Literature Review
Acta Medica Academica 2024;53(3):335-342
DOI: 10.5644/ama2006-124.461

Anatomical Variations of the Vermiform Appendix

Athanasios Sakellariadis[1], Foteini Sofou[1], Dimosthenis Chrysikos[1], Theodoros Sampsakos-Mariolis[2], Dimitrios Schizas[3], Theodoros Troupis[1], Dimitrios Filippou[1, 4]

[1]Department of Anatomy, Medical School, National and Kapodistrian University of Athens, Greece, [2]Department of Anatomy, Nursing School, National and Kapodistrian University of Athens, Greece, [3]1st Department of Surgery, Medical School, National and Kapodistrian University of Athens, Greece, [4]Research and Education Institute in Biomedical Sciences, Piraeus Athens, Greece

Correspondence: *sakellariadist@gmail.com*; Tel.: + 30 694 0755415

Received: 3 October 2024; **Accepted**: 11 December 2024

Abstract

Objective. The aim of the present work is to systematically review and present the existing literature on anatomical variations of the appendix. **Methods.** Detailed research was conducted in the PubMed medical database, using the terms "Appendix" AND "Anatomical variations", and 74 articles were initially revealed. After the application of the inclusion and exclusion criteria, all the non-related articles were excluded, and thus 40 articles were finally selected. **Discussion.** The data analysis suggests that the location and form of the appendix may significantly vary among individuals. Common anatomical variations concerning its location include retrocecal, pelvic, retro-ileal, pre-ileal, prececal and paracecal appendices. The first two variants are the most common, although there is a discrepancy regarding their exact incidence. Rarely, the appendix may be intracecal, intramural, subhepatic or located in the left abdomen; mismatches of the McBurney guide point with the base of the appendix are also recorded. Concerning the appendix's form, several variations in the length, diameter, shape and number of appendages (doubling, tripling) may be present. **Conclusions.** As evident from the presentation of the results, the vermiform appendix presents a wide variety and number of anatomical variations. The latter are of particular clinical importance and should be known to doctors - especially surgeons - to avoid complications in clinical practice.

Key Words: Appendix ▪ Variations ▪ Anatomy ▪ Appendicitis.

Introduction

The vermiform appendix appears as a caudal continuation of the cecum, the first part of the ascending colon. The term 'vermiform' has a Latin origin and was attributed due to its worm-like shape. The appendix is located towards the dead end of the cecum, in the right iliac fossa, approximately 2-3 cm under the ileocecal valve. It consists of the base, the body and the apex/tip. Histologically, the structure of the appendix is composed of four layers: the mucosa, submucosa, muscularis externa and serosa. The appendix is completely covered by peritoneum, and is usually supported by a triangular peritoneal fold, the mesoappendix, along the free edge of which runs the appendicular artery. Inflammation of the appendix (appendicitis) is particularly common, 50,000 such cases are recorded annually in the UK, and is usually treated with appendectomy (1).

The purpose of this paper is to conduct a systematic bibliographic review of the anatomical variations (Position and Form) of the appendix, as well as to highlight the possible effects of these variations in clinical practice.

Materials and Methods

A systematic search using the terms "Appendix" AND "Anatomical Variations" was conducted in the PubMed database, in March 2024, from which

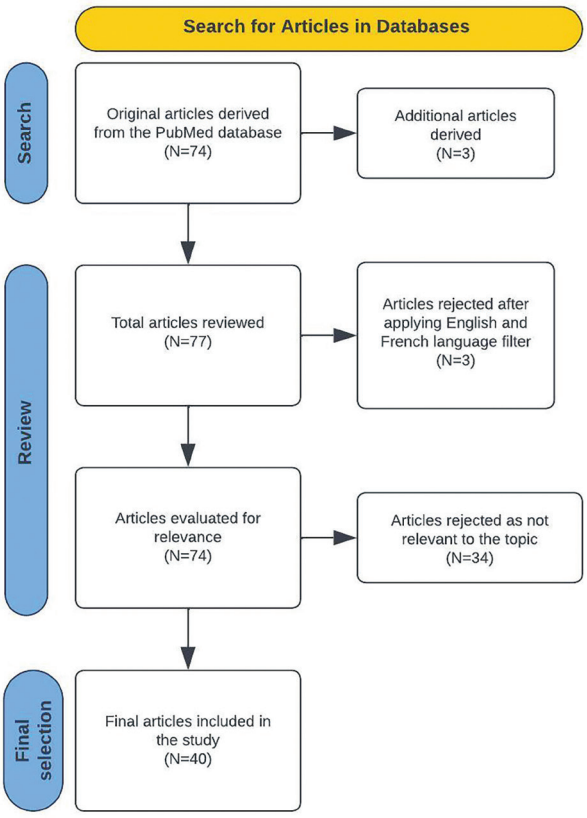

Figure 1. Flow chart of the literature search.

74 articles emerged. After the application of the selection and exclusion criteria (English and French language filter, articles relevant with the topic), 40 articles were deemed appropriate and were finally included in this work (Figure 1).

Results and Discussion

The articles included in this review (40) include case studies (26), cohort studies (8), literature reviews (5) and one meta-analysis.

The case study articles include 2 reports with a retrocecal appendix, 1 with a prececal, 1 with a paracecal, 5 with an appendix in a subhepatic location, 1 with colic, 1 with a subserosal, 1 with an intramural, 3 with left inversion of the position of appendix, 1 with pelvic, 1 in which the appendix was found inside an Amyand's hernia, 1 with the appendix in the chest, 1 with the appendix in the lumbar segment, and 1 with the appendix between the right psoas major and the right iliacus muscle. Regarding the form of the appendix, 5 cases of duplicated appendix as well as 1 case of a 23 cm long appendix were reported. The case studies involved patients aged 6 months to 85 years old. Among them, there are 3 Asians, 1 African and 3 Caucasians. The race of the remaining patients is not decisively determined.

Concerning the cohort studies, 2 assess the reliability of the McBurney's point in determining the location of the appendix, and the remaining 6 describe variations in the appendix's location. Regarding the 6 cohort studies focusing on location variations, retrocecal appendix is mentioned in all 6, subcecal in 3, paracecal in 1, pelvic in 5, retroileal in 5, preileal in 2, colic in 1, prececal in 1, intramural in 1, subhepatic in 1 and ectopic in 1. Three of the cohort studies were performed on cadaveric material from Iran, Bangladesh and Senegal, while in the remaining studies the extraction protocol of the data (anatomical, imaging, clinical or surgical) is not clearly defined.

Of the 5 literature reviews, 2 categorise variations in the location of the appendix, 1 refers to the anatomical variations in the form of the appendix, 1 focuses on the horseshoe appendix, 1 addresses the reliability of the McBurney's point as a guide point for determining the position of the appendix, 1 examines cases of duplication and triplication of the appendix.

The meta-analysis focuses on the location variants and classifies them as retrocecal, pelvic, subcecal, ileal, paracecal, prececal and subhepatic appendices. The patients studied were from Asia (30%), Africa (4%), Europe (18%), North (46%) and South (2%) America. Anatomical Variations of the Vermiform Appendix can be sorted into 2 main categories: Variations in terms of the position and Variations in terms of the form of the appendix.

Variations in Position. The appendix presents several variations in terms of its location, of which the following are frequent in the general population: the retrocecal, the prececal, the paracecal and the subcecal appendix. The retrocecal position of the appendix is the most common anatomical variant, as it is estimated to occur in about 25.4-71% of the general population (1-5). The tip of the

appendix is located posterior to the cecum (1-9). The prececal position is encountered in approximately 4% of the population and refers to the anterior (ventral) location of the appendix's tip relative to the cecum (1, 9). Additionally, the derivation of the appendix from the anterior surface of the cecum has been recorded (10). In the paracecal location, which is found in 3.1-7.5% of the general population, the body of the appendix is located between the lateral surface of the cecum and the lateral abdominal wall (1, 5, 11). In the subcecal location, the tip of the appendix is located caudally to the cecum, with an incidence of 3.5-20.3% in the general population (1-5).

Regarding the position of the appendix relative to the ileum, 2 variations can be distinguished. The retroileal appendix, with a rate of occurrence approximately 5.4-12.5%, describes an appendix whose tip is located posteriorly to the terminal ileum (2-5, 7). The pre-ileal appendix is found in 9.7-18.7% of cases and its tip is located in front of the terminal ileum (5, 7). Another frequent variant found in 16.5-30.35% of the general population is the pelvic location, in which the tip of the appendix is located caudally to the pelvic brim. The pelvic appendix may descend oriented towards the sacrum (1-5, 7, 9, 12).

The subhepatic appendix is another common anatomic variant. Both the cecum and the appendix are located below the liver, as a result of the incomplete descent of the intestinal coils during foetal development. This variant is estimated to occur in about 2.4% of the general population. This position could create significant complications in differential diagnosis of appendicitis, as the patient's symptoms may resemble those of acute cholecystitis (1, 5, 7, 8, 11, 13-17).

McBurney's point is an important guide point for determining the position of the base of the appendix. However, this point is not always accurate, as the base of the appendix may be displaced along the longitudinal or transverse axis (18-20). In fact, one of the studies reviewed found that in only 1 out of 100 subjects in the sample did the base of the appendix correspond to McBurney's point (20).

Rare variations in the position of the appendix (incidence <1%) have also been described in the literature (7, 21, 22). Such variants include intracecal, intramural and subserosal appendices, which can easily be confused (9, 21, 23, 24). In order to avoid errors in differential diagnosis, Chauhan et al. (21) and, Abramson et al. (23), proposed criteria for distinction between intracecal, intramural and subserosal appendices (Table 1). It should be noted that to date, no formal criteria have been established.

Additionally, the appendix may appear in a (para)colic position, in which the body of the

Table 1. Chauhan et al. (21) and Abramson et al. (23) Criteria for the Differential Diagnosis of Intracecal, Intramural and Subserosal Appendix

Intramural Appendix	Intracecal Appendix	Subserosal Appendix
It is located within the wall of the cecum	It is located within the wall of the cecum and can penetrate up to the cecal muscle coat.	The appendix and cecum must be distinguished as distinct and independent organs, macroscopically and microscopically
It is covered internally by the serous membrane of the cecum and externally by the peritoneum	Since local inflammation is found, this should not solely explain the fusion of the appendix with the cecum. The fusion should also exist in the absence of inflammation.	The coats of the appendix wall must be complete and not an extension of the cecal wall.
	There is no distinct mesoappendix.	There is no distinct mesoappendix.
	The base of the appendix cannot be distinguished from the cecum.	The base of the appendix must be different from the cecum's.
	The cecal tissue completely encloses the appendix.	The appendix must be completely covered by the serous membrane of the cecum.
	The vasculature tends to adapt to anatomical variations.	Intussusception, intracecal and intramural appendicitis must be ruled out.

appendix runs parallel to the ascending colon, along its lateral border (4, 22).

Other rare variations of the appendix include: localisation between the right psoas major and the right iliacus muscle (25), in the left abdomen, which is typically due to inversion of the viscera (situs viscerum inversus) or incorrect rotation of the midgut during foetal development (26-28), within an Amyand hernia (29), in the thorax, at the height of the 8th-9th thoracic vertebra (30), or in the lumbar spine (31). The last 3 extremely rare cases were associated with the presence of hernias in the respective areas (15).

Finally, combinations of the anatomical variations described above have also been recorded. A number of reports locate the appendix behind and below the cecum (9), or in retrocecal and retroperitoneal (32), retrocecal and intraperitoneal (32), posterior ileum and cecum (9), prececal and preileal (9), subcecal and prececal (9) and retrocecal positions, or attached to the posterior peritoneum and the wall of the cecum (33).

The statistical distribution of the anatomical variations of the appendix presents significant variation depending on the population under consideration. According to an anatomical study on cadaveric material (200 cadavers) in Iran, the most common variant is the pelvic position of the appendix (55.8%), followed by the subcecal (19%), the retroileal (12.5%), the retrocecal (7%) and the preileal (1.5%) location (3). According to the same survey, the retrocecal position is the most common variant in the US, Europe, Ghana and India. The retroileal location is more frequent in the Thai population, while the pelvic location is prevalent in Zambia and Nigeria (4).

In the meta-analysis included in the present review (1), 114,080 patients with acute appendicitis were studied, and it was found that retrocecal location was the most frequent variant in all races. Specifically, in Africa, the rate of occurrence of the retrocecal location of the appendix was approximately 44.8%, of the pelvic position 27.7%, subcecal 7.7%, ileal (retroileal and preileal) 13.4%, paracecal 6.2%, prececal 3% and of the subhepatic 2.2%. In Asia, the incidence of the retrocecal location was found to be 32%, of the pelvic 29.4%, subcecal 12.9%, ileal (retroileal and preileal) 15.4%, paracecal 8%, prececal 6.7% and of the subhepatic 2.1%. In Europe, the proportion of the retrocecal location of the appendix was approximately 27.6%, of the pelvic 27.1%, subcecal 17.3%, ileal (retroileal and preileal) 10%, paracecal 9.2%, prececal 4% and of the subhepatic 3.2%. In North America, the retrocecal location of the appendix was found in 24.8% of cases, the pelvic in 19.5%, the subcecal in 23.5%, the ileal (retroileal and preileal) in 18.3%, the paracecal in 7.2%, the prececal at 0.6% and the subhepatic at 0.9%. Finally, in South America the incidence of the retrocecal location was found in 36.4% of cases, the pelvic in 31.5%, the subcecal in 17.8%, the ileal (retroileal and preileal) in 16.6% and the paracecal in 6.1%, while no cases of prececal or subhepatic appendicitis were identified.

The relationship between sex and appendix location has not yet clearly identified. In a study of 80 black African cadavers (62 men, 18 women), aged 16 to 78 years (mean age 36 years), the retrocecal position of the appendix was found to be more common in women than in men (P=0.021) (9). However, both in the study of 200 Iranian cadavers (3) and in the meta-analysis mentioned above (1), no statistically significant relationship was observed (3). Overall, genetic factors, lifestyle, geographic region, race, dietary habits and, perhaps, sex are likely to influence, to a greater or lesser extent, the shape and location of the appendix in humans (Figure 2).

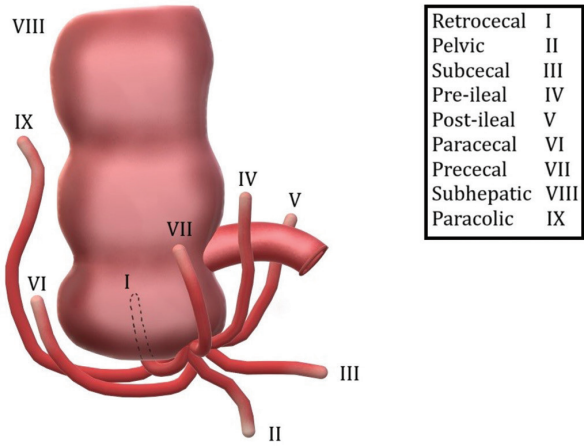

Figure 2. Variations in Position.

Table 2. Cave-Wallbridge Classification of Duplicated Appendix

Type A		Two appendixes arising from 1 cecum, with a common base and then separate.
Type B	Type B1 or Bird-like	Two appendixes arising on either side of the ileocaecal valve, from 1 cecum, but each having a separate base.
	Type B2 or Taenia-colic	One appendix found in the retrocecal position arising from the convergence of the taenia coli and a smaller second appendix along the anterior taenia at a variable distance from the first.
Type C		Two appendixes that arise from 2 cecums, which along the way unite and form a common ascending colon. Each appendix arises from a different cecum.

Variations in Form. These include variations in the number, size and shape of the appendix, as well as variations of the mesoappendix. Number variations include agenesis, and doubling and tripling of the appendix (7). Agenesis refers to the failure to form an appendix. Duplication refers to the presence of two appendixes and is one of the most studied anatomical variations (7, 34-40). According to the Cave-Wallbridge classification, duplicated appendages are distinguished into Type A, B (B1 and B2) and C (35, 36) (Table *2*).

Type B2 duplication is the most frequent variant of this category, accounting for approximately 37% of cases (38). A special case of duplication of the appendix is the horseshoe appendix. This is an especially rare variant, in which the appendix forms a horseshoe-like structure and fuses at its two ends with the cecum. Only 6 cases have been described in the international literature to date (38, 40). Triplication of the appendix is also an extremely rare variant, as only 2 cases have been described to date (38) (Figure 3).

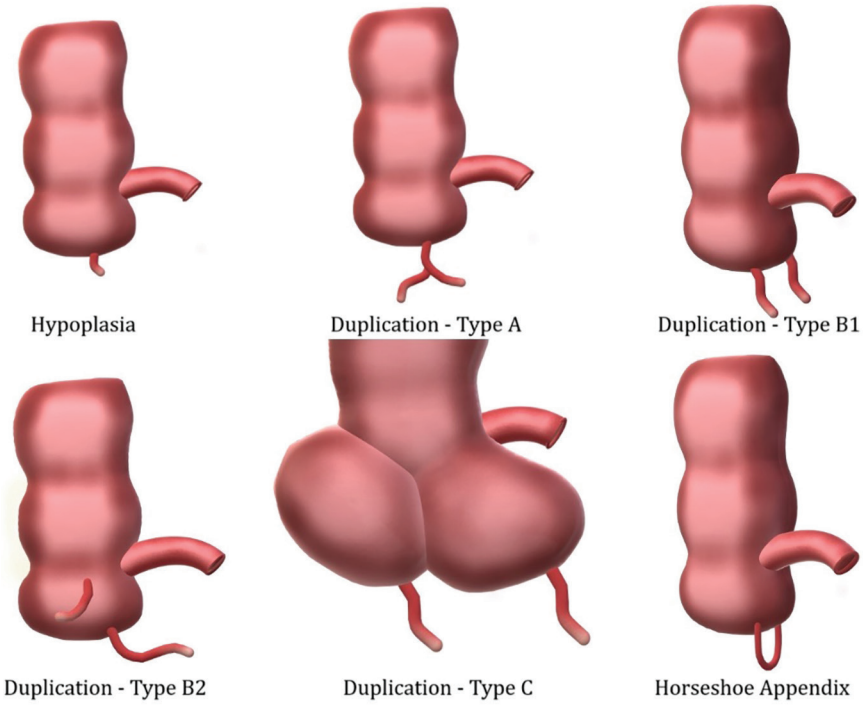

Figure 3. Variations in Form and Size variations concern the length and diameter of the appendix, where significant heterogeneity occurs. The length of the appendix ranges from 0.5 to 23 cm, with the average length between 5.3-11.7 cm. The diameter of the appendix varies from 3.2 mm to 10 mm (1-4, 8). The variant in which the appendix is less developed and smaller than normal size is referred to as hypoplasia, and is also found in the general population.

Shape variations include straight, helical and spiral appendices (Figure 4).

Variations of the mesoappendix also belong to the category of anatomical variations of the form of the appendix. Normally, the appendiceal artery runs along the free edge of the mesoappendix and, consequently, incomplete development of the mesoappendix carries the risk of inadequate perfusion of the appendix and may lead to gangrenous or perforated appendicitis (2, 3).

Concerning the possible correlation between the length/diameter of the appendix and sex/ geographic region/ race, the scientific data do not agree. The anatomical study of 200 random cadavers (153

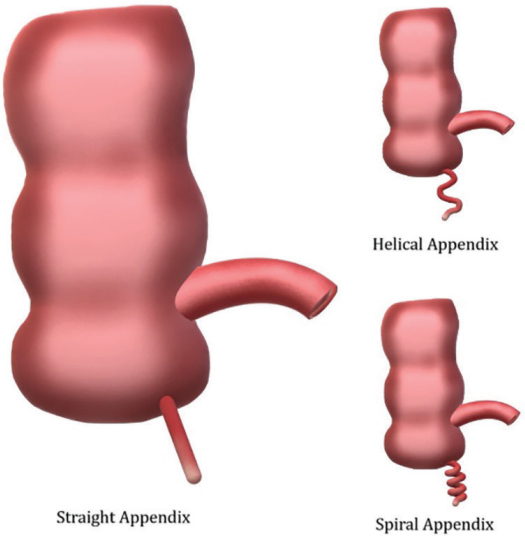

Figure 4. Variations in Shape.

men, 47 women) by the Forensic Service of Zenjan province in Iran (3), indicates a statistically significant relationship between sex and the length of the appendix (males have a longer appendix than females, P<0.01), as well as between age and the length of the appendix (maximum length at 11-19 years, P<0.001). In contrast, the meta-analysis examined (1) did not propose any statistically significant relationship between age or sex and the length of the appendix. It is highly possible that in different populations the length of the appendix is affected by different factors. Regarding race, in a study of 56 cadavers of adult men (18-67 years) from Bangladesh (13), an average length of 10.21 cm (±2.50 cm) was found, while in the study mentioned above with cadaveric material from Iran (4), an average length of 9.12 cm was found for men and 8.03 cm for women (3). In Western countries the length of the appendix tends to be shorter, with the average length ranging between 5.3 and 6.9 cm. Significant differences are also observed on the African continent. For example, the average length of the process in Kenya was found to be 7.65 cm, while in Zambia it was 11.7 cm (3).

Conclusions

In the present review study, an important attempt was made to record and present the various anatomical variations of the vermiform appendix. The most common position variations are the retrocecal, pelvic, preileal, retroileal, subcecal, paracecal and prececal. Regarding the form variations, duplication of the appendix is more frequently recorded, while agenesis, hypoplasia, and triplication constitute uncommon variations. Also, significant variation is observed in appendix's length and diameter. It should be highlighted that the clinical importance of the variants is evenly great, irrespective of their incidence in the general population. Overall, genetic factors, lifestyle, geographic region, race, dietary habits and sex are likely to influence the shape and location of the appendix in humans. Therefore, with approximately 7% of the general population experiencing acute appendicitis during their lifespan (3), knowledge of the appendix's anatomical variations is really crucial for the clinician, and especially for the surgeon, to avoid complications in surgery and clinical practice.

What Is Already Known on This Topic:
Existing literature has already underlined the great diversity regarding the anatomy of the Appendix. In terms of Position, the retrocecal location is widely considered as the most common variant, followed by the pelvic, preileal, retroileal, subcecal, paracecal and prececal locations, all of which have been extensively studied. Regarding the Form variations, duplication is the most common variant and the most studied one, while variations in length and diameter present vast heterogeneity which is affected by many different factors.

What This Study Adds:
The aim of the present study is to investigate the great variety of anatomical variations of the Vermiform Appendix and, in addition, to sum up these variations, categorising them in 2 main groups: Variations in terms of Position and Variations in terms of Form of the Appendix.

Authors' Contributions: Conception and design: AS and FS; Acquisition, analysis and interpretation of data: AS and FS; Drafting the article: AS, FS, DS and DF; Revising it critically for important intellectual content: AS, FS, DS and DF; Approved final version of the manuscript: AS, FS, DC, T S-M and TT.

Conflict of interest: The authors declare that they have no conflict of interest.

References

1. Kacprzyk A, DroŚ J, Stefura T, Krzysztofik M, JasiŃska K, PĘdziwiatr M, et al. Variations and morphometric fea-

tures of the vermiform appendix: A systematic review and meta-analysis of 114,080 subjects with clinical implications. Clin Anat. 2020;33(1):85-98. doi: 10.1002/ca.23474. Epub 2019 Oct 12.

2. Bakar SM, Shamim M, Alam GM, Sarwar M. Negative correlation between age of subjects and length of the appendix in Bangladeshi males. Arch Med Sci. 2013;9(1):55-67. doi: 10.5114/aoms.2013.33349.
3. Ghorbani A, Forouzesh M, Kazemifar AM. Variation in Anatomical Position of Vermiform Appendix among Iranian Population: An Old Issue Which Has Not Lost Its Importance. Anat Res Int. 2014;2014:313575. doi: 10.1155/2014/313575. Epub 2014 Sep 10.
4. Mohammadi S, Hedjazi A, Sajjadian M, Rahmani M, Mohammadi M, Moghadam MD. Morphological variations of the vermiform appendix in Iranian cadavers: a study from developing countries. Folia Morphol (Warsz). 2017;76(4):695-701. doi: 10.5603/FM.a2017.0032. Epub 2017 Mar 29.
5. Singh N, Agrawal P, Singh DK, Agrawal GR. Computed tomography evaluation of variations in positions and measurements of appendix in patients with non-appendicular symptoms: time to revise the diagnostic criteria for appendicitis. Pol J Radiol. 2023;88:e407-14. doi: 10.5114/pjr.2023.131074.
6. Seyedhosseini-Davarani S, Akhgar A. Atypical Presentation of Acute Appendicitis: A 32-year-old Man with Gastroenteritis Symptoms; an Educational Case. Adv J Emerg Med. 2017;2(2):e21. doi: 10.22114/AJEM.v0i0.32.
7. Deshmukh S, Verde F, Johnson PT, Fishman EK, Macura KJ. Anatomical variants and pathologies of the vermix. Emerg Radiol. 2014;21(5):543-52. doi: 10.1007/s10140-014-1206-4. Epub 2014 Feb 26.
8. Laraqui H, Lamgari M, Essarghini M, Zentar A. An unusual presentation of appendicitis: a 23 cm long appendix in Morocco. Pan Afr Med J. 2019;32(72):72. doi: 10.11604/pamj.2019.32.72.18151.
9. Ndoye JM, Ndiaye A, Ndiaye A, Dia A, Fall B, Diop M, et al. Topographie et morphométrie cadavériques de l'appendice vermiculaire [Cadaveric topography and morphometry of the vermiform appendix]. Morphologie. 2005;89(285):59-63. French. doi: 10.1016/s1286-0115(05)83239-4.
10. Nayak SB, Soumya KV. "Anterior appendix": a boon for clinicians and radiologists. Surg Radiol Anat. 2019;41(11):1387-9. doi: 10.1007/s00276-019-02268-x. Epub 2019 Jun 18.
11. Nayak BS, Sirasanagandla SR, George BM, Mishra S, Pamidi N, Kumar V, et al. Lateral pouch appendix associated with retroperitoneal terminal part of the ileum: a potential diagnostic and surgical challenge. Anat Sci Int. 2015;90(4):324-6. doi: 10.1007/s12565-014-0249-7. Epub 2014 Jul 15.
12. Mozafari K, Kang T. A Case Report of Perforated Appendix Vermiform Attached to the Left Ovary. Cureus. 2023;15(12):e51270. doi: 10.7759/cureus.51270.
13. Ashwini E, Varun M, Saravanan PS, Julian S, Sandeep P. Hidden appendix: A case report and literature review of perforated acute appendicitis masquerading as acute cholecystitis. Int J Surg Case Rep. 2022;97:107480. doi: 10.1016/j.ijscr.2022.107480. Epub 2022 Aug 8.
14. Evola G, Lanaia A, Cantella R, Di Fidio C, Di Fede GF, Piazza L. Subhepatic perforated acute appendicitis in a patient with midgut malrotation: A case report and review of the literature. Int J Surg Case Rep. 2022;95:107249. doi: 10.1016/j.ijscr.2022.107249. Epub 2022 May 28.
15. Longani SK, Ahmed A. Classical Presentation of Acute Appendicitis in the Case of a Subhepatic Appendix. Cureus. 2019;11(10):e6035. doi: 10.7759/cureus.6035.
16. M V N, Gireesh, Subhash LP, Pai V. Sub-hepatic caecum. J Clin Diagn Res. 2013;7(9):1992-3. doi: 10.7860/JCDR/2013/6061.3380. Epub 2013 Sep 10.
17. Yoon EJ, Kim JW, Hong JH, Song SG, Kim HC, Hur YH, et al. Thermal Injury to the Subhepatic Appendix Following Percutaneous Ultrasound-Guided Radiofrequency Ablation for Hepatocellular Carcinoma: A Case Report. Diagnostics (Basel). 2023;13(21):3322. doi: 10.3390/diagnostics13213322.
18. Ghonge NP, Setia V, Aggarwal B. "Surface map" of the appendix: a novel tool for the preoperative demonstration of appendicular location with reference to McBurney's point using a multidetector CT. Diagn Interv Radiol. 2012;18(6):582-6. doi: 10.4261/1305-3825.DIR.5784-12.1. Epub 2012 Jul 30.
19. Hale SJ, Mirjalili SA, Stringer MD. Inconsistencies in surface anatomy: The need for an evidence-based reappraisal. Clin Anat. 2010;23(8):922-30. doi: 10.1002/ca.21044.
20. Naraynsingh V, Ramdass MJ, Singh J, Singh-Rampaul R, Maharaj D. McBurney's point: Are we missing it? Surg Radiol Anat. 2022;24(6):363-5. doi: 10.1007/s00276-002-0069-7.
21. Chauhan S, Anand S. Intracecal appendix: an extremely rare anatomical variation. A case report and review of literature. Surg Radiol Anat. 2017;40(1):111-4. doi: 10.1007/s00276-017-1890-3.
22. Munasinghe BM, Karunatileke CT, Hewawasam GGC, Hewavitharane CG, Kuruppu K. A peculiar appendix: A case report. Int J Surg Case Rep. 2022;99:107726. doi: 10.1016/j.ijscr.2022.107726. Epub 2022 Oct 10.
23. Abramson DJ. Vermiform appendix located within the cecal wall. Anomalies and bizarre locations. Dis Colon Rectum. 1983;26(6):386-9. doi: 10.1007/BF02553380.
24. Cañizares Quisiguiña SI, Guamán Maldonado LV, Hidalgo Jaramillo IM, Borja Herrera TP, Carrión Guzmán CLÁ. Incidental neuroendocrine tumor of a complete subserosal appendix: an unusual presentation of a rare anatomi-

cal variation. A case report and review of literature. BMC Surg. 2021;21(1):421. doi: 10.1186/s12893-021-01429-3.

25. Rousan LA, Jibril MI. Retro-psoas muscle vermiform appendix: an unusual location. Surg Radiol Anat. 2020;42(10):1259-61. doi: 10.1007/s00276-020-02477-9.
26. Hu Q, Shi J, Sun Y. Left-sided appendicitis due to anatomical variation: A case report. Front Surg. 2022;9:896116. doi: 10.3389/fsurg.2022.896116.
27. Evola G, Ferrara F, Di Fede GF, Patanè M, Sarvà S, Piazza L. Left-sided acute appendicitis in a patient with situs viscerum inversus totalis: A case report. Int J Surg Case Rep. 2022;90:106658. doi: 10.1016/j.ijscr.2021.106658. Epub 2021 Dec 4.
28. AlKeileh TB, Elsayed S, Adam RM, Nour M, Bhagchandi T. Left-sided appendicitis managed laparoscopically: a case report. J Med Case Rep. 2024;18(1):21. doi: 10.1186/s13256-023-04301-5.
29. Kakodkar P, Neo WX, Khan MHT, Baig MN, Khan T. An Incidental Discovery of Amyand's Hernia: A Case Study and Literature Review on Its Intraoperative Management. Cureus. 2020;12(12):e11858. doi: 10.7759/cureus.11858.
30. Fawcitt R. Appendix situated within the thorax. Br J Radiol. 1948;21(250):523-5. doi: 10.1259/0007-1285-21-250-523.
31. Babcock WW. Lumbar appendicitis and lumbar appendectomy. Surg Gynecol Obstet. 1946;82:414-6.
32. Williamson WA, Bush RD, Williams LF Jr. Retrocecal appendicitis. Am J Surg. 1981;141(4):507-9. doi: 10.1016/0002-9610(81)90149-5.
33. Yazawa K, Azuma Y, Kurokawa T, Yoshioka Y, Tsurita G, Shinozaki M. Abdominal CT-aided diagnosis of acute appendicitis in the presence of mobile cecum: A case report. Int J Surg Case Rep. 2018;42:258-260. doi: 10.1016/j.ijscr.2017.12.035. Epub 2017 Dec 28.
34. Akbaş A, Hacim NA, Daşiran F, Dagmura H, Daldal E. Acute Mono-appendicitis in a Case of Duplex Appendix: A Rare Finding. J Coll Physicians Surg Pak. 2020;30(4):440-2. doi: 10.29271/jcpsp.2020.04.440.
35. Alves JR, Maranhão IG, de Oliveira PV. Appendicitis in double cecal appendix: Case report. World J Clin Cases. 2014;2(8):391-4. doi: 10.12998/wjcc.v2.i8.391.
36. Dubhashi SP, Dubhashi UP, Kumar H, Patil C. Double Appendix. Indian J Surg. 2015;77(Suppl 3):1389-90. doi: 10.1007/s12262-013-1014-1. Epub 2013 Dec 4.
37. Markou M, Sotiropoulou R, Perente S, Kougioumtzi IT, Foutzitzi S, Chatzipantelis P, et al. Double appendixes: A rare case report. Clin Case Rep. 2022;10(2):e05330. doi: 10.1002/ccr3.5330.
38. Nageswaran H, Khan U, Hill F, Maw A. Appendiceal Duplication: A Comprehensive Review of Published Cases and Clinical Recommendations. World J Surg. 2018;42(2):574-81. doi: 10.1007/s00268-017-4178-1.
39. Olarinoye-Alegbejo MI, Steve K, Ologun GO. Incidental finding of double appendix during laparotomy for intussusception: A case report. Int J Surg Case Rep. 2020;75:219-21. doi: 10.1016/j.ijscr.2020.09.043. Epub 2020 Sep 14.
40. Xiang H, Han J, Ridley WE, Ridley LJ. Horseshoe appendix: Anatomical variant. J Med Imaging Radiat Oncol. 2018;62 Suppl 1:83. doi: 10.1111/1754-9485.31_12784.