



## COMPUTED TOMOGRAPHY EVALUATION IN POSITIONS AND MEASUREMENTS OF APPENDIX WITH NON-APPENDICULAR SYMPTOMS

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### ABSTRACT

**Background:** Acute abdominal pain is common in clinical practice, and while appendicitis is frequent, patients may present with non-appendicular symptoms but show abnormal appendix findings on imaging. Computed Tomography (CT) is vital in diagnosing appendicitis, but its role in assessing the appendix for non-specific abdominal complaints remains unexplored. **Objective:** This study investigates appendix positions and measurements using CT imaging in patients with non-appendicular symptoms to identify anatomical variations that may be overlooked. **Methods:** A retrospective analysis was conducted on patients undergoing abdominal CT scans for non-appendicitis related symptoms. Appendix position, size, and characteristics were evaluated and compared with clinical outcomes. Statistical analysis correlated anatomical variations with symptoms and diagnoses. **Results:** Findings showed variations in appendix position, size, and structure in patients with non-appendicular symptoms, leading to revised diagnoses and suggesting CT's importance in evaluating abdominal pathology. **Conclusion:** CT evaluation of the appendix in non-specific abdominal pain provides insights into anatomical variations that may be missed. Further studies are needed to understand CT's role and develop clinical guidelines for non-appendicular conditions.

**KEYWORDS :** Computed Tomography, Appendix, Abdominal Pain, Non-Appendicular Symptoms, Imaging, Diagnosis.

### INTRODUCTION

The vermiform appendix is highly variable in position, extent, and organ relations [1]. Understanding these variations is crucial as different positions can produce varying symptoms in appendicitis that may mimic other diseases [2,3]. The appendix is a diverticulum averaging 10 cm that arises from the postero-medial caecal wall, 3 cm below the ileocecal valve at three taeniae confluence [4,5]. While its origin remains constant, the tip position varies due to cecal embryonic development [6,7] and appendix length [8]. Studies report different prevalent positions, with retrocecal [9], pelvic [10,11], or post-ileal [1] being most common [12], variations possibly linked to lifestyle and genetics [13]. Ultrasonography and multidetector computed tomography (MDCT) are primary imaging tools. MDCT's advanced technology enables clear visualization of the entire appendix and its relationship to adjacent structures [14]. On CT, normal appendix diameter is under 6 mm serosa-to-serosa [16,17], though some consider 7 mm the appropriate threshold [17]. Normal wall thickness is below 2 mm [16]. While normal appendix contains air or contrast material, fluid may indicate pathology. This study aims to determine the frequency of anatomical positions in patients with non-appendicular symptoms and measure the appendix's diameter, wall thickness, and length.

### Aims and Objectives

1. To assess the various anatomical variants of appendix on computed tomography.
2. To estimate the frequency distribution of different anatomical positions.
3. To measure the diameter, wall thickness, and length of appendix in patients with non-appendicular symptoms.

### MATERIALS AND METHODS:

**Place of Study:** KONASEEMA INSTITUTE OF MEDICAL SCIENCES AND RESEARCH FOUNDATION, AMALAPURAM.

**Duration of Study:** 6 months.

### Inclusion Criteria

1. Patients who had undergone computed tomography (CT) scan of abdomen for various non-appendicular signs and symptoms.

### Exclusion Criteria

1. Patients in whom the appendix could not be identified or in whom various parameters were unmeasurable were excluded from the present study.
2. Similarly, patients with non-appendicular signs and symptoms but showing appendicolith or other CT features suggesting some peri-appendiceal inflammation were also excluded from the study.
3. Appendicectomised individuals are excluded from the study.

**Sample Size:** 340

**Study Design:** Retrospective descriptive cross sectional study.

### Methods of Collection of Data :

All patients underwent CT scan using Phillips Brilliance 64-slice scanner after bowel preparation with bisacodyl tablets and 6 hours fasting. A 1.5 liters solution of 3% mannitol was given over 50 minutes, and images were acquired with 5 mm slice thickness using parameters: 120 KV, 200-300 mAs, pitch: 1.078, gantry rotation time: 0.75 s, FOV: 300-400 mm, slice interval: 5 mm, scan time: 8.6 s, collimation: 64 × 0.625. Iodixanol contrast (2 ml/kg) was administered intravenously. Appendix positions were classified as: Retrocecal (posterior and superior to cecum/ascending colon), Paracecal (lateral to

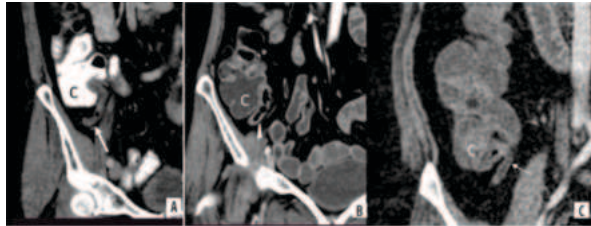
cecum/ascending colon), Sub-cecal (under cecum), Pelvic (pointing towards pelvis), Pre-ileal and post-ileal (antero-superior or postero-superior to ileum), and Promontoric (below pre/post-ileal positions). Data analysis included percentage distribution of appendix variants, mean diameter, wall thickness, and appendicular length.

### Statistical Analysis

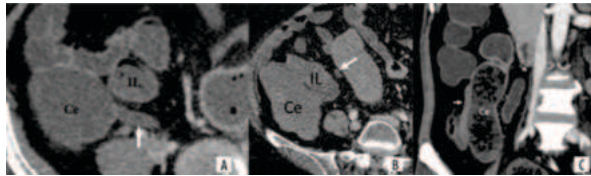
The collected data will be compiled, tabulated, and is being statistically analysed using Statistical Package for Social Services (SPSS), 21<sup>st</sup> version.

### RESULTS

Of 340 patients (18-87 years) who underwent abdominal CT scan, 193 were males and 157 females. The most common appendicular locations were retrocecal (n=86, 25.4%), sub-cecal (n=69, 20.3%), post-ileal (n=64, 18.7%) and pelvic (n=56, 16.5%). Pre-ileal and promontory locations each had 26 patients (7.9%), while paracecal was least common with 10 patients (3.1%).



**Figure :1** Contrast enhanced computed tomography images in coronal plane (A-C) show sub-cecal appendix (marked with arrow), with tip lying below the cecum (C).



**Figure :2** Contrast enhanced computed tomography images in axial plane show (A) and (B) post-ileal and pre-ileal locations of appendix (marked with arrow), with tip lying posterior and anterior to the distal ileum (IL), respectively. (C) Paracecal location with appendix lying lateral to the cecum (Ce).

**Table: 1 Distribution of Different Anatomical Locations of Appendix Among Study Group.**

POSITION	NUMBER OF PATIENTS	PERCENTAGE
RETROCEACAL	86	25.4%
SUBCEACAL	69	20.3%
POSTILEAL	64	18.7%
PELVIC	56	16.5%
PREILEAL	26	7.9%
PROMONTORY	26	7.9%
PARACEACAL	10	3.1%

**Table: 2 Measurement Parameters of Appendix Among Patients**

PARAMETER	RANGE (mm)	MEAN (mm)	SD(mm)
LENGTH	6.4-13.4	65.9	22.4
DIAMETER	2.0-11.6	6.5	1.56
WALL THICKNESS	2.0-5.3	3.5	0.4

**Table: 3 Frequency Distribution of Study Population According to Wall Thickness**

WALL THICKNESS (mm)	Number of subjects, N=340	PERCENTAGE
< 2	83	24.4%
>2-3	245	72.12%
>3-4	10	3.04%
>4	2	0.5%

Of 86 patients with retrocecal appendix, 3 had sub-hepatic appendiceal tip (Table 1). Mean appendix length was 65.9 mm (range: 6.4-134.0 mm). Appendiceal diameter ranged 2.0-11.6 mm, averaging 6.5 mm (Table 2). Wall diameter <6 mm was found in 176 (51.87%) patients, and >6 mm in 164 (48.12%) patients. Mean wall thickness was 3.5 mm (range: 2.0-5.3 mm). Most patients had wall thickness <3 mm, with only 10 (3%) and 2 (0.5%) patients having thickness >3 and 4 mm respectively (Table 3). No significant differences were found between gender and diameter (p=0.183), age and diameter (p=0.217), age and length (p=0.192), gender and length (p=0.224), age and wall thickness (p=0.208), or gender and wall thickness (p=0.118).

### DISCUSSION

The appendix shows variation in position, length, diameter, and wall thickness. A normal appendix can have diameter greater than 6 mm and wall thickness exceeding 3 mm. Patients with suspected appendicitis may not show increased diameter, wall thickness, or peri-appendiceal inflammation. In our study, the most common appendix location was retrocecal (25.4%), followed by sub-cecal (20.3%), post-ileal (18.7%), pelvic (16.5%), and pre-ileal and promontory positions (7.9% each), with paracecal being least common. This correlated with a cadaver study reporting retrocecal (43.5%), sub-cecal (24.4%), post-ileal (14.3%), pelvic (9.3%), paracecal (5.8%), and pre-ileal (2.4%) positions [9]. On ultrasound, normal appendix appears as a compressible blind-ending tubular structure, with diameter less than 6 mm from serosa-to-serosa [6]. Published literature reports normal appendix diameter ranging 6.4-13.4 mm [15]. In our study, diameter varied 2.0-11.6 mm, averaging 6.5 mm, with 48% of patients showing diameter greater than 6 mm due to air, fecal material, or contrast agent. Benjaminov et al. [15] reported similar findings with mean diameter 6.5 mm  $\pm$  1.5 mm (SD). Our findings indicate diameter above 6 mm without other CT features of appendicitis is not a reliable cut-off value. While our study benefits from large sample size and CT-based measurements, limitations include lack of patient follow-up and reliance on clinical examination for inclusion criteria.

### CONCLUSION

The appendix shows varying normal and abnormal appearances on CT scans. Understanding a normal appendix's characteristics is crucial for diagnosing acute appendicitis. While appendices under 6 mm may be normal, diameter alone can lead to misdiagnosis, as sizes over 6 mm can overlap between normal and acute appendicitis. Diameter should be evaluated alongside clinical signs to prevent overdiagnosis. We recommend standardizing CT criteria for appendicitis diagnosis, with future studies needed to establish reliable criteria.

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