Original article

Development of the vermiform appendix in children from different age ranges

Jorge, A.*, Ferreira, JR. and Pacheco, YG.

Anatomy Area, Department of Morphology, Faculty of Medicine, University of Brasilia – UnB
*E-mail: tatita.df@hotmail.com

Abstract

There is no precise anatomical trace that limits the vermiform appendix of the cecum in the newborn and in the child in the first years of life. The appendix presents a conical form, with an enlarged base and a narrow apex. The objective of the present work was to identify certain anatomical parameters, and to relate them chronologically to the different age groups in order to define when exactly the base of implantation of this organ in the cecum resembles the adult's anatomy. Sixty-seven (67) ileocecal transition pieces were grouped according to the different age groups: Group A (18 pieces of newborns at term) – Group B (14 pieces of six months-old children) – Group C (13 pieces of 12 month-old children) – Group D (11 pieces of 24 month-old children) and Group E (11 pieces of adults). The point of contact of the ileum anti-mesenteric edge in the cecum was identified and the distance between this and the edges, right (d.r.e.i) and left (d.l.e.i.), of the appendix implantation was assessed. The results were demonstrated through the crossing of variables in the different age groups and the statistical significance level was considered for $p < 0.05$. From the sixty-seven (67) pieces, forty-seven (70.1%) were obtained from males and twenty (29.9%) from females. The average extension of the vermiform appendix length was 5.3 cm. The retro ileum position was predominant in the first year of life (groups A, B and C). The average of the variables according to the age group (groups A, B, C, D and E) was: D.L.E.I. = 0.0-0.0-0.5-2.0-2.5 cm respectively. D.R.E.I. = 1.1-1.0-1.3-2.3-2.8 cm respectively. DIAMETER of the BASE = 1.0-0.8-0.4-0.3-0.5 cm respectively. The crossing of the average values of the distances from the left margin of the appendix base to the ileum (d.l.e.i.) was performed in groups A, B, C and D with the average value in group E (adult). Differences between these variables are statistically significant with $p = 0.00$ for groups A, B and C and $p = 0.003$ for group D, refuting the null hypothesis and confirming the alternative hypothesis. When the distance from the right margin of the appendix base to the ileum (d.r.e.i.) between groups A, B, C, D and group E is analyzed, the results also seemed to be statistically significant with $p = 0.00$ and $p = 0.004$ respectively. It was concluded that the development of the left margin of the vermiform appendix implantation to the ileum is considered as the most important anatomical parameter as much to the utmost acquisition of the form of the organ (narrow base), similar to that found in the adult individuals, as to the definition of the anatomical transition between the cecum and the vermiform appendix.

Keywords: vermiform appendix, cecum-appendicular region, appendicitis, in children.

1 Introduction

Results from studies evaluating the anatomical changes that occur along the development of the cecum-appendicular region responsible for the ultimate appearance of the vermiform appendix (narrow and well-defined base) similar to that observed in adult individuals, present no unanimity (BELLELLI, 1938; LAMBERTINI, 1932; MAISEL, 1960). It was observed that the vermiform appendix presents a variable location; however, there is a region in the organ that occupies a fixed site, where the outlet of the appendicular opening or appendix base is observed. In adult individuals, the appendicular base or fixed point is found at the inferior-medial wall of the cecum, below the ileocecal valve, exactly at the confluence of the three taenias of the large intestine. In newborns and young children, the base of this organ remains with no precise demarcation or limit of the lower cecum extremity, which adopts a conical configuration (AJMANI, ML. and AJMANI K., 1983; BERRY, 1895; KATZARSKI, GOPAL RAO and BRADY, 1979; HUNTER, 1928; OJEIFO, EJIWUNMI and IKLAKI, 1989; TESTUT and LATARJET, 1952; WAKELEY, 1933).

There is a consensus in literature in relation to the differentiated development of the distal cecal regions, higher in the right wall in relation to the left, what makes the appendix to develop from its pyramidal shape with enlarged base into a shape similar to the narrow-based shape found in adult individuals (COLLINS, 1932; CONDON, 1986; CRELIN, 1988; DI DIO, HABR-GAMA, GAMA et al., 1999; FERGUSON, 1891; FITZGERALD, NOLAN and O'NEILL, 1971; GARIS, 1941; MCVAY, 1984; TESTUT and LATARJET, 1952; WAKELEY, 1933).

The vermiform appendix development biology demonstrates that the viscera are subject to position variations as the proximal part of the large intestine elongates and the cecum, along with the appendix, dislocates towards the right iliac cavity. During this process, the appendix may reach that back part of the cecum (retro-cecum) and the pelvis (pelvic or descendent) or become a retro-ileum appendix.

The vermiform appendix is an anatomic organ with considerable significance in the medical practice. Its inflammation has been pointed as the most common cause of urgency laparotomy, being unusual among children younger the two years of age and reaching its peak of highest incidence at the second and beginning of the third decades of life. The sex incidence relation is 1:1 before puberty, increasing among males from 15 to 25 years of age (2:1) and decreasing until it is once again equal (STORER, 1985).

The reduced number of acute appendicitis cases in the first years of life (2/100) may be explained by the distinct anatomical characteristics of the appendix and its relation with the cecum (GROSFELD, WEINBERGER and CLATWORTHY, 1973). The suspect of a non-mechanic and obstructive etiology for the development of the inflammatory affection is always considered (CONDON, 1986).

The present work was aimed at identifying some anatomic parameters of the vermiform appendix in children from different age ranges with the objective of defining exactly when and how its enlarged-base conical aspect becomes similar to the anatomical standard observed in adult individuals.

2 Material and methods

This descriptive and quantitative research was submitted to the Ethics Research Committee of the University of Brasilia Medical School (CEP-FM009/2006) and conducted at the Mesoscopy Laboratory (Morphology Area). Samples were collected in the Pathology Unit of the Brasilia Maternal-Infantile Hospital. The exclusion criteria were: individuals not presenting any type of digestive tract malformation according to the macroscopic analysis.

Sixty-seven (67) ileocecal transition pieces were grouped according to the different age groups: Group A (18 pieces from newborns at term) – Group B (14 pieces from six month-old children) – Group C (13 pieces from 12 month-old children) – Group D (11 pieces from 24 month-old children) and Group E (11 pieces from adult individuals).

The ileocecal region was checked before dissection (Figure 1) for the verification of the abdomen localization according to regions (quadrants) and classification of the vermiform appendix position (retrocecal, retroileal, pelvic, free). Following, the distal portion of the ileum, cecum and the proximal portion of the large intestine were dissected, removed and fixed with 10% formaldehyde. The contact of the anti-mesenteric edge of the ileum with the cecum wall could be determined through simple inspection (Figure 2). The distance from this point up to the implantation and verification of the organ base diameter at the cecum distal region was measured.

Morphometry: the length of the vermiform appendix was initially measured (1). Following, the contact point of the anti-mesenteric edge of the ileum with the cecum was identified. The distance between this latter and the right (d.r.e.i) and left (d.l.e.i) edges of the vermiform appendix implantation were measured (2a and 2b), respectively. Finally, the diameter of the organ was evaluated in three different points along its length: at its base, intermediate

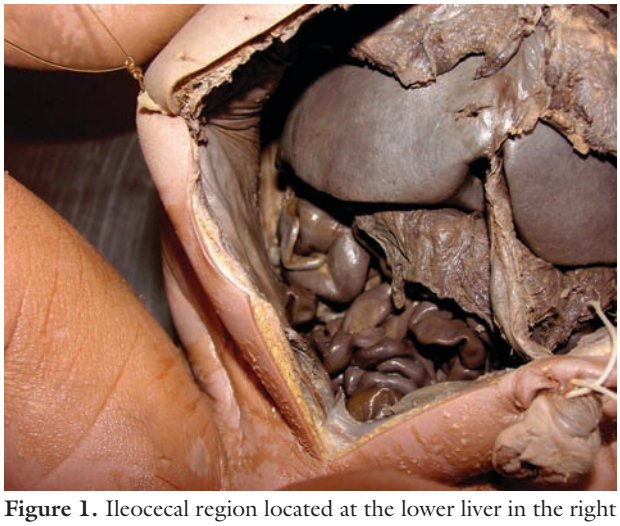

Figure 1. Ileocecal region located at the lower liver in the right hypochondria of female newborns.

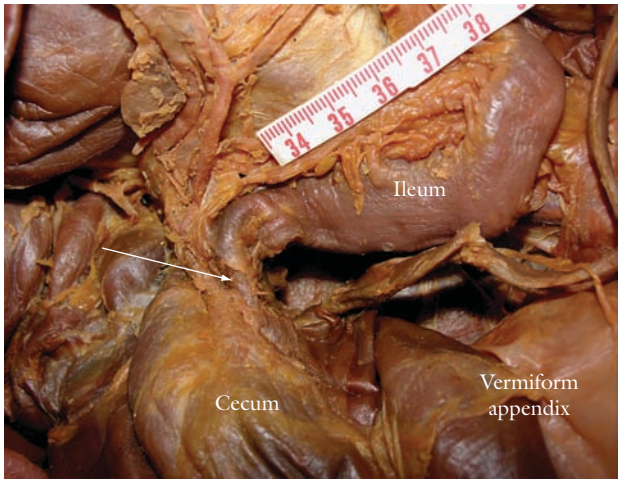

Figure 2. Junction point between the terminal ileum and the cecum (arrow). Piece from male individuals.

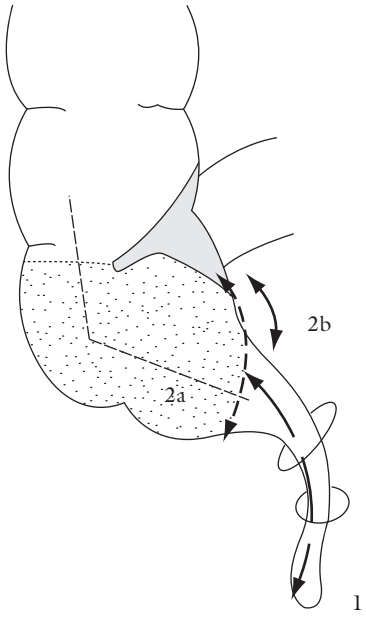

Figure 3. Design representing the vermiform appendix and its implantation in the cecum used as parameter for morphometric data.

portion and close to the apex (Figure 3). The taenias were evaluated through mesoscopy.

In cases where the appendix base presents infundibular shape, only the distance between the ileocecal junction point and the right edge of the appendix base (2a) could be measured, once the left edge, as previously mentioned, was coincident with the ileocecal junction.

Data obtained in this work were digitalized with the aid of the SPSS software. For the statistical analysis, the Mann-Whitney non-parametric test for independent samples was used. The results were demonstrated through the crossing of variables at the different age ranges: distance from the right and left edges of the implantation of the vermiform appendix to the ileocecal junction; difference in the appendix length; changes on the diameter of the appendix base along the years; age of appearing of taenias. For the statistic significance level, a value of $p < 0.05$ was adopted. All measurements were recorded in centimeters using a metal caliper rule (Vonder® of calibration 150 mm – 6''). A Metal angle measurer, protractor and magnification lenses (Ransor II -20) aided in the assessment of the structures evaluated.

3 Results

The morphologic and macro and mesoscopic aspects of the vermiform appendix development biology among children from birth up to twenty-four month of age were studied. Among the sixty-seven (67) transition pieces studied, forty-nine (70.1%) were from male individuals and twenty (29.9%) were from female individuals.

The cecum fixation site in the peritoneal cavity was more frequent at the right iliac fossa region, and the pelvic position of the vermiform appendix was the most observed among retrocecal, retroileal and free positions (Table 1).

Analyzing the vermiform appendix position according to age range, it was observed that the retroileal condition was predominant during the first year of life (groups A, B and C) after birth (Table 2).

The length (cm) of the vermiform appendix ranged from 2.5 to 12.5, with average of 5.36 cm (Figure 4).

The cecal region, along its development, experiences differentiated growth in some of its portions, and this is the reason why its appendicular structures undergo modifications in shape, dimension and localization. The cecum at birth (group A) and at six months of life (group B) presented infundibular aspect with no sacculations (Figures 4a,b and 5a,b) and the transition between its lower portion and the vermiform appendix is quite imprecise.

The distance between the right edge of the vermiform appendix implantation and the contact point of the ileum and the cecum (d.r.e.i) presents small length variations for groups (A, B, C and D), as demonstrated in Figure 5.

On the other hand, the distance from the left edge of the vermiform appendix implantation (d.l.e.i.) increased progressively for groups A, B, C and D, distancing from the

Table 1. Vermiform appendix position in relation to abdomen regions, Brasilia, Brazil (2007).

Appendix vermiform	Cecum	
	Right iliac fossa	Right Hypochondria
Pelvic	31	00
Retroileal	24	02
Retrocecal	08	00
Free	00	02
Total	63	04

Table 2. Absolute frequency of the vermiform appendix position in children and adults from different age ranges. Brasilia, Brazil, 2007.

Appendix vermiform	Cecum				
	Birth	6 monthes	1 year	2 year	Adult
Pelvic	04	01	09	08	09
Retroileal	12	13	01	00	00
Retrocecal	02	00	02	02	02
Free	00	00	01	01	00
Total	18	14	13	11	11

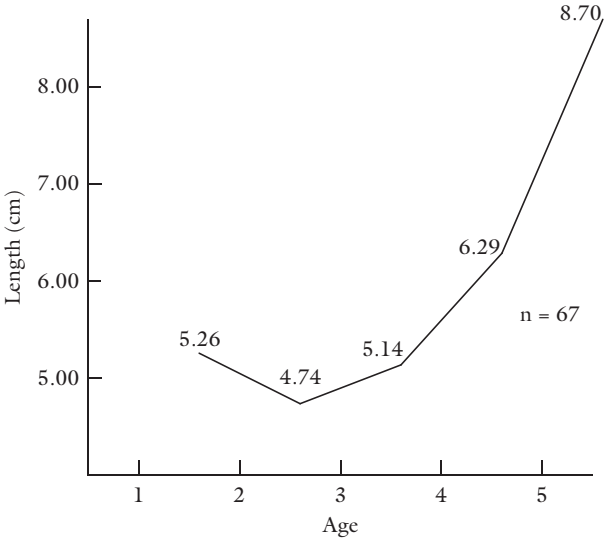

Figure 4. Demonstration of the vermiform appendix average length in centimeters per age range. Age: 1 = birth; 2 = 6 months; 3 = 1 year; 4 = 2 years; 5 = adult.

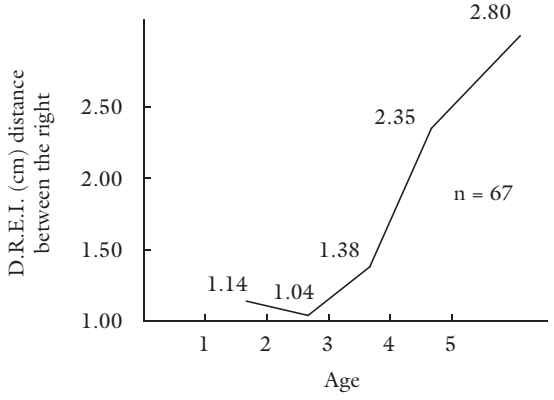

Figure 5. Demonstration of the average distance from the right edge of the vermiform appendix base to the ileum in centimeters per age range. Age: 1 = birth; 2 = 6 months; 3 = 1 year; 4 = 2 years; 5 = adult.

ileocecal contact site and decreasing the organ implantation base (Figure 6).

The external diameter of the appendix base is higher among newborn children (group A) and, from this point on, this value progressively decreases at the six month of age (group B), twelve months of age (group C) and twenty-four months of age (group D). In the control group (group E), a small but not significant increase on the average value is evidenced (Figure 7).

The development of appendicular apex external diameter demonstrated through the curve of Figure 8 revealed

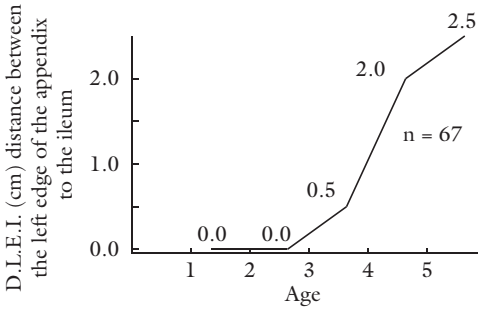

Figure 6. Demonstration of the average distance from the left edge of the vermiform appendix base to the ileum in centimeters per age range. Age: 1 = birth; 2 = 6 months; 3 = 1 year; 4 = 2 years; 5 = adult.

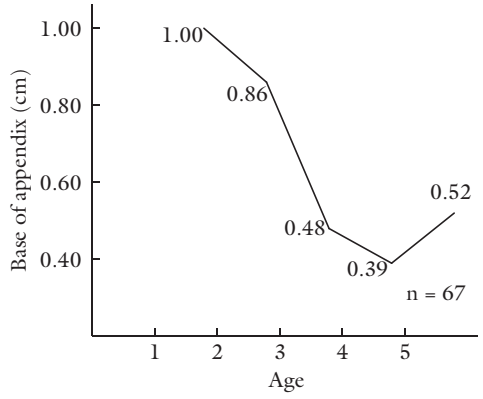

Figure 7. Demonstration of the average from the base of the vermiform appendix in centimeters per age range. Age: 1 = birth; 2 = 6 months; 3 = 1 year; 4 = 2 years; 5 = adult.

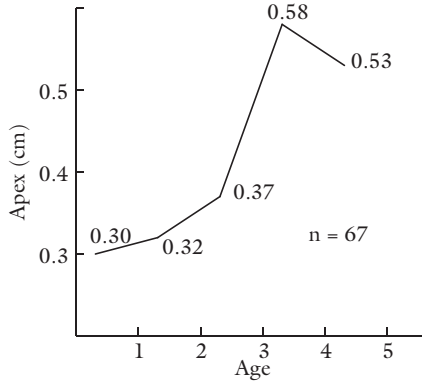

Figure 8. Demonstration of the average external diameter value of the vermiform appendix apex in centimeters per age range. Age: 1 = birth; 2 = 6 months; 3 = 1 year; 4 = 2 years; 5 = adult.

increasing and directly proportional values at the different age ranges (groups A, B, C, D and E).

Evaluating results of the distance from the left edge of the vermiform appendix base to the ileum (d.l.e.i.), a progressive increase of its extension is only observed from the first year of life on. The absolute values found for group E were higher than those of groups A, B, C and D. Comparing the average d.l.e.i. values between group E and the other age ranges (groups A, B, C and D) alone, one observes that the difference between distances is statistically significant ($p = 0.00$) in relation to birth, six months, twelve months and also at the age of 2 years; $p = 0.003$ (Figures 9a, b, c, d).

Evaluating the distance from the right edge of the vermiform appendix base to the ileum (d.r.e.i.), a progressive increase of its extension from the first year of life on is also observed. Through the comparison of average d.r.e.i values between group E and groups A, B, C and D alone, it is possible observing the existence of a difference statistically significant ($p = 0.00$) in relation to birth, six months of life and also in relation to group D (two-year-old children), $p = 0.004$ (Figures 10a, b, c, d).

4 Discussion

In human beings, along history and considering the dimensions and the lack of definition of its true function, the vermiform appendix was considered as a rudimentary and vestigial organ, which effective contribution along with other organs from the digestive system has been questioned (CANÇADO, 1988).

The analysis of results of this study has demonstrated that its average length is similar to that presented by Katzarski, Gopal Rao and Brady, (1979) and Ajmani, ML. and Ajmani K. (1983). Collins (1932) reports that the largest appendix described in literature found in 1980 by Grauer measured 33 cm. This size variety suggests that this organ is not under involution, but rather under a morphologic adaptation process.

The vermiform appendix is considered as the organ with the highest topographic variation in the abdomen. Studies have reported a variation of results in relation to its position in relation to other abdominal and pelvic organs (AJMANI, ML. and AJMANI K., 1983; BERRY, 1895; COLLINS, 1932; FERGUSON, 1891; FITZGERALD, NOLAN and O'NEILL, 1971; GARIS, 1941; MALAS, GOKÇIMEN and SULAK, 2001, 2004). In this work, the position of the vermiform appendix was found predominantly retroileal in the first year of life. During the second year of life, the predominant position was pelvic, result in disagreement with some other works (BERRY, 1895; COLLINS, 1932; FITZGERALD, NOLAN and O'NEILL, 1971).

The analysis of results is in agreement with description of Testut and Latarjet (1952) in relation to the anatomy of the cecal region in very young children. The cecum, from birth to the first year of life, presents conical shape, and its base is upward and towards the left side, from where its vertex sharpens and prolongs as vermiform appendix. Its surface does not present neither haustrations (sacculations) nor taenias. From this period on, the cecal-appendicular region presents a peculiar shape and other positions progressively are adopted by the vermiform appendix. There are reasons in literature to justify the different locations of the vermiform appendix that

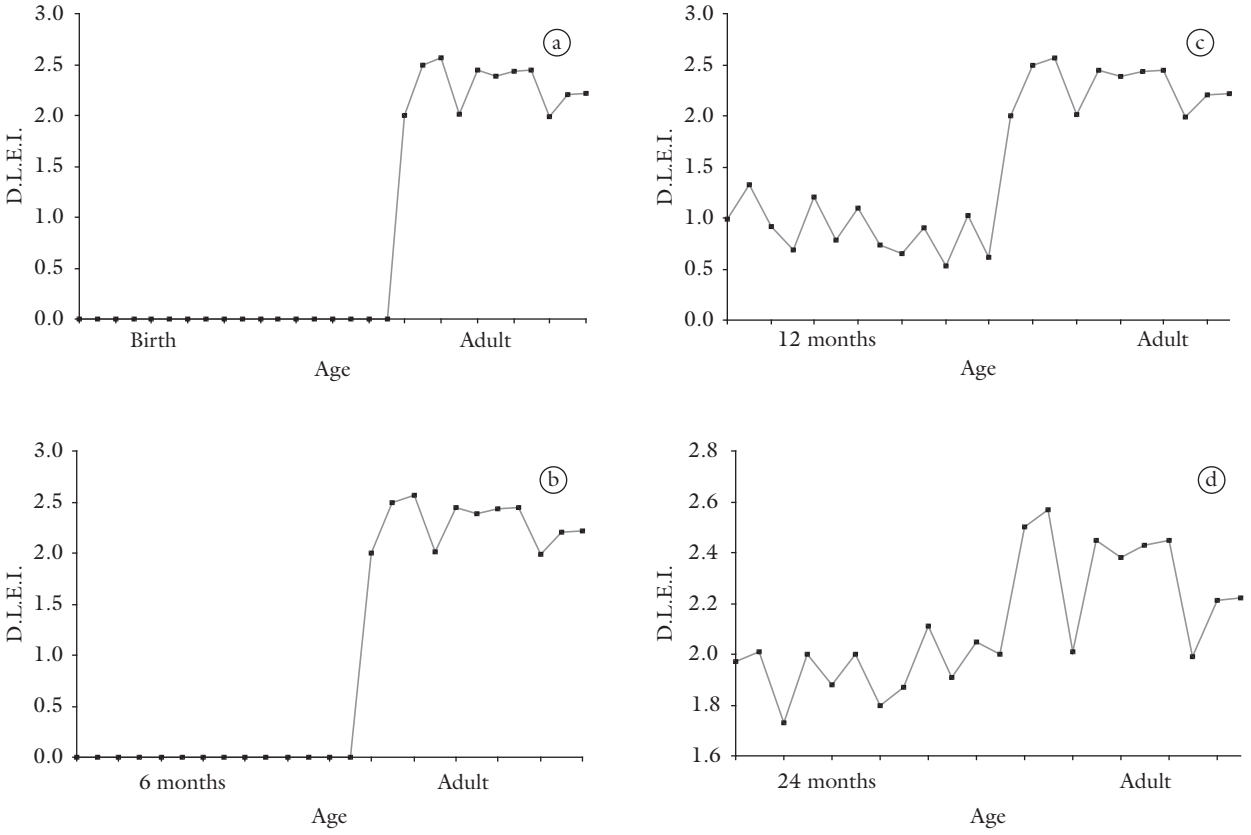

Figure 9. Graphic demonstration of the absolute value of the distance from the left edge of the vermiform appendix implantation to the ileum (d.l.e.i.) in centimeters, between different age ranges and the control group E (adult).

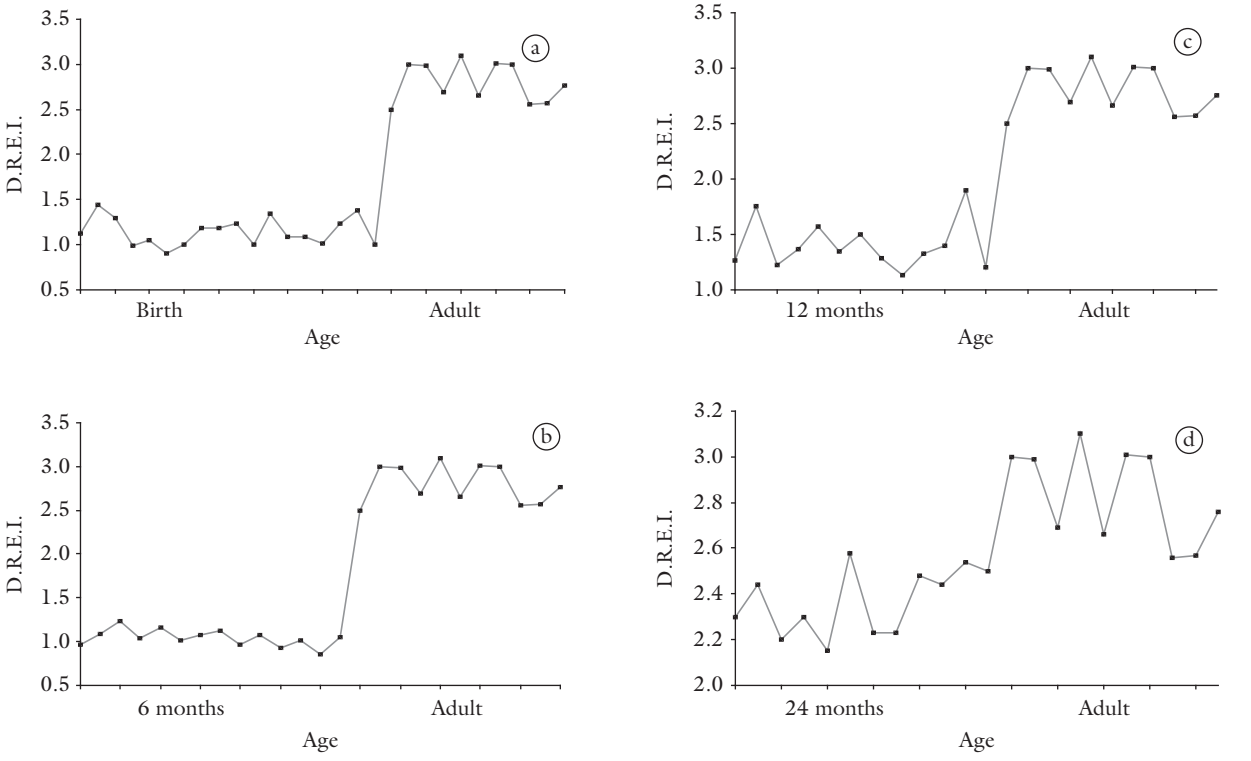

Figure 10. Graphic demonstration of the absolute value of the distance from the right edge of the vermiform appendix implantation to the ileum (d.r.e.i.) in centimeters, between different age ranges and the control group E (adult).

include the presence of the content and the cecum internal pressure, the effect of gravity in relation to the two-footed position adopted by human beings, the course and branches of the appendicular artery and the appearance of recess and peritoneum divisions (SMITH, 1911; WAKELEY, 1933). However, still considering the aspects already mentioned, it is believed that the morphologic alterations of the cecal region after birth is a relevant contribution for the determination of the ultimate position of the vermiform appendix, whatever it is, as demonstrated in this study.

Literature considers that the cecal-appendicular transition, according to the external appearance, presents three distinct shapes. Between birth and the first year of life, the cecum presents a pyramidal shape, where the vermiform appendix prolongs from its apex (type I = infantile). In the young child, the cecum presents a differentiated growth and approximates the implantation of the appendix of the terminal ileum (type II = child). These structural modifications that emerge and develop along years determine the appearance of the appendix found in adult individuals (type III), with narrow base at 2.5 cm from the ileocecal junction (GARIS, 1941).

Many authors agree that the lower edge of the cecum at the right side of the vermiform appendix opening expands and grows more in length that in the left lower edge and that, besides dislocating the base of the vermiform appendix towards the ileum, grants an anatomic shape to the cecal-appendicular region similar to that found in adult individuals (CONDON, 1986; DI DIO, HABR-GAMA, GAMA et al., 1999; GARIS, 1941; MCVAY, 1984; TESTUT and LATARJET, 1952; WAKELEY, 1933).

The mesoscopy revealed that the vermiform appendix presented wide base and the lack of an anatomic component that makes it different from the cecum (groups A and B). This opening extends since the junction point between both intestines (ileocecal transition) up to the right edge of implantation of the organ in the cecum. It was observed that the diameter of the appendix base decreased in length since its left edge progressively approximated to the right edge, making the implantation of the organ to separate from the junction with the ileum. Therefore, the appearance of a gap between the ileum and the left edge of the vermiform appendix occurred, which is not apparent before the age of six months of life (d.l.e.i.).

Is has also been demonstrated that the cecum, at a given age, presented two edges in its lower region: one at the right side and another at the left side of the appendix. It is worth mentioning that this aspect presents the outline (beginning) of the future cecal profile cul-de-sac (Figures 14a, b).

Unlike what has been reported by the authors mentioned above, this study revealed that the distance between the junction point of both intestines and the implantation of the appendix left base (d.l.e.i.) increases in length more than the contralateral edge (d.r.e.i.), transforming the pyramidal shape of the vermiform appendix (cecal-appendicular region). From the first year of life on, the diameter of the vermiform appendix base decreases in size and at the second year of life, the anatomic aspect of the cecal-appendicular region is proportionally very similar to that found in adult individuals.

Figures 9 a, b, c, d clearly demonstrate the relation between distances from the left edge of the vermiform appendix base to the ileum (d.l.e.i.) present in group A, B, C and D with values found in adult individuals. The difference between this statistically significant variable ($p < 0.05$) for groups A, B, C and D rejects the null hypothesis and adopts the alternative hypothesis, in other words, this anatomic parameter (d.l.e.i.) seems to be a relevant factor in the development of the vermiform appendix along the first years of life.

On the other hand, the distance from the right edge of the appendix base to the ileum (d.r.e.i.) did not change much between infantile groups when compared to the control group.

The authors consider that the cecal diverticulum forms from the sixth embryonic week on (MOORE, 1984). The vermiform appendix develops as continuity of the cecal diverticulum, emerging from its most lower region, but with no anatomic evidence of the limit between one organ and another.

It is observed that anatomic pieces (Figures 11, 12, 13a, b) still with no cul- de-sac appearance, presented lower expansion (vermiform appendix) at predominantly retroileal position, as also described in other publications (SMITH, 1911; OJEIFO, EJIWUNMI and IKLAKI, 1989).

According to the authors, the aspect of the cecum in cul-de-sac with several large sacs (regions) emerge with the increase on the internal pressure, as a result of the fecal content, which expands the organ walls and forms a typical characteristic of the large intestine, the haustrations (WAKELEY, 1933). The spatial modification of the cecum longitudinal muscular layer sheaves arranged into three concentrated sheaves (taenias) precedes the appearance of haustrations and hence contributes for their formation (CONDON, 1986). Thus, identifying in which period taenias are present at cecum level may also demonstrate when the cecum start presenting haustrations and hence the cul-de-sac aspect.

Many authors report that the presence of three intestinal taenias meeting towards the appendix and the growth of the cecum lower region are described as the most expressive factors for the definition of the anatomic transition between these two organs (DI DIO, HABR-GAMA, GAMA et al., 1999; GARIS, 1941; MCVAY, 1984; TESTUT and LATARJET, 1952; WAKELEY, 1933). Through the macroscopic inspection of the ileocecal transition pieces, which are object of this study, it was evidenced that taenias are absent in groups A, B and C, and that only from the second years of life on (group D), the presence of these muscular structures may be verified. Based on these findings and according to other authors (HUNTER, 1928; PACE, 1971), there is no coherence asseverating that the differentiated growth of cecum regions after the appearance of taenias would justify the transformation of the cecal-appendicular presentation under the shape of a well-defined elongated projection with narrow base and lower and medial location in relation to the cecum before the second year after birth. Based on analyses performed, it is possible inferring that the modification of the cecum infundibular profile is evidenced by the emergence and progressive increase of the distance between the appendix base and the ileum (d.l.e.i.), rather that by the higher growth of the right lower edge in relation to the cecum left edge. It is important suggesting that this asymmetric growth could surely collaborate for the several positions adopted by the vermiform appendix; however, the occurrence of this differentiation before the

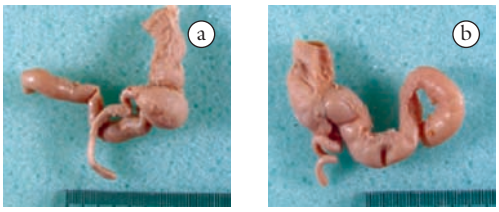

Figure 11. Ileocecal region of male children born at term. a) Pieces 05; and b) 71 – group A.

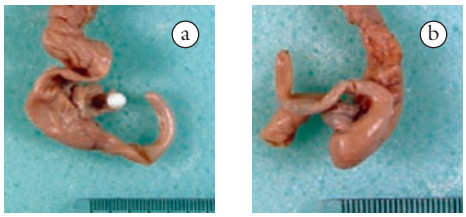

Figure 12. Ileocecal region of male children with 6 months of life. a) Pieces 12; and b) 66 – group B.

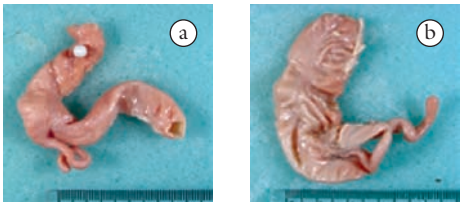

Figure 13. Ileocecal region of male children with 12 months of life. a) Pieces 124; and b) 135 – group C.

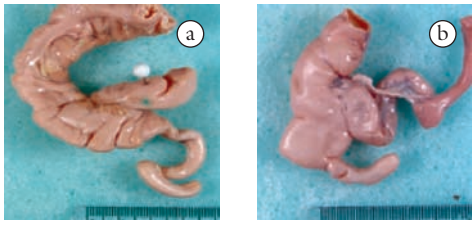

Figure 14. Ileocecal region of male children with 2 years of life. a) Pieces 18; and b) 08 – group D.

second year of life would be chronologically improbable, since the cecum in cul-de-sac develops only from the second year after birth on.

The vermiform appendix inflammatory process almost never occurs during the first year after birth (BARLETT, ERAKLIS and WILKISON, 1970; BELL, 1982; GILBERT, EMMENS and PUTNAM, 1985). The incidence of appendicitis among children younger than two years of age is smaller than 2% (GROSFELD, WEINBERGER and CLATWORTHY, 1973). Based on the anatomic characteristics of the cecal-appendicular region, Parsons, Miscall and McSherry (1970) and Cançado (1988) consider acute appendicitis as a rare infection among children younger than one year of age. The results presented in this study are not in agreement with these authors, once even considering results that approximate diameters of the vermiform appendix base between groups D and E (Figure 9c, d), there is a statistical difference between results and therefore, the null hypothesis should not be rejected. Further studies should be conducted with other ultra-structural techniques in order to elucidate these questions.

The conical shape of the vermiform appendix demonstrated with a wide implantation in the cecum and with higher internal diameter in relation to the apex grants the organ a natural protection against possible mechanical obstructions of its lumen. The retroileal position predominantly observed along the first year of life is considered the second most important aspect, so far not mentioned in literature, in the prevention of eventual appendix obstruction cases. The reason is quite simple. Due to gravity, the retroileal ascendant direction of the cecal-appendicular region tends to dislocate any fecal stasis or impactation of fecalito at the cecal-appendicular transition proximities.

The appendix has been usually removed during other abdominal surgeries with the objective of preventing a possible condition of acute abdominal pain with surgical indication. More recently, its extirpation has been selectively indicated with the objective of suppressing immunologic reactions and avoiding the appearance of inflammatory diseases against the digestive system (BJERKE, BRANDTZAEG and ROGNUM, 1986; KHLYSTOVA and RABOTNIKOVA, 1984; DASSO, OBIAKOR, BACH et al., 2000; KOUTROUBAKIS and VLACHONIKOLIS, 2000; LOREN, 2006; MELLEMKJAER, JOHANSEN, LINET et al., 1998; RUTGEERTS, D'HAENS, HIELE et al., 1994; SPOETTI, HAUSMANN, HERLYN et al., 2006; SAKIMBAEV, 1984). Time, experience, new ideas and discoveries made some surgeons to adopt this less incisive procedure when it is found free of pathologies. This behavior change reflects the evolution of techniques of several surgical specialties. The vermiform appendix is currently used as "a sphincterian muscle" in urology surgeries that remove the urinary bladder and use the intestine in the reconstruction and integration of the urinary system (DVORACEK and KOCVARA, 1995). This may also be successfully used in a temporary transposition for a diseased ureter, allowing the urine to flow from the kidneys to the bladder. Thus, the appendix, once considered as a useless organ, is now considered as useful in reparatory surgeries, also promoting a local immunity, identifying and eliminating antigens from food, drugs and from the intestinal microbial flora. In the past, the appendix was removed; now, it is no longer rejected if healthy.

5 Conclusion

The high frequency of the retroileal position within the first year of life corroborates the low incidence of vermiform appendix inflammation rate among young children. The retroileal position associated to the gravity effect represents strong indicative of protection against mechanical obstructions of the lumen.

The average length of the vermiform appendix was 5.3 cm with maximum extension of 12.5 cm, reason why it cannot be considered as a rudimentary organ under involution. No

evidence of regression on its dimensions along the years was observed, except for vermiform appendix base.

The vermiform appendix base presents a relative decrease in size after birth. Its spatial configuration (shape) at the age of two years is very close to that found in adult individuals. The statistical analysis demonstrated that the values found do not exclude the null hypothesis. The emergence and growth of the distance from the left edge of the vermiform appendix implantation to the ileum is the most important anatomic parameter in the acquisition of the ultimate shape of the organ (narrow base), which is similar to that found in adult individuals. The emergence of the left edge establishes the limit on the anatomic definition of the transition between cecum and the vermiform appendix.

The infundibular shape and the retroileal position present during the first year of life are factors of natural protection against casual lumen mechanical obstruction of the vermiform appendix. The anatomic characteristics described at the cecal-appendicular region before the second year of life justify the low acute appendicitis rate among young children.

The non-prophylactic removal of the vermiform appendix is current a consensus in the surgical practice, once it deals about a useful tissue in the reconstruction of diseased organs, incompatible with organic rejections.

References

AJMANI, ML. and AJMANI, K. The position, length and arterial supply of vermiform appendix. *Anatomischer Anzeiger*. 1983, vol. 153, no. 4, p. 369-374.

BARLETT, RH., ERAKLIS, AJ. and WILKISON, RH. Appendicitis in infancy. *Surgery, Gynecology and Obstetrics*. 1970, vol. 130, p. 99-104.

BELL, MJ. Appendicectomy in Childhood: analysis of 105 negative explorations. *American Journal of Surgery*. 1982, vol. 144, no. 3, p. 335-337.

BELLELLI, F. Splancnologia. In Bell, MJ. (Ed.). *Anatomia del neonato*. 6 ed. Napoli, 1938. p. 120-121.

BERRY, RJ. The anatomy of the vermiform appendix. *Anatomischer Anzeiger*. 1895, vol. 10, p. 761-769.

BJERKE, OK., BRANDTZAEG, OP. and ROGNUM, TO. Distribution of immunoglobulin producing cells is different in normal human appendix and colon mucosa. *Gut*. 1986, vol. 27, p. 667-674.

CANÇADO, JR. apendicite aguda e outras afecções do apêndice. In DANI, R., CASTRO, LP. (Ed.). *Gastroenterologia clínica*. 2 ed. Rio de Janeiro: Guanabara Koogan S.A., 1988. p. 822-829. (vol. 2).

COLLINS, DC. The length and position of the vermiform appendix. *Annals of Surgery*. 1932, vol. 96, p. 1044-1048.

CONDON, RE. Appendicitis. In SABISTON, DC. (Ed.). *Textbook of surgery*. 13 ed. Tokyo: W. B. Saunders Company, 1986. p. 967-981.

CRELIN, ES. Intestino grosso. In Crelin, ES. (Ed.). *Anatomia do recém-nascido*. 1 ed. São Paulo: Panamericana, 1988. p. 56-57.

DASSO, JF., OBIAKOR, H., BACH, H. et al. Morphological and immunohistological study of the human and rabbit appendix for comparasion with the avian bursa. *Developmental and Comparative Immunology*. 2000, vol. 24, p. 797-814.

DIO, LJA. Sistema digestório. In Dio, LJA. (Ed.). *Tratado de anatomia aplicada*. 1 ed. São Paulo: Póluss, 1999. p. 558-561.

DVORACEK, J. and KOCVARA, R. The vermiform appendix and its use in urology. *Rozhledy v Chirurgii: mesicnik Ceskoslovenske chirurgicke spolecnosti*. 1995, vol. 74, no. 4, p. 176-9.

FERGUSON, J. Some important points regarding the appendix vermiformis. *American Journal of Medicine Sciences*. 1891, p. 61-62.

FITZGERALD, MJT., NOLAN, JP. and O'NEILL, MN. The position of the human caecum in fetal life. *Journal of Anatomy*. 1971, vol. 109, no. 1, p. 71-74.

GARIS, CF. Topography and Development of the Cecum-Appendix. *Annals of Surgery*. 1941, vol. 113, no. 4, p. 540-548.

GILBERT, SR., EMMENS, RW. and PUTNAM, TC. Appendicitis in children. *Surgery,Gynecology and Obstetrics*. 1982, vol. 161, p. 261-267.

GROSFELD, JL., WEINBERGER, M. and CLATWORTHY Jr., W. Acute appendicitis in the first two years of life. *Journal of Pediatric Surgery*. 1973, vol. 8, no. 2, p. 285-292.

HUNTER, HR. A note on the development of the ascending colon. *Journal of Anatomy*. 1928, vol. 62, p. 297-300.

KATZARSKI, M., GOPAL-RAO, UK. and BRADY, K. Blood supply and position of The vermiform appendix in zambians. *Medical Journal of Zambia*. 1979, vol. 13, no. 2, p. 32-34.

KHLYSTOVA, ZS. and RABOTNIKOVA, EL. Development of the mucosa and differentiation of the lymphocytes of the vermiform appendix of the human fetus. *Arkhiv Anatomii, Gistologii I Embriologii*. 1984, vol. 86, no. 5, p. 63-68.

KOUTROUBAKIS, IE. and VLACHONIKOLIS, IG. Appendectomy and the development of ulcerative colitis: results of a metaanalysis of published case-control studies. *American Journal of Gastroenterology*. 2000, vol. 95, p, 171-176.

LAMBERTINI, G. Anatomia Nipioligica. In CACACE, E. (Ed.). *Tratado di Nipiologia*. Roma: Minerva Medica, 1932. p. 208-211.

LOREN, GM. *Scientific American*: ask the experts. New York: Scientific American, 2006. Available from: <http://www.scientificamerican.com/section.cfm?id=ask-the-experts>. Access in: 20/09/2006.

MAISEL, H. The position of the human vermiform appendix in fetal and adult age groups. *Anatomy Record*. 1960, vol. 136, no. 4, p. 385-389.

MALAS, MA., GÖKÇIMEN, A. and SULAK, O. Growing of caecum and vermiform appendix during the fetal period. *Fetal Diagnosis and Therapy*. 2001, vol. 16, no. 3, p. 173-177.

MALAS, MA., SULAK, O., GÖKÇIMEN, A. et al. Development of the vermiform appendix during the fetal period. *Surgery Radiologics Anatomy*. 2004, vol. 26, no. 3, p. 202-207.

McVAY, CB. Abdominal cavity and contents. In McVay, CB. (Ed.). *Surgical Anatomy*. 6 ed. Tokyo: W. B. Saunders Company, 1984. p. 689-709.

MELLEMKJAER, L., JOHANSEN, C., LINET, MS. et al. Cancer risk following appendectomy for acute appendicitis. *Cancer Causes Control*. 1998, vol. 9, p. 183-187.

MOORE, KL. Aparelho digestivo. In Moore, KL. (Ed.). *Embriologia clínica*. 3 ed. Rio de Janeiro: Interamericana, 1984. p. 227-229.

OJEIFO, JO., EJIWUNMI, AB. and IKLAKI, J. The position of the vermiform appendix in nigerians with a review of the literatue. *West African Journal of Medicine*. 1989, vol. 8, no. 3, p. 198-204.

PACE, JL. The age of appearance of the haustra of the human colon. *Journal of Anatomy*. 1971, vol. 109, no. 1, p. 75-80.

PARSONS, JM., MISCALL, BG. and McSHERRY, CK. Appendicitis in the new born infant. *Surgery*. 1970, vol. 67, p. 841-846.

RUTGEERTS, P., D'HAENS, G., HIELE, M. et al. Appendectomy protects against ulcerative colitis. *Gastroenterology*. 1994, vol. 106, p. 1251-1253.

SAKIMBAEV, ER. Age anatomy of the grouped limph nodules in the human appendix. *Arkhiv Anatomii, Gistologii I Embriologii*. 1984, vol. 87, no. 8, p. 60-64.

SMITH, GM. A statistical review of the variations in the anatomic positions of the cecum and the processus vemiformis int the infant. *Anatomy Record*. 1911, vol. 5, p. 549-556.

SPOETTI, T., HAUSMANN, M., HERLYN M. et al. Monocyte Chemoattractant Protein 1 (MCP-1) inhibits the intestinal-like differentiation of monocytes. *Clinical and Experimental Immunology*. 2006, vol. 145, p. 190-199.

Statistical Package for the Social Sciences - SPSS. São Paulo: SPSS, 2006. Available from: <http://www.spss.com.br>. Access in: 25/07/2006.

STORER, EH. Apêndice. In SCHWARTZ, SL., SHIRES., GT., SPENCER, FC. et al. (Ed.). *Princípios de cirurgia*. 4 ed. Rio de Janeiro: Guanabara Koogan S.A., 1985. p. 1385-1397. (vol. 2).

TESTUT, L. and JACOB, O. Cavidad abominal y Su Contenido. In TESTUT, L., JACOB, O. (Ed.). *Tratado de anatomia topográfica*: com aplicaciones médicoquirúrgicas. Spain: Salvat, 1952. p. 257-269. (tomo 2).

TESTUT, L. and LATARJET, A. Tubo digestivo: ciego e apêndice. In Testut, L., Latarjet, A. (Ed.). *Tratado de anatomia humana*. Spain: Salvat, 1952. p. 408-447. (tomo 4).

WAKELEY, CPG. The position of the vermiform appendix as ascertained by an analysis of 10,000 cases. *Journal of Anatomy*. 1933, vol. 67, p. 277-283.

Received March 15, 2009
Accepted July 7, 2009