



## MORPHOGENESIS OF HUMAN TESTES AT DIFFERENT AGE GROUPS

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**ABSTRACT**

The testes are primary reproductive organs or gonads in males, which are responsible for production of testosterone and secondary sexual characters.

**AIMS & OBJECTIVES:** The present study is done to observe morphology and morphometric parameters at different ages.

**MATERIALS & METHODS:** A total number of 64 testes of pre and post natal age groups from 17 male foetal cadavers, 6 autopsies of Forensic department, One cadaver of Anatomy department, 16 from pathology department. The prenatal specimens were collected from aborted embryos and dead foetuses of 6-40 weeks gestation. The postnatal testes were collected from individuals of 9-78 years of age. Crown-rump length (CRL) and crown-heel length (CHL) of the foetuses were measured in millimetres and weight of the foetuses was recorded in grams.

**RESULTS:** The embryos of 6-10 weeks post conceptional age gonads 3 were observed in lumbar level. In the foetuses of 13-28 weeks gestation 2 were abdominal (33.33%) and 4 were inguinal canal (66.66%). The percentage of inguinal canal location is very high. In the 29-40 weeks gestational ages 18 were intra scrotal (81.81%) and 4 specimens were at the neck of scrotum (18.18%). The incidence of undescended testes is 3.33%. There is gradual increase in length, width and thickness with a slightly more values on right side when compared to left side. The left testes are heavier than right testes.

**CONCLUSION:** The incidence of inguinal canal location in 2nd trimester and at the neck of scrotum in 3rd trimester is higher in prenatal age group. The incidence of undescended observed in the post natal age group is also higher in the present study.

**KEYWORDS :** Testes, Crown rump length, Crown-heel length, weight

**INTRODUCTION**

Key event in mammalian development is acquisition of a sexually dimorphic phenotype. At the time of fertilization genetic sex is determined by the presence or absence of a Y chromosome that directs the bipotent embryonic gonads to differentiate in to either testes or ovaries. In a male embryo or fetus subsequently, hormones produced by the testes trigger development of male phenotype. In the absence of testes and their biochemical products, female phenotype including the gonads develops.

The testes are primary reproductive organs or gonads in males, which are responsible for production of testosterone and secondary sexual characters. Male infertility depends on supply and maturation of germ cells i.e., spermatogenic cells. The human testis proceeds through periods of profound morphological changes from birth to maturity.

There is relationship between intrauterine development and pubertal and adulthood variations of testes. Morphology and location of testes play an important role in development and/or malformations of male external genitalia. Exact knowledge of normal gonad and its variations are necessary for establishing a base line for comparing abnormal testis.

**AIMS & OBJECTIVES:**

The present study is done to observe morphology and morphometric parameters at different ages.

**MATERIAL & METHODS:**

This work was conducted in the Department of Anatomy with the cooperation of the departments of Obstetrics and Gynaecology, Forensic medicine and pathology at RIMS, Ongole. Institutional ethics committee approved collection of embryonic tissue after obtaining informed consent from patients. Materials studied include spontaneously aborted/ dead foetuses of different periods of intra uterine life as well as testes representing prepubertal, pubertal, reproductive and andropausal ages.

A total number of 64 testes of pre and postnatal age groups were collected from 17 male fetal cadavers, 6 autopsies of Forensic department, one cadaver of Anatomy department, 16 from pathology. The prenatal specimens were collected from aborted embryos and dead foetuses of 6-40 weeks gestation. The postnatal testes were collected from individuals of 9-78 years of age. This study was conducted from October 2015 to September 2016.

**Prenatal Specimens:** A total of 17 embryos and foetuses were studied in the prenatal group. A total of 34 sets of testes were collected from 17

dead male foetuses at Government General Hospital, RIMS, Ongole. The gestation ages of foetuses ranged from 6 weeks to 40 weeks.

**Postnatal Specimens:**

a) **Prepubertal age** – A total of 2 testes specimens were collected from an autopsy body of 9 year old male received by Forensic Department.

b) **Pubertal age** – A total of 3 testes of 11-20 years age were collected from Forensic autopsies

c) **Reproductive age** – A total of 14 testes were collected from Forensic Department autopsies. The specimens were obtained from individuals of 21-45 years of age.

d) **Andropausal age** – A total number of 11 testes of 46-78 years were collected from male cadaver from department of Anatomy, Forensic autopsies.

The dead foetuses from maternity hospital were transported in 10% formalin solution to the Department of Anatomy. Crown-rump (C-R) and CROWN-HEEL (C-H) lengths of the foetuses were measured in millimetres and weights of the foetuses were recorded in grams. External features and visible anomalies were recorded. Subsequently the foetuses were preserved in 10% formalin solution after injecting into the pleura, peritoneal and orbital cavities. The extremities were preserved by multiple injection technique described by Ajmani (1996)<sup>1</sup>.

**RESULTS****DISTRIBUTION OF SPECIMENS OF TESTES COLLECTED**

A total number of 64 testes of pre and postnatal age groups were studied (Table-1) for morphological features and morphometric parameters. In the prenatal group 34 testes of 0-40 week's gestational ages were collected from 17 male fetal cadavers received from Department of Obstetrics and Gynaecology, RIMS, Ongole. In the postnatal group 30 testes were collected from cadavers of Forensic autopsies, Anatomy and Pathology department. The postnatal specimens were collected from individuals of 9-78 years of age.

**Table 1: Categorization of specimen collected**

Type of specimen	No. Of cases	Right	Left	Total
Prenatal	17	17	17	34
Postnatal	23	15	15	30
Total	38	32	32	64

The prenatal specimens were categorized into those of 0-12, 13-28, 29-40 weeks of gestational age (Table-2). In the prenatal age group the 2

smallest embryos of 6-10 weeks gestational age were subjected to serial sectioning after recording their crown-rump lengths (CRL) as removal of gonads by dissection was not possible in such small embryos.

**Table 2: Categorization of prenatal testes**

Gestational age	Right	Left	Total
0-12 wk	3	3	6
13-28 wk	3	3	6
29-40 wk	11	11	22
Total	17	17	34

The postnatal testes were categorized into prepubertal (0-10yrs), pubertal (11-20 yrs), reproductive (21-45 yrs) and andropausal (>45 yrs) age groups (Table-3).

**Table 3: Categorization of postnatal testes**

Category (Age in yrs)	No. Of cases	Right	Left	Total
Pre pubertal (0-10)	01	1	1	2
Pubertal (11-20)	02	1	2	3
Reproductive (21-45)	11	8	6	14
Andropausal (46-78)	09	5	6	11
Total	23	15	15	30

The details of source of specimens in pre and postnatal age groups are shown in table-4.

Among the 17 dead fetuses utilized in the present study 16 were apparently normal and one was a case of anencephaly. The gestational age of fetuses ranged from 6-40 wks post conception and their CRL varied from 12-310mm. The weight of fetuses ranged from 1-2500 gm.

Among the postnatal specimens 2 testes were removed from one of the dissection hall cadavers. The specimens obtained from department of Forensic medicine include 12 testes collected from 6 males who died in road traffic accidents. 16 testes were collected after surgical procedures. Among the postnatal specimens include those collected from one case of infertility, one case of undescended testis and 2 cases of sertoli cell only syndrome.

**Table 4: Origin of specimen of testes**

Origin of specimen and No.of cases	No. Of specimens
<b>Prenatal Testes</b>	
1. P.I.H (1)	2
2. Spontaneous abortion (3)	6
3. I.U.D (11)	22
4. Abnormal presentation-Breech (1)	2
5. Fetal Anamolies-Anencephaly (1)	2
<b>Postnatal Testes</b>	
1. R.T.A (6)	12
2. Surgical cases (16)	32
3. Dissection hall cadaver (1)	02

**Morphological Features**

In the 3 smallest embryos of 6-10 wks post conceptional ge gonads were observed at lumbar level in serial sections (Fig-1,2,3,4,5) and (Table-5). In the fetuses of 13-28 wks of gestation 2 were intra abdominal (33.33%) and 4(66.66%) were in inguinal canal (Fig-6). In the 29-40 wks gestational age 18 were intrascrotal (81.81%) and 4 testes (18.18%) were at the neck of scrotum (Fig-7) and (Table-5). In one normal (32 wks) and one anencephalic (36 wks) fetus the testes were at the neck of scrotum.

**Table 5: Position of testes at different age**

Category and No. Of specimens	Abdominal	Inguinal canal	Neck of scrotum	Scrotal
<b>Prenatal age group</b>				
0-12 wk (6)	06	-	-	-
13-28 wk (6)	02 (33.33%)	04 (66.66%)	-	-
29-40 wk (22)	-	-	04 (18.18%)	18 (81.81%)
<b>Postnatal age</b>				
Prepubertal (2)	-	-	-	02

Pubertal(3)	-	-	-	03
Reproductive (14)	-	-	01 (7.14%)	13
Andropausal (11)	-	-	-	11
<b>Total</b>	<b>08</b>	<b>05</b>	<b>04</b>	<b>47</b>

In the post natal group all the testes except one were in scrotum (Fig-8, Table-5). In a case of cryptorchidism in the reproductive age group (7.14%) testes was at the neck of scrotum. The total incidence of undescended testes in the present study on postnatal age group is 3.33%.

All the testes were oval in shape (Fig-6,8). Surface of testes of all the prenatal and postnatal testes were in smooth appearance. All the prenatal and Prepubertal testes were pink in colour (Fig-7). But postpubertal, reproductive and andropausal testes were bluish white in colour (Fig-8).

**MORPHOMETRIC PARAMETERS**

Length, width and thickness of prenatal testes of 6-40 wks varied from 5-10.5mm, 3-5.8mm and 1-4.2mm respectively. The average length, width, thickness of testes in 0-40 weeks are 8.75mm, 4.9mm, 3.9mm. The averages at different gestational ages (Table-6) indicate a gradual increase in length, width and thickness during prenatal period. The length, width and thickness are slightly more on the right side when compared to left side. Weight of prenatal testes varied from 90-160mg. It showed a gradual increase (Table-6). The left testes are heavier than right testes.

**Table 6: Morphometric parameters (Averages) of prenatal testes**

Age (wks)	Length, Width, Thickness (mm) Right	Length, width, Thickness (mm) Left	Weight (mg) Right	Weight (mg) Left
0-12 wk	Serially sectioned (03)	Serially sectioned (03)	Serially sectioned (03)	Serially sectioned (03)
13-28 wk	8.08x4.56x3.0 (03)	8.0x4.36x2.93 (03)	93.3	99
29-40 wk	8.88x5.1x3.49 (11)	8.75x5.03x3.43 (11)	113	122

In postnatal group morphometric parameters were measured in all the forensic autopsies and dissection hall cadaver and in some of the specimens received by pathology department. In postnatal testes length varied from 3.8-5.1 cm. The width and thickness varied between 1.8-3.0 cm and 2.5-3.1 cm respectively (Table-7). In postnatal testes there was a gradual increase in length from prepubertal to reproductive and to menopausal ages. Width and thickness of testes also increased with age in the postnatal group. Weight of postnatal testes varied from 8 gm to 15.5 gm. There is gradual increase in weight with increase in age. In the postnatal specimens the average weight of left testes is 12 gm and that of the right is 12.3gm.

**Table 7: Morphometric parameters (Averages) of postnatal testes**

Age	Length, width, thickness (cms) Right	Length, width, thickness (cm) Left	Weight (gm) Right	Weight (gm) Left
Prepubertal	3.8x1.8x2.5 (01)	3.5x1.8x2.5 (01)	8.0	8.2
Pubertal	4.2x2.0x3.0 (01)	4.0x2.0x3.0 (02)	12	12
Reproductive	4.6x2.6x3.9 (04)	4.4x2.6x3.0 (04)	13.75	14.82
Andropausal	5.1x3.0x3.1 (02)	4.7x2.9x2.9 (03)	15.5	15.4

**DISCUSSION**

A total of 64 testes collected from prenatal and postnatal age group males of 6 weeks gestational age to 78 years andropausal age were included in this study. All the specimens collected were broadly categorized in to prenatal and post natal age groups. The number of cases in these two broad categories and the number of testes observed for morphological and morphometric parameters were shown in (Tables-6,7)

All the embryos and fetuses observed were apparently normal except one case of anencephalic fetus with associated GIT, renal and gonadal abnormalities. The CRL of fetuses studied varied from 12mm to 310mm and were weighing from 1.0 to 2500 grams. In the postnatal age groups specimen collected were from apparently normal

individuals of 9 years to 78 years age excepting a case of unilateral undescended testis, one case of infertility and 2 cases of sertoli cell only syndrome.

A total of 34 testes of prenatal and 30 testes of post natal category were observed for age related morphological and morphometric parameters.

#### Morphological Parameters:

Very limited observations were reported in the literature on morphology of testes. Those that were reported have little significance as they were conducted on a small number and on a narrow age group. In the present study all the prenatal and post natal specimens were oval in shape and were showing smooth surface. Both prenatal and prepubertal testes were pink in color where as there is gradual change in color to bluish white in postpubertal to reproductive age group and finally in the andropausal age they were blue or gray in color. There is gradual thickening of tunica albuginea with increasing age that may be the cause for change in color. The observations on color, shape and surface are in agreement with those reported in literature.

In less than 12 weeks age embryos and foetuses the gonads were intrabdominal in location. In the foetuses of 13-28 weeks gestational age one fetus of 20 weeks (fig), both the testis were abdominal (33.33%) and in the other two foetuses they were in the inguinal canal (66.66%). The percentage of inguinal canal location observed in the present study is very high when compared with that reported by sampaino and Favento (1998)<sup>2</sup> for 10-23 weeks. In the 29-40 weeks gestational age group two foetuses of 32 and 34 weeks showed bilateral location of testes at the neck of scrotum (18.18%). Of these 2, one is a case of Anencephaly. In all the other specimens they were in scrotum (81.81%). The observations in this large group of 22 testes are not in agreement with those reported by Mala et al (1999)<sup>3</sup> on intra scrotal (30%) location. Further Malas et al did not observe the gonads at the neck of scrotum. In the present study 18.18% incidence of this location was observed.

In all the postnatal specimens the testes were scrotal in position except in one case of unilateral undescended testis in a 27 year old in whom the left testis was located at the level of neck of scrotum. The incidence of undescended testes in the present study is 3.33% which is more than the incidence (0.8%) reported by MacKinnon (2005)<sup>1</sup> and that of Mc Gregor (1995)<sup>5</sup> for unilateral maldescent (0.1%-0.2%).

#### Morphometric parameters

There is a gradual increase in length, width and thickness in prenatal age group (Table-6). In the prenatal group a slight increase of these parameters on the right when compared to the left side. Reports on prenatal testicular length, width and thickness were not available on the local population. In postnatal testes length varied from 3.8-5.1 cm. In postnatal testes there was a gradual increase in length from prepubertal to reproductive and to menopausal ages. Width and thickness of testes also increased with age in the postnatal group. The average measurements recorded in post pubertal age group are nearer to the values reported in the literature by Last (1999)<sup>6</sup>, Datta (2003)<sup>7</sup> and Collins (2005)<sup>8</sup>.

Weight of left testes is slightly more than that of right testes in prenatal age group. This finding is agreeing with the statement of Muller and Skakkabaek (1983)<sup>9</sup> and Collins (2005)<sup>8</sup>. In 29-40 weeks gestational age group the average weights of right and left testes (11.3gm and 12.2gm) are nearing to the averages observed in the postnatal age group (12.8 gm and 12.3gm). This finding is in agreement with the statement of Irkilata et al (2005)<sup>10</sup>. In the postnatal age the average weight of left testes (12.8gm) is slightly more than that of the right (12.3gm). The average values in the present study are less than that reported by Kaler (1978)<sup>11</sup>.

#### CONCLUSION

The incidence of inguinal canal location in 2<sup>nd</sup> trimester and at the neck of scrotum in 3<sup>rd</sup> trimester is higher in prenatal age group. The incidence of undescended observed in the post natal age group is also higher in the present study. As the observation were on a small population during the limited period of study the present work needs to be extended on a larger population of different ages for establishing a base line data that can be used for interpreting normal developmental pattern and for explaining developmental anomalies.



Fig 1: Foetal testis-20 wks -Intraabdominal location

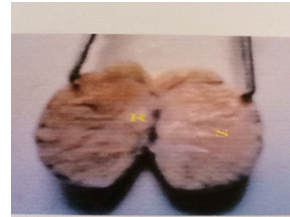


Fig 2: Prepubertal testis

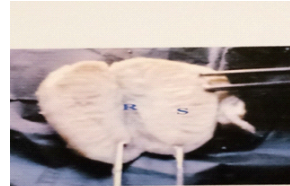


Fig 3: Reproductive testis

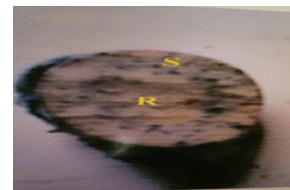


Fig 4: Andropausal testis



Fig 5: 12mm embryo-6wks post conception-CS 16 stage sagittal section-Gonadal ridge in lumbar region

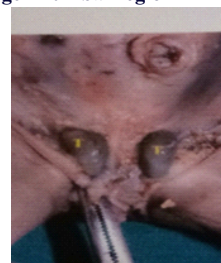


Fig 6: Foetal testis-28 wks-Inguinal location of testes

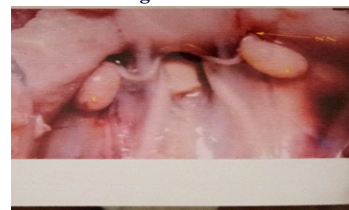


Fig 7: Foetal testis-30wks- Neck of scrotum



**Fig 8: Adult testis and its coverings in scrotum**

#### REFERENCES

1. Ajmani ML (1998): Embalming principles and legal aspects. Jaypee Brothers, Medical Publishers (P) Ltd. New Delhi.
2. Sampaio FJB and Favent LA (1998): Analysis of testicular migration during the fetal period in humans. *J Urol*; 159: 540-2.
3. Malas MA Sulak o Ozturk A (1999): The growth of the testes during the fetal period. *BJU International*; 84:689-692.
4. Mc Kinnon (1999): synopsis of surgical anatomy; 12th edition; pg 124-135.
5. Mc Gregor Lee (1999): synopsis of surgical anatomy; 12th edition; pg 124-135.
6. RJ Last (1999); Text book of human anatomy; 10th edition.300-312.
7. Datta, 2003 Text book of anatomy; Male genital system, pg 301-330.
8. Collins P, Standring S wigley C (2005): prenatal and neonatal growth – In *Grays Anatomy*, 39th edition, 211-215. Elsevier Churchill Livingstone.
9. Muller J, Skakkebeck N E (1983); *International journal of Andrologia*; 6:145-156; Quantification of germ cells and seminiferous tubules by stereological examination of testes.
10. Irkalata, Dayanac, Yildirim, Cincik (2005); *Journal of Andrologia (undescended testes)* vol 37;pg 65-68.
11. Kaler and Neaves (1978): cited from *biology of reproduction*; 38: 653-665.