

MORPHOGENESIS: MAPPING THE SHAPE AND ALIGNMENT OF HUMAN FOETAL OVARIES

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ABSTRACT

Aim: To determine the morphological features such as shape and orientation of human foetal ovaries during development

Materials and methods: The study comprises of 40 human fetuses (80 ovaries) aged between 12 to 32 weeks without any gross abnormalities.

Result: The most common shape observed across the gestation was almond shape (58.75%) and the least observed was the S-Shaped (11.25%). The oblique orientation was the most common presentation followed by the vertical (47.50%) and the least observed as horizontal (11.25%)

Conclusion: Ovarian morphology and orientation varied throughout development, occasionally demonstrating a mixed presentation. Almond shape was most common shape found in all trimester of pregnancy. These findings contribute foundational insights into human fetal anatomical development and the mechanical shifts the ovaries undergo across gestation.

KEYWORDS: Development, morphology, foetal ovaries

INTRODUCTION

The prenatal period constitutes a critical window for the development of female reproductive organs.¹ In both sexes, gonadal differentiation begins when primordial germ cells migrate from the yolk sac via the dorsal mesentery. By the fifth week, they populate the posterior abdominal wall mesenchyme adjacent to the tenth thoracic vertebra. The arrival of migrating primordial germ cells triggers the proliferation and thickening of the coelomic epithelium, leading to the formation of the paired genital ridges.^{2,3} After the 6th week of development these cells proceed in different fates in males and females. While the absence of a Y chromosome initiates ovarian differentiation, a complete 46,XX complement is essential for normal ovarian development.⁴ Each organ possesses a critical developmental window during gestation; disruption of growth during this specific period can permanently impair organ function, increasing susceptibility to disease later in life.⁵ Congenital and acquired ovarian pathologies often originate during intrauterine development, given the broad spectrum of abnormalities that can manifest across the ovarian life cycle hence the knowledge of the ovarian morphology is essential.⁶ Understanding ovarian morphology may provide deeper insights into both normal developmental anatomy and congenital malformations of the external genitalia.

MATERIALS AND METHODS

40 aborted fetuses (80 ovaries) without any gross abnormality were collected ranging from 12 to 32 weeks from MGM Medical College Kamothe, Department of Obstetrics and Gynaecology kalamboli, Navi Mumbai and Aurangabad after ethical review and permission from the MGMIHS Ethical committee (MGMIHS/RS/2015-16/195). Gestational age was determined based on obstetrical history, crown-rump length (CRL), and foot length. The fetuses were preserved in 10 % formalin. A median incision along the abdominal wall was taken and the flaps were reflected laterally. The ovaries were observed for their position and shape.

RESULT

Morphological analysis revealed four distinct ovarian shapes, characterized as 1) almond, 2) rod-like, 3) bean-shaped, and 4) S-shaped. The most common shape observed across the gestation was almond shape (58.75%) across trimester and the least observed was the S-Shaped (11.25%), Table 1. Almond was the most prevalent shape during weeks 12–15, 18–20, 21–23, 28–30, and 32–34, whereas a rod shape predominated during weeks 24–26. The right and left ovaries showed difference distribution in the shapes. In the present study either both of them presented the same shape or different shapes across the gestation. (Figure 1-3)

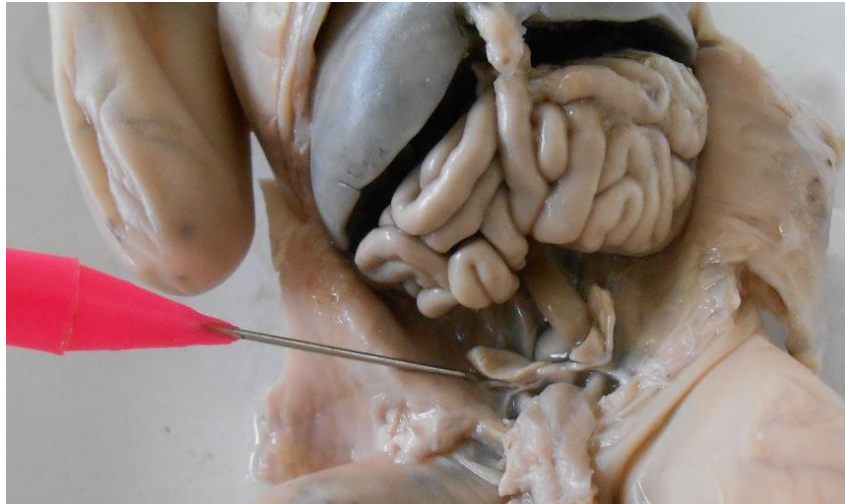


Figure 1: An 18-week female foetus. The black arrow indicates the horizontally oriented, almond-shaped right ovary, while the red arrow denotes the vertically oriented, bean-shaped left ovary

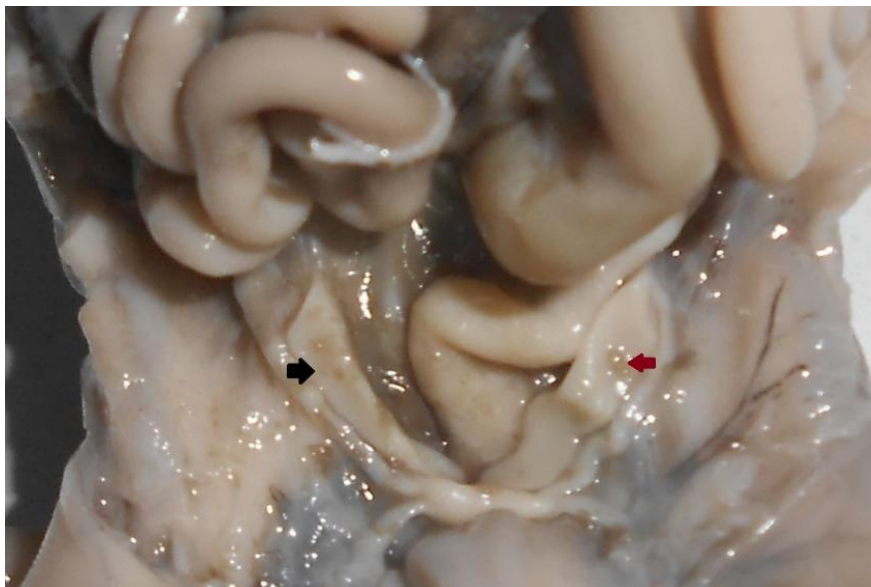


Figure 2: A 15-week female foetus demonstrating an oblique orientation of both ovaries. The black arrow indicates the rod-shaped right ovary, while the left arrow highlights the S-shaped left ovary.

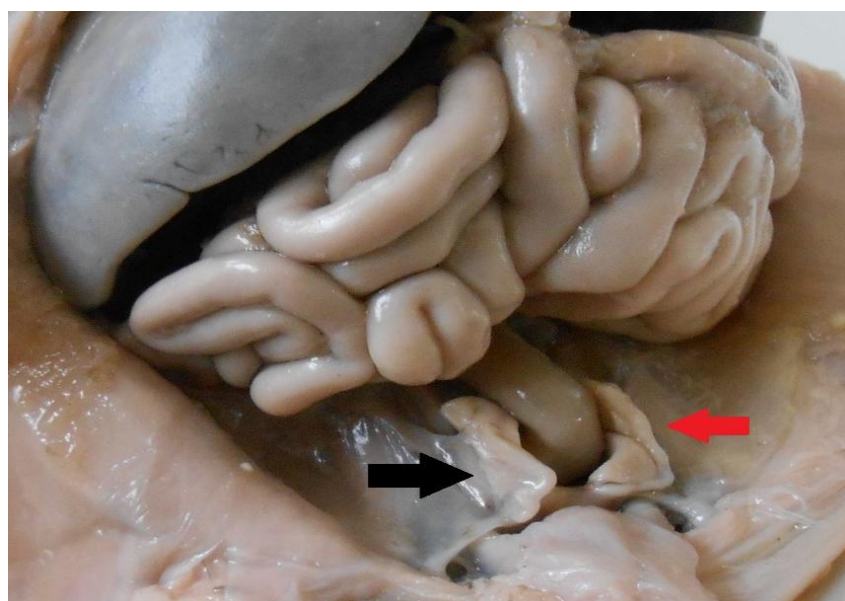


Figure 3: A 22-week female foetus. The Black arrow shows right ovary and red arrow shows left ovary both oriented vertical

Table 1: Showing percentage of distribution of different ovarian shapes

Almond	Rod	Bean	S shaped
47/80	13/80	11/80	9/80
58.75%	16%	13.75%	11.25%

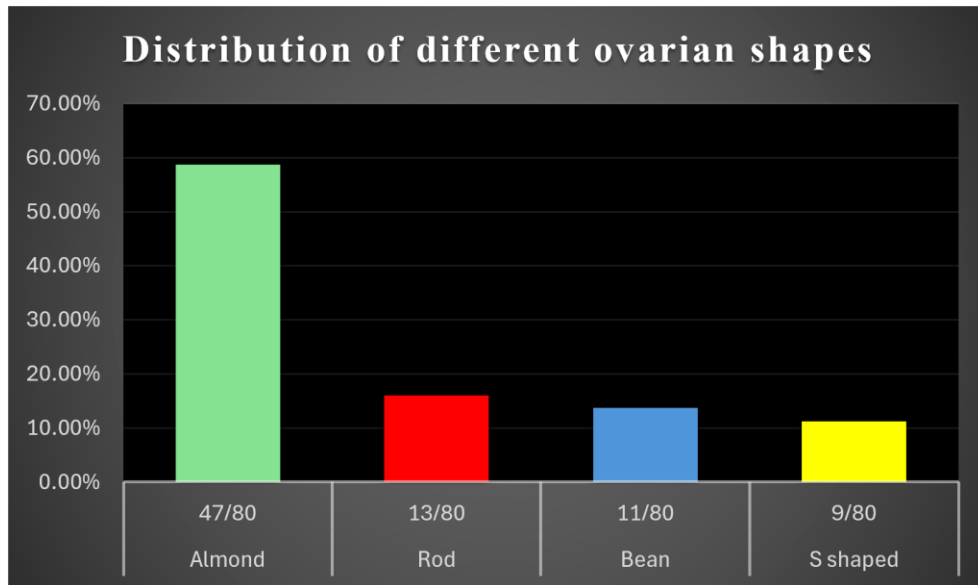


Figure 4: Percentage of distribution of different types of ovarian shapes

The orientation of the long axis of ovaries was observed. Three different orientations were appreciated in the present study such as 1) horizontal, 2) vertical and 3) oblique (Figure 5). Combination of orientations was appreciated in right and left ovary in fetuses. (Figure 1-3). The ovaries were most commonly obliquely placed. Vertical orientation ranked second followed by horizontal. (Table 2 & Figure 6).

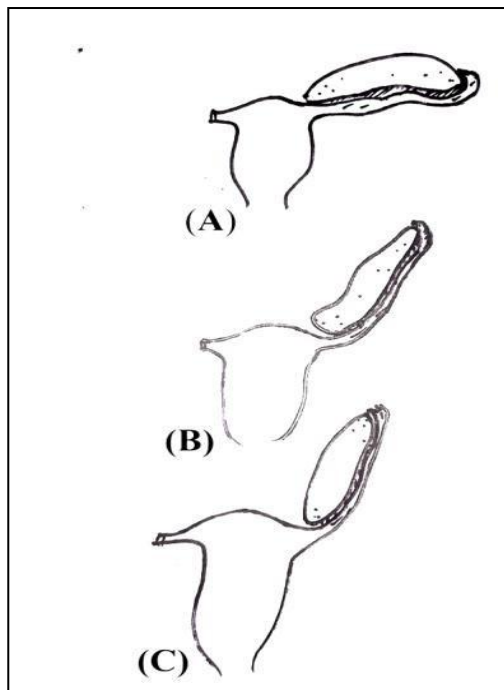


Figure 5: Diagrammatic schema showing different ovarian position. (A) Showing the horizontal position of the ovaries (B) Oblique position of the ovaries (C) Vertical position of the ovary.

Table 2: Percentage of different type of ovarian orientation of long axis

Oblique	Vertical	Horizontal
38/80	33/80	9/80
47.50%	41.25%	11.25%

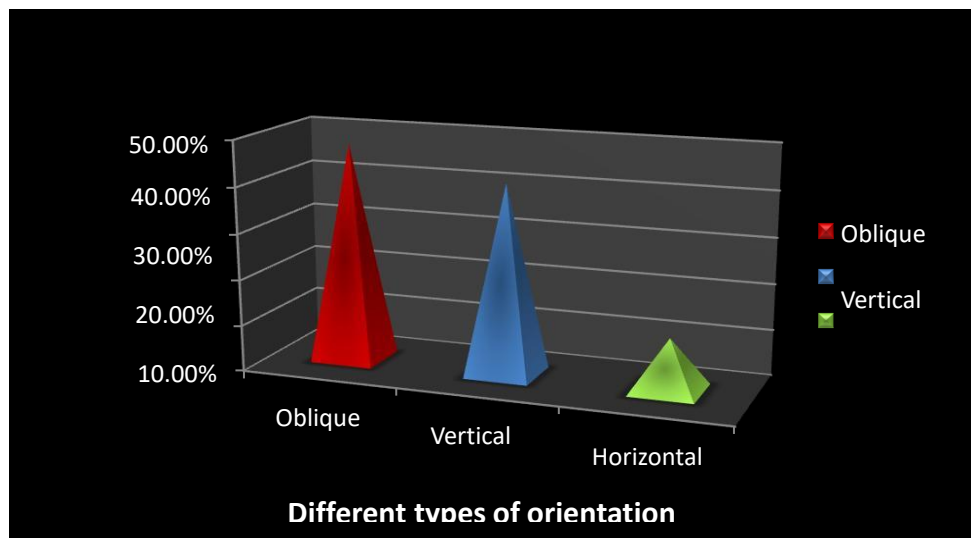


Figure 6: Percentage of distribution of different types of ovarian long axis

DISCUSSION

Shape:

The present study has classified 4 different types of ovarian shapes. In the present study the most common shape observed was almond 58.75% both followed by Rod (16%), Bean (13.75%) and S Shape (11.25%). Ovarian morphology varied notably between sides, with identical shapes observed bilaterally in only 16 out of 40 cases (40%). Consistent with previous literature, an almond-like morphology was the most prevalent shape, aligning with the findings of Sulak et al. (2006)⁶, Rani and Prasuna (2017)⁷, and Momin and Singh (2017).⁸ According to Sulak et al. (2006)⁶, ovarian shape frequencies vary across gestational stages. The almond shape (Type T4) was most common in the first trimester (9-12 weeks) (45.8%), second trimester (13-25 weeks) (55.0%), and at full term (38-40 weeks) (43.7%). In contrast, a rod-shaped morphology predominated during the third trimester (50.0%)⁶. However, the study by Rani and Devi (2011)⁹ stated that the oval shape was most common in ovaries (66.68%) followed by rod (20%), almond, and “S” shapes (6.66% each).

Orientation:

Analysis of ovarian positioning revealed three orientations; an oblique orientation was most frequent 47.50%, while vertical and horizontal orientations accounted for 41.25% and 11.25% of the cases, respectively. Furthermore, combinations of different orientations were observed between the right and left ovaries in the foetuses.

According to Momin and Singh (2017)⁸, the orientation of the foetal ovaries varies according to gestational age. The ovaries maintain a vertical alignment up to the 16th week of gestation, transitioning by week 18 to an oblique placement observed in 66.66% of cases (with a vertical configuration persisting in the remaining 33.33%). This oblique orientation within the false pelvis is retained through the 29th week. From weeks 30 to 38, the ovarian axis shifts to a near-horizontal position, before returning to an oblique orientation as full term (40 weeks) is reached. In contrast, the current study did not detect these patterns; instead, combination of foetal orientations persisted across all gestational stages, with oblique presentations becoming most prominent in the later weeks. These findings align with those of Sulak et al. (2006)⁶ and Rani and Prasuna (2017)⁷, who similarly identified the oblique position as the most frequent orientation. The ovaries of nulliparous adult women generally have a vertical long axis.¹⁰ This might indicate that may be the foetal ovaries change their orientation towards adulthood. Limited published data exist concerning the precise shapes and anatomical alignment of the ovaries.

CONCLUSION

We conclude that the ovarian shapes and orientations changes across the gestation. Elucidating the structural and developmental variations of the ovaries in utero provides a critical foundation for mapping subsequent ovarian pathologies and pubertal deviations. By redefining our understanding of early reproductive organogenesis, these insights transcend basic developmental findings and hold significant clinical and diagnostic utility in obstetrics, fetal pathology, and forensic pathology

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REFERENCES

1. Wells L. J. Descent of the testis: anatomical and hormonal considerations. *Surgery* 1943; 14: 436-472 150
2. Larsens human embryology. 6th edition. Churchill Livingstone Elsevier. 2009; 500-540
3. Sadler TW. Langman's medical embryology. Wolters Kluwer (India) publication. 13th edition. 2017; 261-277
4. Hughes IA. Minireview: Sex Differentiation. *Endocrinology* 2001; 142 (8): 3281–3287. <https://doi.org/10.1210/endo.142.8.8406>
5. de Bruin JP, Nikkels PG, Bruinse HW, Haafte MV, Looman CWN, te Velde ER. Morphometry of human ovaries in normal and growth-restricted fetuses. *Early Human Development*. 2001; 60 (3): 179-192. [https://doi.org/10.1016/S0378-3782\(00\)00118-3](https://doi.org/10.1016/S0378-3782(00)00118-3)
6. Sulak O, Malas MA, Esen K, Cetin E, Tagil SM. Size and location of the fetal human ovary. *Fetal Diagn Ther*. 2006; 21(1):26-33. DOI: 10.1159/000089044
7. Rani TS, Prasuna T. Study of essential parameters of foetal ovaries during intra uterine life. *International journal of anatomy*. 2017; 3(1):12-14
8. Momin AD & Singh N. Positions and relations of ovary in developing human foetuses (2019). *National Journal of clinical anatomy*. 2017; 6(1) :9 – 15
9. Rani UV and Devi SV. Morphological and morphometric parameters of human ovaries from embryonic to menopausal age. *IJABMR*. 2011;1(2):89-92
10. Bannister LI-I. Dyson M: Reproductive system; in Williams Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE, Ferguson MW. *Gray's Anatomy*, ed 37. London, Churchill Livingstone, 1995, 1847-1880