative appendectomy rates. Clinical scoring systems, such as the Alvarado and Tzanakis scores, aid in diagnosis, but their comparative accuracy remains under evaluation.
Aim: To compare the diagnostic accuracy of the Tzanakis scoring system with the Alvarado scoring system in suspected acute appendicitis cases, using histopathology as the gold standard.
Methods: This prospective, hospital-based study was conducted at a tertiary care center over one year and included 153 patients aged 11–60 years presenting with clinically suspected acute appendicitis. Both Tzanakis and Alvarado scores were calculated preoperatively. All patients underwent appendectomy, and histopathological examination confirmed the diagnosis. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), diagnostic accuracy, and receiver operating characteristic (ROC) curve analysis were performed for both scoring systems.
Results: Tzanakis score ≥8 was observed in 83% of patients, while 69.9% had Alvarado score ≥7. Tzanakis demonstrated higher sensitivity (96.8%), specificity (75.9%), PPV (94.5%), NPV (84.6%), and diagnostic accuracy (92.8%) compared to Alvarado (77.4%, 62.1%, 89.7%, 39.1%, and 74.5%, respectively). ROC analysis showed AUC of 0.948 for Tzanakis versus 0.726 for Alvarado.
Conclusion: The Tzanakis score outperforms the Alvarado score in diagnosing acute appendicitis and should be preferred when ultrasonography is available.

Keywords: *Acute appendicitis, Tzanakis score, Alvarado score, diagnostic accuracy, ROC curve.*

INTRODUCTION

Acute appendicitis is one of the most frequent causes of acute abdominal pain requiring emergency surgical intervention, particularly in the second and third decades of life. It remains a major global surgical concern due to its potential complications, including perforation and peritonitis, if not diagnosed and treated promptly. The clinical presentation of acute appendicitis can vary significantly, often overlapping with other abdominal conditions, which makes early and accurate diagnosis a critical, yet challenging task. This diagnostic uncertainty has prompted the development and use of clinical scoring systems aimed at improving diagnostic precision and reducing unnecessary surgeries.

Among the many scoring systems available, the Alvarado scoring system and the Tzanakis scoring system are two of the most frequently used worldwide. The Alvarado score, developed in the 1980s, is based on a combination of clinical symptoms (e.g., migratory right iliac fossa pain, nausea, anorexia), signs (e.g., rebound tenderness, elevated temperature), and laboratory findings (e.g., leukocytosis and neutrophilia). The total score ranges from 0 to 10, with a score of 7 or more generally considered diagnostic of acute appendicitis [1].

Despite its widespread usage, the Alvarado score has shown limitations in accuracy when applied across different populations and settings, particularly in the Indian subcontinent. To address these shortcomings, the Tzanakis scoring system was introduced, which incorporates not only clinical features and laboratory parameters but also the results of ultrasonographic (USG) imaging. This makes the Tzanakis score a more comprehensive diagnostic tool, as it combines four key components: tenderness in the right iliac fossa, rebound tenderness, leukocytosis, and a positive USG for appendicitis. A score of 8 or more out of 15 suggests a strong likelihood of acute appendicitis [2].

Numerous studies have been conducted to evaluate and compare the diagnostic performance of the Alvarado and Tzanakis scoring systems. In an Indian tertiary care setting, a comparative study involving 200 patients reported the sensitivity and specificity of the Alvarado score as 84.26% and 72.7%, respectively. The Tzanakis score, on the other hand, demonstrated a slightly higher sensitivity of 88.2% with the same specificity of 72.7%. The overall diagnostic accuracy was also higher for the Tzanakis score (86.5%) compared to the Alvarado score (83%) [3].

Supporting evidence from a retrospective analysis involving 200 surgical cases revealed similar findings. The Tzanakis score showed a higher sensitivity (86.9%) compared to the Alvarado score (76.0%), while both maintained equal specificity of 75% [4]. Another comparative study from Eastern India also highlighted that the Tzanakis score had a superior sensitivity (94.44%) and positive predictive value (98.84%) compared to the Alvarado score (77.77% sensitivity and 97.22% PPV) [5].

A large meta-analysis involving 14 studies and over 2,200 patients further substantiated these findings. The pooled sensitivity of the Tzanakis score was 0.86 with an area under the curve (AUC) of 0.93, while the Alvarado score had a lower sensitivity of 0.67 and AUC of 0.74. This indicates a significantly higher diagnostic performance for the Tzanakis scoring system. Additionally, in another hospital-based study involving 200 patients, the Tzanakis score again outperformed the Alvarado score in both sensitivity and diagnostic accuracy [6].

Interestingly, one rural hospital study reported a slightly lower sensitivity for the Tzanakis score (52.7%) but an exceptionally high specificity (92.31%), suggesting that while it may not detect all true cases, it is very effective at ruling out false positives [7]. However, other studies continue to show that despite variability in population and settings, the Tzanakis score consistently performs better or at least equally well as the Alvarado score.

Contrasting findings have also been observed. One study found that the Alvarado score had a better specificity (100%) and higher AUC (0.874) compared to the Tzanakis score (AUC = 0.860), though the latter still demonstrated higher sensitivity [8]. A larger Indian study reported similar trends, favoring the Tzanakis system for better integration of clinical, imaging, and laboratory data in improving diagnostic accuracy.

In a prospective Indian study of 420 patients, both scores were compared using histopathology as the gold standard. The Tzanakis score showed a diagnostic accuracy of 88.81%, slightly higher than the Alvarado score at 87.62% [9]. It has also been emphasized that the Alvarado score, though effective in Western populations, may have limitations when applied in Asian settings, further supporting the relevance of the Tzanakis score in Indian healthcare environments [10].

While both scoring systems offer practical benefits in diagnosing acute appendicitis, current evidence suggests that the Tzanakis score may provide better diagnostic performance, particularly in settings where imaging support is available. An integrated use of clinical judgment supported by scoring systems can help optimize patient outcomes and minimize unnecessary surgical interventions.
This study aimed to compare the diagnostic accuracy of the Tzanakis and Alvarado scoring systems in identifying acute appendicitis, using histopathology as the gold standard, and to evaluate their effectiveness in reducing negative appendectomy rates.

METHODOLOGY

1. Study Design

This was a prospective, hospital-based comparative study aimed at evaluating the diagnostic accuracy of the Tzanakis and Alvarado scoring systems in suspected cases of acute appendicitis. Both scores were applied preoperatively and their results were compared against histopathological findings.

2. Study Setting
The study was conducted in the Department of General Surgery at Gauhati Medical College and Hospital, Guwahati, a tertiary care center with facilities for emergency surgery, radiological investigations, and histopathological examination.

3. Study Duration
The study was carried out over a period of one year, from 1st June 2019 to 31st May 2020, ensuring adequate patient enrollment and completion of data collection.

4. Participants – Inclusion and Exclusion Criteria
Patients aged 11 to 60 years, clinically suspected of acute appendicitis and undergoing appendectomy were included. Exclusion criteria were age below 10 or above 60 years, unwillingness for surgery, generalized peritonitis, appendicular lump or abscess, and recurrent appendicitis.

5. Study Sampling
A consecutive sampling method was used. All eligible patients who presented during the study period and met the inclusion criteria were enrolled without randomization.

6. Study Sample Size
A total of 153 patients were included in the study. This number was based on the expected case load and ensured sufficient statistical power for comparison.

7. Study Groups
There were no separate intervention groups. Each patient was assessed using both Tzanakis and Alvarado scoring systems prior to surgery, and scores were compared with postoperative histopathology.

8. Study Parameters
Parameters included demographic data, clinical signs and symptoms, laboratory results, ultrasound findings, scoring system values, intraoperative observations, histopathology results, and negative appendectomy rates.

9. Study Procedure
After clinical evaluation and investigations, Tzanakis and Alvarado scores were calculated for each patient. Appendectomy was performed based on clinical judgment, and specimens were sent for histopathology.

10. Study Data Collection
Data were recorded in a structured proforma including history, examination findings, lab and USG results, surgical notes, and histopathology reports. Scores were noted before surgery.

11. Data Analysis
Data were analyzed using SPSS and Excel. Sensitivity, specificity, positive and negative predictive values, and diagnostic accuracy were calculated. Chi-square test and ROC curves were used for comparison.

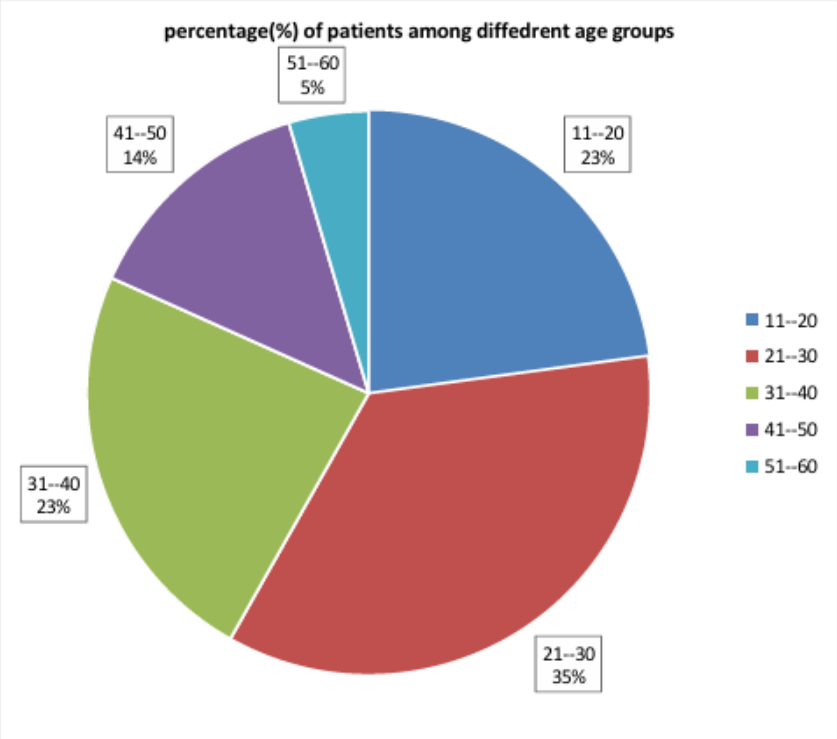
12. Ethical Considerations
Ethical approval was obtained from the Institutional Ethics Committee. Written informed consent was taken from all patients. Confidentiality was maintained throughout the study.

RESULTS

1. Incidence of Appendicitis in Different Age Groups
The highest incidence of acute appendicitis was observed in the 21–30 years age group (35.3%), indicating a higher prevalence in young adults. Incidence declined progressively in older age groups (Table 1).

Table 1: Incidence of Appendicitis in Different Age Groups

Age Group (years)	Number of Patients	Percentage
11–20	35	22.9%
21–30	54	35.3%
31–40	36	23.5%
41–50	21	13.7%
51–60	7	4.6%
Total	**153**	**100%**



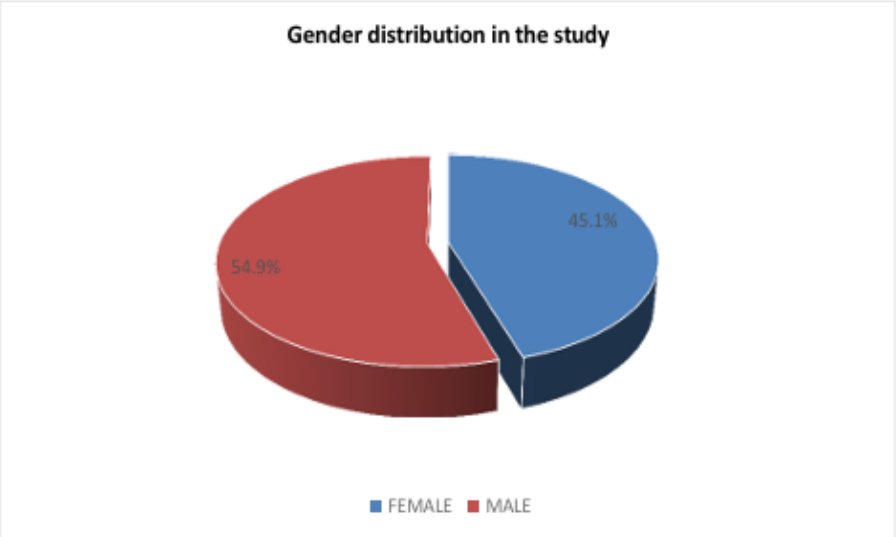
Graph 1: Incidence of Appendicitis in Different Age Groups

2. Gender Distribution

There was a slight male predominance with 54.9% males and 45.1% females among the study population. This is consistent with other epidemiological data (Table 2).

Table 2: Gender Distribution of Patients

Gender	Number of Patients	Percentage
Male	84	54.9%
Female	69	45.1%
Total	**153**	**100%**



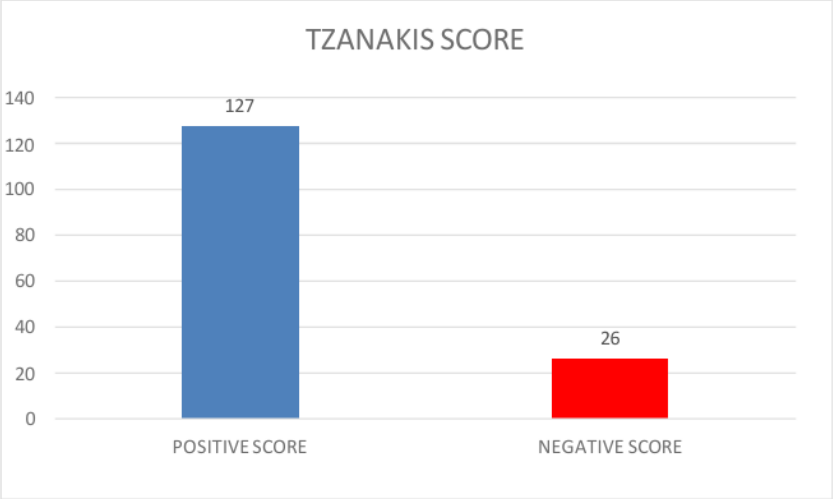
Graph 2: Gender Distribution of Patients

3. Tzanakis Score Distribution

83% of patients had a Tzanakis score ≥8, indicating a strong correlation with histologically confirmed appendicitis (Table 3).

Table 3: Tzanakis Score-Wise Distribution of Patients

Tzanakis Score	Number of Patients	Percentage
≥8	127	83.0%
<8	26	17.0%
Total	**153**	**100%**



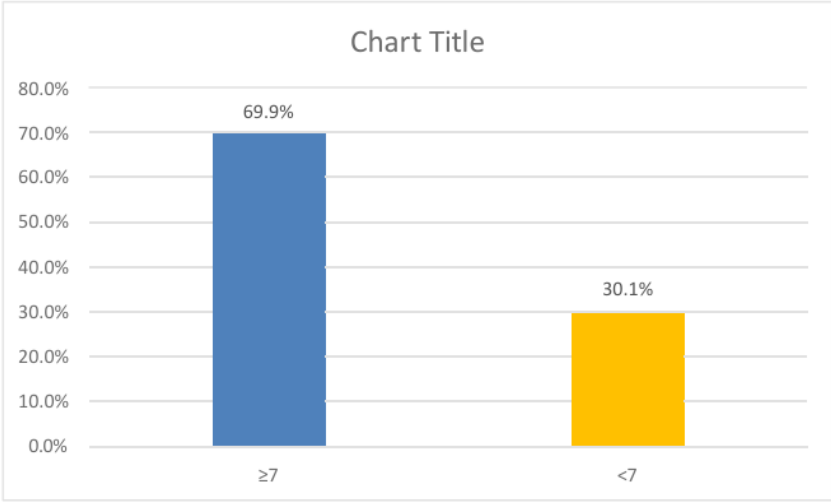
Graph 3: Tzanakis Score-Wise Distribution of Patients

4. Alvarado Score Distribution

Only 69.9% had an Alvarado score ≥7, indicating comparatively lower diagnostic alignment with histopathology than Tzanakis (Table 4).

Table 4: Alvarado Score-Wise Distribution of Patients

Alvarado Score	Number of Patients	Percentage
≥7	107	69.9%
<7	46	30.1%
Total	**153**	**100%**



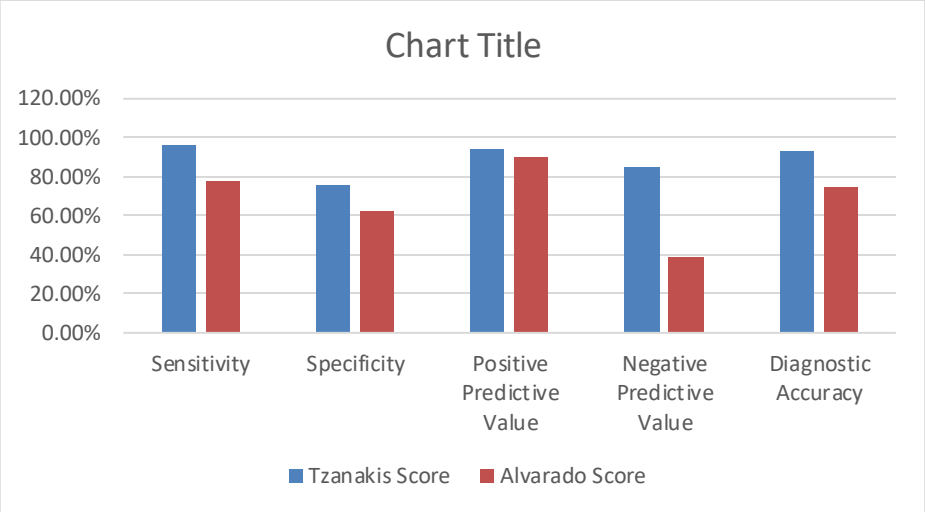
Graph 4: Alvarado Score-Wise Distribution of Patients

5. Diagnostic Accuracy Comparison

Tzanakis score showed superior diagnostic accuracy (92.8%) compared to Alvarado (74.5%), with higher sensitivity and NPV (Table 5).

Table 5: Diagnostic Indices Comparison

Statistic	Tzanakis Score	Alvarado Score
Sensitivity	96.8%	77.4%
Specificity	75.9%	62.1%
Positive Predictive Value	94.5%	89.7%
Negative Predictive Value	84.6%	39.1%
Diagnostic Accuracy	92.8%	74.5%



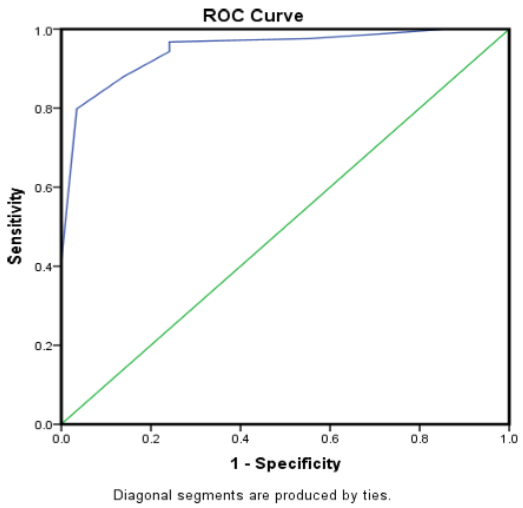
Graph 5: Diagnostic Indices Comparison

6. Table 6: ROC Curve Analysis

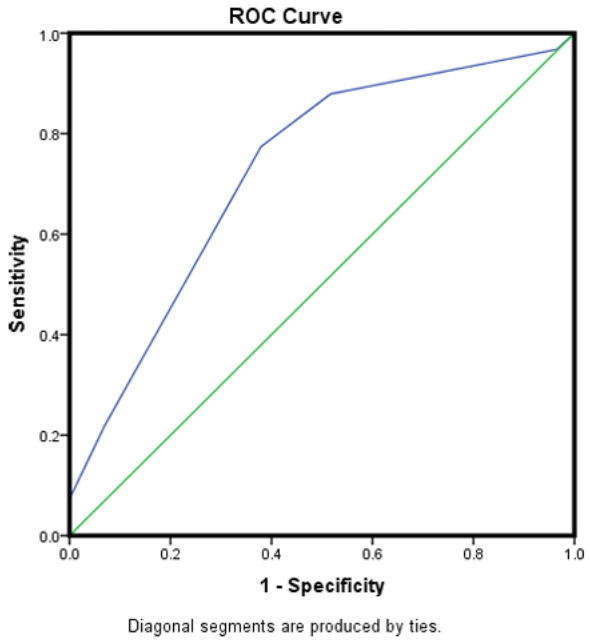
The ROC curve for Tzanakis had an AUC of 0.948, much higher than Alvarado's 0.726, suggesting better diagnostic discrimination (Table 6).

Table 6: ROC Curve Values for Scoring Systems

Score Type	AUC	p-Value	95% Confidence Interval
Tzanakis	0.9480	<0.0001	0.9100–0.9860
Alvarado	0.7260	<0.0001	0.6200–0.8310



Graph 6: Roc curve for Tzanakis score



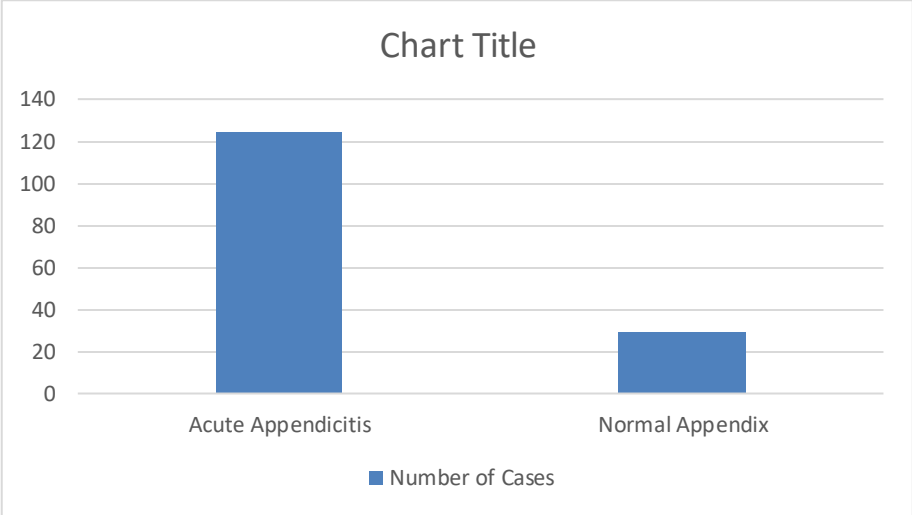
Graph 7: Roc Curve for Alvarado Score

7. Histopathological Outcomes

Histopathological examination confirmed acute appendicitis in 81.05% of operated patients, validating the clinical and scoring-based diagnoses (Table 7).

Table 7: Histopathological Analysis of Resected Specimens

Histopathology Report	Number of Cases	Percentage
Acute Appendicitis	124	81.05%
Normal Appendix	29	18.95%
Total	**153**	**100%**



Graph 8: Histopathological Analysis of Resected Specimens

DISCUSSION

This study evaluated the diagnostic accuracy of the Tzanakis and Alvarado scoring systems in acute appendicitis and found Tzanakis to be significantly superior. The majority of cases occurred in the 21–30 years age group (35.3%), consistent with existing literature that identifies young adults as the most affected demographic (Khorwal et al., 2022) [3]. Male predominance (54.9%) also aligned with established trends (Iqbal et al., 2022) [9].

Our study found that 83% of patients had a Tzanakis score ≥8, strongly correlating with confirmed appendicitis on histopathology. In contrast, only 69.9% had an Alvarado score ≥7. This supports findings by (Awan et al., 2024), whose meta-analysis reported higher sensitivity and diagnostic odds ratio for Tzanakis (OR = 22.52) versus Alvarado (OR = 4.92) [2].

The diagnostic accuracy in our study was 92.8% for Tzanakis and 74.5% for Alvarado, closely mirroring data from (Patel et al., 2022), who reported 94.44% sensitivity for Tzanakis versus 77.77% for Alvarado [5]. Moreover, our ROC curve analysis revealed an AUC of 0.948 for Tzanakis, substantially better than Alvarado's 0.726, again aligning with earlier findings (Shandil et al., 2024) [1].

Histopathological confirmation of appendicitis in 81.05% of cases supports the clinical utility of these scoring systems and indicates a reasonably low negative appendectomy rate of 18.95%. While some studies such as (Wasim & Kaushal, 2023) have reported better AUC for Alvarado in specific settings, our results, in line with most Indian and international studies, demonstrate superior diagnostic performance of Tzanakis, particularly in sensitivity and negative predictive value [8]. Thus, Tzanakis scoring, which incorporates ultrasonography, offers a more reliable and holistic assessment of appendicitis, especially in settings where avoiding unnecessary surgeries is crucial.

CONCLUSION

This study demonstrates that the Tzanakis scoring system has superior diagnostic performance compared to the Alvarado scoring system in patients with suspected acute appendicitis. With higher sensitivity, specificity, and diagnostic accuracy, Tzanakis offers a more reliable tool for clinical decision-making, particularly in settings with access to ultrasonography. Its higher negative predictive value helps to reduce unnecessary surgeries and associated morbidity. Integrating Tzanakis scoring into routine practice, along with clinical judgment, may optimize patient outcomes and improve the efficiency of appendicitis diagnosis in tertiary care settings.

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