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*Research article*

## **Lengths and Positions of the Vermiform Appendix among Sudanese Cadavers**

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**Abstract: Background/objective:** The anatomy of vermiform appendix displays great variations in length and position between different populations. The reports relating these variations to a specific etiological factor are few. This study aims to describe the positions and lengths of vermiform appendix among Sudanese cadavers. **Methods:** This descriptive study was carried out in Omdurman Teaching Hospital Morgue and Omdurman Islamic University-Sudan. Sixty Sudanese cadavers (30 male and 30 female), were dissected in the period from June 2013 to June 2014. The positions and the lengths of vermiform appendix were measured in millimeters. The data was analyzed by SPSS version 20. **Results:** The cadavers' age ranged between 20 to 80 years according to their medico-legal reports. Retrocaecal position was mainly observed in 60%, pelvic in 35%, post-ileal in 3.3%, and pre-ileal in 1.7%. The lengths of the appendix was found < 69 mm in 23.3%, 70–110 mm in 60%, and > 110 mm in 16.7%, also the study showed insignificant difference between the lengths and ages ( $p < 0.08$ ), and between males and females ( $p = 0.23$ ). Age was the influencing factor for the positions of vermiform appendixes ( $p = 0.04$ ). **Conclusion:** The study showed that the commonest lengths of the appendix were 70–110 mm while the common position was retrocaecal regardless to age or gender. This data should be considered in surgical removal of the inflamed appendix.

**Keywords:** Cadavers; vermiform appendix; position; length

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## 1. Introduction

Vermiform appendix is a narrow blind tube that forms a part of the gastro-intestinal tract, and lies postero-medial to the cecum. It is usually about three to four inches (7.6 to 10.2 cm) long and extends from the cecum in the lower right-hand part of the abdomen [1]. Even though its anatomy displays great variations in length and position across different populations, thus far, very few studies have attempted to attribute these variations to specific etiological factor. Some authors propose that appendix is the shrunken remainder of the cecum that was found in remote human ancestors. However, in 2013, Smith refuted the idea of an inverse relationship between cecum presence and size with the appendix size [2].

According to Wakeley, vermiform appendix can be found in subcaecal, retrocaecal, retrocolic, post-ileal, preileal, and pelvic position [3]. Its length can also vary considerably from 2 to 20 cm with an average of 9 cm, and is usually about 0.5 cm longer in males than in females [4]. It is typically longer in infants and may atrophy or diminish in size in later adulthood [5]. Appendix position was found to be important, as the appendicitis may produce different symptoms and signs [6]. Hence, obtaining evidence of these variations is essential for accurate diagnosis and treatment of the condition [7].

In a recent study correlates the histological features of the appendix as a function of age and found no significant correlation [8].

Appendicitis is diagnosed through medical examination whereby typical signs and symptoms are noted. Thus, being aware of possible appendix positions facilitates the diagnosis. Owing to different positions of the appendix, appendicitis can be misdiagnosed as other diseases, increasing the potential for subsequent complications [9]. Owing to this issue, this study aims to determine the positions and lengths of vermiform appendix, as well as, their relationship with age and sex of the individual.

## 2. Materials and Methods

The present study was performed on sixty Sudanese cadavers (30 male, 30 female) to determine the lengths and positions of vermiform appendices. The data was collected in the period from June 2013 to June 2014.

The dissection for the appendix was performed 4–6 hours after autopsy processing, before the organ was displaced by manipulation and dissection from the right iliac fossa. The abdomen was opened by a long midline incision and the flaps were reflected to provide a good view of the abdominal cavity and its contents. The anterior caecal taenia coli acts as the best guide for the vermiform appendix, as the length of the vermiform appendix is established by measuring the distance from the base to the tip of the appendix with the help of a measuring tape graduated in millimeters. Although the relation of the base of the appendix to the caecum is constant, the position of the free part of the vermiform appendix was studied in relation to the caecum, the terminal parts of ileum and the direction of the tip of the appendix.

The data was collected by observation checklist for measuring the lengths and positions of

vermiform appendix. The positions of the vermiform appendix were studied in relation to the caecum with the terminal parts of ileum and the direction of the tip of the appendix, while the lengths were measured by ruler in millimeters. The ethical approval was taken from the authorities of the Omdurman Teaching Hospital and the ethical committee of Omdurman Islamic University. The demographic data were taken from different medico-legal cases, such as homicidal, suicidal, and road traffic accidents. All samples were included, since the appendix morphology was found normal following dissection. The data was analyzed by using SPSS statistical software version 20. The descriptive analysis was performed then the chi square test was done to identify the relationship between the demographic characteristics compared to the lengths and positions of the vermiform appendix. The  $p$ -value less than 0.05 was considered significant.

### 3. Results and Tables

The study included 60 Cadavers (30 male, 30 female), with age groups ranged from 20 years to 80 years. Table 1 showed the positions of vermiform appendix among Sudanese Cadavers; 60% of them with normal positions (retrocaecal), while (35%) pelvic, (3.3%) post-ileal and pre-ileal (1.7%), however, the subcaecal was not found in the present study. The lengths of vermiform appendix among Sudanese Cadavers were ranged from 31 mm to 160 mm. The normal length (70–110 mm) were found in 60% while the abnormalities have seen in 40% divided into (23.3%) below normal length (31–69 mm), and above normal length (111–149 mm) were recorded in 15% and 1.7% has length between 150–160 mm (Table 1).

In this study it was found that: age groups was influencing factor for the positions of vermiform appendix among Sudanese Cadavers significantly ( $p = 0.04$ ), while gender was not influencing factor for the positions of vermiform appendix among Sudanese Cadavers ( $p = 0.35$ ) (Table 2).

The present study found that, age groups and gender were found to be not influencing factors for the lengths of vermiform appendixes among Sudanese Cadavers ( $p = 0.08$ , and 0.23 respectively), and the length of normal appendixes was found longer in males than in females (Table 3).

**Table 1. Demographic characteristics and positions and lengths of vermiform appendix among Sudanese Cadavers.**

	Parameter	n (%)
Sex	Male	30 (50%)
	Female	30 (50%)
Age	20-40 years	22 (36.7%)
	41-60 years	28 (46.7%)
	61-80 years	10 (16.6%)
Positions	Retrocaecal	36 (60%)
	Pelvic	21(35%)
	Post-ileal	2 (3.3%)
	Pre-ileal	1 (1.7%)
Lengths	Sub-caecal	0 (0%)
	31-69 mm	14 (23.3%)
	70-110 mm	36 (60%)
	111-149 mm	9 (15%)
	150-160 mm	1 (1.7%)

n = number

**Table 2. Relationships between anatomical positions of vermiform appendixes Sudanese Cadavers age and gender.**

Position Variable		Retrocaecal	Pelvic	Post-ileal	Pre-ileal	Sub-caecal	<i>p</i> -value
Age	19-40	15 (68.2%)	6 (27.3%)	1 (4.5%)	0 (0%)	0 (0%)	0.04*
	41-60	17 (60.7%)	9 (32.1%)	1 (3.6%)	1 (3.6%)	0 (0%)	
	60 -80	4 (40%)	6 (60%)	0 (0%)	0 (0%)	0 (0%)	
Gender	Male	19 (63.3%)	10 (33.3%)	1 (3.3%)	0 (0%)	0 (0%)	0.35
	Female	17 (56.7%)	11 (36.7%)	1 (3.3%)	1 (3.3%)	0 (0%)	

\* Significant

**Table 3. Relationships between anatomical lengths of vermiform appendixes among Sudanese Cadavers age and gender.**

Length Variable		31-69 mm	70- 110 mm	111-149 mm	150-160 mm	<i>p</i> -value
Age	19-40	9 (40.9%)	10 (45.5%)	3 (13.6%)	0 (0%)	0.08
	41-60	5 (17.9%)	20 (71.4%)	3 (10.7%)	0 (0%)	
	60-80	0 (0%)	6 (60%)	3 (30%)	1 (10%)	
Gender	Male	2 (6.7%)	26 (86.6%)	2 (6.7%)	0 (0%)	0.23
	Female	12 (40%)	10 (33.3%)	7 (23.3%)	1 (3.3%)	

#### 4. Discussion

Appendicitis is one of the common causes of acute abdominal pain, and its variable position and length may compromise the diagnosis [10].

In the present study, appendix was usually found in the retrocaecal position (60%), which is the normal developmental position of the appendix, followed by pelvis position (35.0%), and the pre-ileal position (1.7%). These findings are similar to those reported by Uttam [11], Wakeley [3], Maisel [12], Solanke [13], Gladstone and Wakeley [14], Clegg-Lamprey et al. [15], Ajmani and Ajmani [16], and Mwachaka et al. [17], where retrocaecal position was more prevalent than the pelvis one.

Even though no explanation has been provided for the differences in retrocaecal appendix positions they are most likely affected by genetic and life style factors such as nutritional regimen [18].

In human beings, the interactions between the immune system and the microbiome have led to an improvement in the understanding of the function of the appendix as repository for beneficial bacteria in the colon [19]. Having a good understanding of the position, length, outer girth and distance from ileocaecal junction of vermiform appendix would help in minimizing the complications of appendicular pathology [20].

As can be seen, our results did not coincide with those reported in other studies, such as Ghorbani et al. [21], Paul et al. [22], Ojeifo et al. [23], and Rahman et al. [20], who found that, pelvis position was more common than the retrocaecal one. We posit that the differences are due to the variation in ethnic groups.

Even though retrocaecal is the most common appendix location in both males and females, its frequency was higher among males. Thus, it is likely that the variation between our results and those

reported in the aforementioned stems from our small sample size and population differences.

In this study, the length of the normal appendix was greater in males than in females, in line with the works of Ajmani and Ajmani [16], Gholalipour et al. [24], and Katzurski et al. [25], However, Bakheit and Warille [26] and Rahman et al. [27], reported opposite findings.

It has been stated that, appendix achieved its adult proportions and doesn't continue to grow throughout childhood after 3 years of age [28]. However, and in consistent with Ghorbani et al. [21] this study found that the appendix length significantly increased with study subjects age.

In conclusion, this study determined the most common variety, lengths of appendix among Sudanese Cadavers, which can likely help in diagnosis of acute appendicitis based on our findings.

### Conflict of Interest

The authors declare no conflict of interests regarding this paper.

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