

# ANALYSIS OF TESTICULAR MIGRATION DURING THE FETAL PERIOD IN HUMANS

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## ABSTRACT

**Purpose:** We present an analysis concerning the testicular migration and its position correlated to body weight, crown-rump length and gestational age during the fetal period in humans without congenital abnormalities.

**Materials and Methods:** We studied bilaterally 142 testes taken from 71 fresh human fetuses between 10 and 35 weeks after conception. The fetuses were also evaluated in regard to crown-rump length and body weight. The position of the testes was correlated to the fetal parameters.

**Results:** In 37 fetuses (74 testes) at 10 to 23 weeks after conception only 7 testes (9.45%) had migrated from the abdomen and were situated in the inguinal canal, in 19 fetuses (38 testes) at 24 to 26 weeks after conception 22 testes (57.9%) had migrated from the abdomen and in 9 fetuses (18 testes) at 27 to 29 weeks after conception only 3 testes (16.7%) had not descended to the scrotum. The testes had not descended into the scrotum in any fetus weighing 990 gm. or less and with a crown-rump length of 24.5 cm. or less. On the other hand, in all fetuses weighing more than 1,220 gm. and with a crown-rump length of more than 27.5 cm. the testis was in the scrotum.

**Conclusions:** Until 23 weeks after conception the majority of testes remain in the abdomen. The more intense migration of the testes through the inguinal canal occurred between 21 and 25 weeks after conception. After 30 weeks after conception all testes were descended to the scrotum in all fetuses.

KEY WORDS: testis, fetus, anatomy

During fetal period in humans the testes migrate from the abdomen to the scrotum, traversing the abdominal wall and the inguinal canal. The mechanisms involved in testicular descent remain controversial. The most accepted theories for explanation of testicular descent in humans are related to increase in intra-abdominal pressure and to other events that occur under the stimulus of the placental gonadotropins, such as development of the gubernaculum, processus vaginalis, inguinal canal spermatic vessels and scrotum.<sup>1-7</sup>

Although there are many studies available on testicular maldescent (cryptorchidism) and its relationship with epididymal abnormalities,<sup>8-14</sup> there are few studies concerning normal descent during the fetal period in humans. Also, there are few studies concerning the timing of testicular descent correlated with fetal parameters. Moreover, the studies available present some controversial results and involve a small number of fetuses. We present a precise analysis concerning testicular migration and its position correlated to body weight, crown-rump length and gestational age during the fetal period in humans without congenital abnormalities.

## MATERIALS AND METHODS

We studied bilaterally 142 testes taken from 71 fresh human fetuses that died of causes unrelated to the urogenital tract. The fetuses were well preserved and none had any kind of detectable congenital malformation.<sup>15</sup> Gestational age ranged between 10 and 35 weeks after conception and was estimated according to foot length criteria.<sup>16-23</sup> The fetuses

were also evaluated in regard to crown-rump length and body weight, immediately before dissection.

The abdomen, inguinal region and scrotum were opened, and the position of the testes was recorded according to body weight, crown-rump length and gestational age. Then the tunica vaginalis was opened and the testis was exposed. The testis and epididymis were dissected, and configurations were noted. Because epididymal abnormalities are known to be associated with cryptorchidism, if any abnormality of the epididymis and its relationship with the testis existed, the fetuses were excluded from study.

## RESULTS

The testis was regarded as abdominal when it was proximal to the internal ring, canalicular or inguinal when it was found between the internal and external inguinal ring, and descended or scrotal when it was inferior to the external ring. The table indicates the location of the testis versus gestational age, body weight and crown-rump length. The figure shows the most frequent position of the testes according to gestational age in weeks after conception. Asymmetric testicular migration was present in 7 fetuses, and in 4 cases the left testis was in a more inferior position than the right testis but this difference was not statistically significant.

## DISCUSSION

The moment when the testis starts its migration from the abdomen, as well as the correlation between its position during descent and gestational age, body weight and crown-rump length is not completely clear. In 37 fetuses (74 testes) at 10 to 23 weeks after conception only 7 testes (9.45%) had migrated from the abdomen and were situated in the inguinal canal. In 19 fetuses (38 testes) at 24 to 26 weeks after

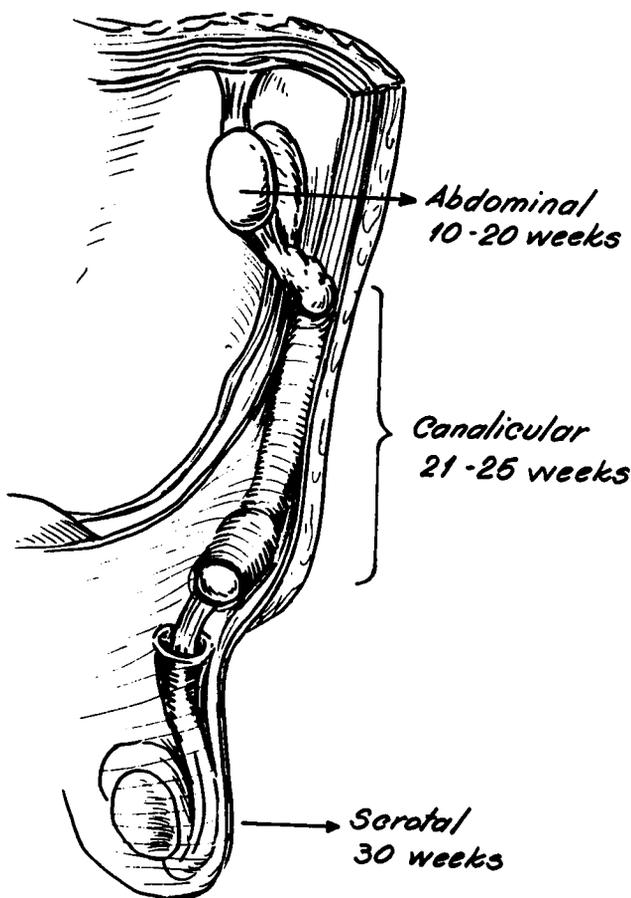
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Results of testis location according to gestational age, body weight and crown-rump length

	% Testis Position		
	Abdominal	Inguinal	Scrotal
Gestational age (wks. after conception):			
10-21	88.3	11.7	0
22-26	57.7	42.3	0
27-35	6.7	3.3	90
Body wt. (gm.):			
14-430	94.8	5.2	0
435-970	53.8	46.2	0
990-2,530	6.25	9.4	84.35
Crown-rump length (cm.):			
6.4-20.5	82.8	17.2	0
21-25.5	45.2	45.2	9.6
26-33	12.5	0	87.5



Schematic drawing from anterior view of left posterior abdominal wall shows most frequent position of testes during fetal period according to gestational age in weeks after conception.

conception 22 testes (57.9%) had migrated from the abdomen, indicating that testicular migration is intensified during this period. In 9 fetuses (18 testes) at 27 to 29 weeks after conception only 3 testes (16.7%) had not descended to the scrotum. Heyns considered a testis descended when it was inferior to the external ring.<sup>5</sup> Using a calculated menstrual age of gestation he found only 1 descended testis in fetuses at 21 weeks after conception, with descent increasing to 10% at 22 weeks after conception, 50% at 25 weeks, 75% at 26 weeks and 80% at 32 weeks. In an ultrasound study of intrauterine fetuses Birnholz noted that 62% of the testes descended

between 28 and 30 weeks (fertilization age of gestation), and 93% descended after 32 weeks.<sup>24</sup>

Our results reveal that the testis started its migration from the abdomen during the second trimester of gestation (after 17 weeks after conception), and this migration intensified between 24 and 26 weeks after conception. Until 23 weeks after conception the majority (90.54%) of the testes studied were still in the abdomen. In none of the fetuses was the testis descended to the scrotum at 27 weeks after conception or less. After 30 weeks after conception all testes had descended to the scrotum.

The testis had not descended to the scrotum in any fetus weighing 990 gm. or less. On the other hand, the testis was in the scrotum in all fetuses weighing more than 1,220 gm. Heyns noted only 1 descended testis in fetuses weighing less than 700 gm., and the percentage of descended testes increased to 22% with 700 to 799 gm., 50% with 1,000 to 1,200 gm. and 72% with more than 1,200 gm. body weight.<sup>5</sup> Scorer noted descent in 38% of fetuses weighing between 900 and 1,800 gm. and in 82% weighing between 1,800 and 2,500 gm.<sup>25</sup>

The testis had not descended to the scrotum in any fetus with a crown-rump length of 24.5 cm. or less. On the other hand, the testis was in the scrotum in all fetuses with more than 27.5 cm. of crown-rump length. Heyns noted only 1 descended testis in fetuses with crown-rump length less than 20.9 cm., and the percentage of descended testis increased to 21% with 21.0 to 23.9 cm., 54% with 24.0 to 26.9 cm. and 72% with more than 27.0 cm. of crown-rump length.<sup>5</sup>

Most authors believe that the actual passage of the testis through the inguinal canal would appear to be rapid.<sup>2,5,14,24,25</sup> Heyns found only 2.6% of the testes in the inguinal canal between 21 and 29 weeks after conception.<sup>5</sup> We found 30 testes (20.5%) in the inguinal canal between 17 and 29 weeks after conception. Of these 30 testes 22 (73.3% of the intracanalicular testes) were in fetuses between 21 and 25 weeks after conception, indicating that during this period passage through the inguinal canal is more intense.

CONCLUSIONS

Until 23 weeks after conception the majority of testes are still in the abdomen. The more intense migration of the testes through the inguinal canal occurs between 21 and 25 weeks after conception. The testis had not descended to the scrotum in any fetus at 27 weeks after conception or less, while in all fetuses the testis had descended to the scrotum at 30 weeks after conception or more.

REFERENCES

1. Rajfer, J. and Walsh, P. C.: Hormonal regulation of testicular descent: experimental and clinical observations. *J. Urol.*, **118**: 985, 1977.
2. Backhouse, K. M.: Embryology of testicular descent and maldescent. *Urol. Clin. N. Amer.*, **9**: 315, 1982.
3. Elder, J. S., Isaacs, J. T. and Walsh, P. C.: Androgenic sensitivity of the gubernaculum testis: evidence for hormonal/mechanical interactions in testicular descent. *J. Urol.*, **127**: 170, 1982.
4. Hadziselimovic, F.: Mechanism of testicular descent. *Urol. Res.*, **12**: 155, 1984.
5. Heyns, C. F.: The gubernaculum during testicular descent in the human fetuses. *J. Anat.*, **153**: 754, 1987.
6. Heyns, C. F. and Hutson, J. M.: Historical review of theories on testicular descent. *J. Urol.*, **153**: 754, 1995.
7. Husmann, D. A. and Levy, J. B.: Current concepts in the pathophysiology of testicular undescend. *Urology*, **46**: 267, 1995.
8. Turek, P. J., Ewalt, D. H., Snyder, H. M., III and Duckett, J. W.: Normal epididymal anatomy in boys. *J. Urol.*, **151**: 726, 1994.
9. Gill, B., Kogan, S., Starr, S., Reda, E. and Levitt, S.: Significance of epididymal and ductal anomalies associated with testicular maldescent. *J. Urol.*, **142**: 556, 1989.
10. Cromie, W. J.: Congenital anomalies of the testis, vas epididymis, and inguinal canal. *Urol. Clin. N. Amer.*, **5**: 237, 1978.

11. Marshall, F. F.: Anomalies associated with cryptorchidism. *Urol. Clin. N. Amer.*, **9**: 339, 1982.
12. Elder, J. S.: Epididymal anomalies associated with hydrocele/hernia and cryptorchidism: implications regarding testicular descent. *J. Urol.*, **148**: 624, 1992.
13. Barthold, J. S. and Redman, J. F.: Association of epididymal anomalies with patent processus vaginalis in hernia, hydrocele and cryptorchidism. *J. Urol.*, **156**: 2054, 1996.
14. Scorer, C. G. and Farrington, G. H.: Development and descent of the testis. In: *Congenital Deformities of the Testis and Epididymis*. New York: Appleton-Century-Crofts, pp. 1-27, 1971.
15. Streeter, G. L.: Weight, sitting height, head size, foot length and menstrual age of the human embryo. *Contr. Embryol. Carnegie Inst.*, **11**: 143, 1920.
16. Hern, W. N.: Correlation of fetal age and measurements between 10 and 26 weeks of gestation. *Obst. Gynec.*, **63**: 26, 1984.
17. Mercer, B. M., Skalar, S., Shariatmadar, A., Gillieson, M. S. and D'Alton, M. E.: Fetal foot length as a predictor of gestational age. *Amer. J. Obst. Gynec.*, **156**: 350, 1987.
18. Platt, L. D., Medearis, A. L., De Vore, G. R., Horenstein, J. M., Carlson, D. E. and Brar, H. S.: Fetal foot length: relationship to menstrual age and fetal measurements in the second trimester. *Obst. Gynec.*, **71**: 526, 1988.
19. Escala, J. M., Keating, M. A., Boyd, G., Pierce, A., Hutton, J. L. and Lister, J.: Development of elastic fibers in the upper urinary tract. *J. Urol.*, **141**: 969, 1989.
20. Sampaio, F. J. B. and Ambrósio, J. D.: Longueur du rein et longueur du pied. Analyse corrélative au cours de la période foetale. *J. Urol. (Paris)*, **96**: 129, 1990.
21. Sampaio, F. J. B. and Aragão, A. H. M.: Study of the fetal kidney length growth during the second and third trimesters of gestation. *Eur. Urol.*, **17**: 62, 1990.
22. Sampaio, F. J. B.: Analysis of kidney volume growth during the fetal period in humans. *Urol. Res.*, **20**: 271, 1992.
23. Sampaio, F. J. B.: Theoretical kidney volume versus real kidney volume: comparative evaluation in fetuses. *Surg. Rad. Anat.*, **17**: 71, 1995.
24. Birnholz, J. C.: Determination of fetal sex. *New Engl. J. Med.*, **309**: 942, 1983.
25. Scorer, C. G.: The anatomy of testicular descent—normal and incomplete. *Brit. J. Surg.*, **49**: 357, 1962.