Testicular microlithiasis and undescended testis

Goede, J.

Chapter 3.2

The volume of retractile testes in boys

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Abstract

Purpose

We used ultrasound to determine the volume of retractile testes in boys, and compared these volumes with normative testicular volume values.

Materials and Methods

A total of 171 boys were enrolled in this study, of whom 14 were excluded from analysis. The 157 boys included (age 0.8 to 11.5 years) were recruited from 2 different populations. The first subgroup comprised 92 boys previously excluded from a study aimed at obtaining normative values of ultrasonographically scanned testes. The second group included 65 boys who had been referred to our outpatient clinic for non-scrotal testis and who were diagnosed with retractile testis. Testicular volume was measured by ultrasound in a scrotal position or in an inguinal position. Three separate transverse and longitudinal images of each testis were recorded. Length, width and height were measured and the volume was calculated with the formula for an ellipsoid = π/6 x length x width x height. The highest value of the three testicular volumes was determined and taken as volume measurement.

Results

The volumes measured by ultrasound for the 157 boys with 276 retractile testes ranged from 0.18 to 1.49 ml (mean 0.50). The volumes of the retractile testes were significantly smaller than normative values ($p < 0.001$). Furthermore, the testicular volumes of retractile testes measured in an inguinal position were significantly smaller than those measured in scrotal position ($p < 0.001$).

Conclusions

The volumes of retractile testes are significantly smaller than recently determined normative values.

Introduction

A retractile testis is defined as a testis which can be brought into a stable position at the bottom of the scrotum. As a result of an active cremasteric reflex the testis moves up into the groin region during evaluation. The presence of the cremasteric reflex does not in itself define the presence of a RT. As many as 35% of testes are described as retractile, with a peak incidence at the ages of 5 and 6 years.[1] A RT is usually considered to be a physiological variant of normal but some initially RT become secondarily ascended over time. However, some authors have suggested impairment of testicular growth ass well as abnormal testicular function and infertility due to morphological changes in the testes.[2-5] In adult patients with RT impairment of spermatogenesis has been found.[6] Therefore, accurate measurement of testicular volume seems prudent in the evaluation of boys with RT because in adults testicular size is directly correlated with testicular function.[7] A few studies have analysed testicular volume in RT but measurements have only been performed by Prader orchidometer. In 1 study testicular volume was significantly lower in patients with RT.[3] We used ultrasound to prospectively assess the testicular volume of RT and we compared testicular size with normative values.[8] We presumed that testicular volumes of RT are comparable to normative values.

Materials and Methods

Study design

This survey comprises 2 subgroups. The first group was excluded from a cohort of 932 boys constructed to obtain normative values for testicular volume measured by US after physical examination revealed RT (population-based subgroup). The second group was boys referred to our outpatient clinic for UDT and diagnosed with RT (clinic-based subgroup). In the population-based subgroup 100 US examinations were performed by 1 physician (JG) and in the clinic-based subgroup 71 were performed by another physician (WWMH). There was a good correlation between the measurements of both researchers.[9] In all patient measurement of testicular volume was performed once.

Boys with at least one RT on examination were included in the study. Boys with conditions that may influence testicular growth including growth retardation, hormonal disturbances, chromosomal abnormalities or previous groin surgery were excluded from analysis. Boys with UDT, hydrocele, varicocele or a history of scrotal pathology were also excluded, bringing the total number excluded to 14.

Definitions

An RT was defined as a testis which could be brought into a low scrotal position where it remained until the cremasteric reflex was elicited with no shortness of cord structures. To define RT the cremasteric reflex was elicited by lightly stroking the thigh which resulted in a suprascrotal position of the testis as the result of an active reflex. When the testis was positioned in the groin region, a RT was diagnosed if the testis could be brought into a low scrotal position with the boy in a squatting position. UDT was defined as a testis that could not be manipulated into a stable scrotal position with shortness of cord structures.

Study protocol

Questionnaire

In both subgroups a questionnaire was used by the examiner to interview the parents, which included medical problems, medication, major surgery, prior groin surgery, gestational age, birth weight and ethnicity. These data were documented in a database. No information was obtained from medical records.

Physical examination

In the supine and crossed-legged position, testicular examination of the left testis was performed first, followed by the right testis. Testis position was classified as low scrotal or inguinal, and the testis was diagnosed as descended, retractile or undescended.

Testicular volume

Volume of the left testis was measured first, followed by the right. All US were performed with the same equipment (Falco Auto Image, Falco Software Co, Tomsk, Russia) using a 12 MHz linear array transducer. To measure the volume the scanner was placed on the scrotum with only light pressure to avoid distorting the testicular shape. If the testis could be brought into a scrotal position, volume measurement was performed on the scrotum. However, if the testis had an inguinal position, US was performed in the groin region. Three separate transverse and longitudinal images of each testis were recorded. The volume was calculated with the formula π/6 x length x width x height, which was also used in other studies.[10] The highest value of 3 volumes was determined and taken as the volume measurement. Additional findings, such as hydrocele and TM were also assessed. Parenchymal disturbances like testicular tumor, intratesticular varicocele or infarction were not studied.

Statistical methods

Differences in testicular volume between RT and normative values, and between inguinal and scrotal measurements were tested using the independent t test (sample size 30 or

greater, normality assumed) as well as the Mann-Whitney test (sample size less than 30, not normality assumed). The chi-square test was used to investigate the differences between scrotal and inguinal position of the testis during measurements and unilateral vs bilateral RT. We analysed the data for normal distribution on actual distribution by performing the Kolmogorow-Smirnov test in the whole group and in the subgroups, and found no significant differences (all values $p > 0.05$).

Ethical approval

The study on normative values for testicular volume measured by US was approved by the ethical committee of the hospital (reference number: M06-056). For the boys of the clinic based subgroup ethical approval was not obtained because testicular ultrasound is a standard procedure in the evaluation of these boys. Informed consent was obtained in all cases.

Results

A total of 171 boys (age range 0.8 to 12.0 years, mean 6.2) with 295 RT were enrolled in the study. The population based subgroup included 100 boys (age range 0.8 to 11.1 years, mean 5.9) and the clinic based subgroup included 71 boys (age range 1.6 to 12.0 years, mean 6.6). There was no significant age difference between the two subgroups (independent t test $p = 0.107$). Of these boys 157 (age range 0.8 to 11.5 years, mean 6.0) with 276 RT were included in this study and 14 (8.2%, age range 4.1 to 12.0 years, mean 7.7) were excluded (7 UDT, 4 previous groin surgery or scrotal pathology, 2 TM, 1 syndrome associated with growth retardation).

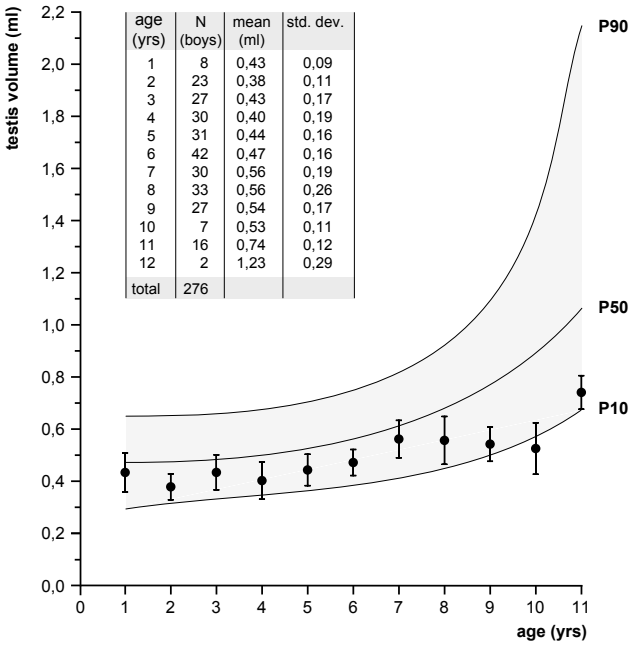
Boys with RT

Of these boys 143 had no substantial history of pathology (91.1%), 7 had asthma (4.5%), 4 had eczema and/or allergy (2.5 %) and 3 had psychiatric problems (1.9%). There were 144 Caucasian (91.7%), 7 Turkish (4.5%), 3 African-American (1.9%), 2 Asian (1.3%) and 1 North-African (0.6%). For height and weight no significant differences were found for each age group compared with reference data for Dutch boys (paired t test $p > 0.05$).[11]

General RT volume

Volumes of 276 RT (119 bilateral, 38 unilateral) measured by US ranged from 0.18 to 1.49 ml (mean 0.50). Figure 1 shows the volumes per age relative to normative values. The RT was smaller than normative values, and this was statistically significant for left, right and mean (independent t test $p < 0.001$).

Figure 1
Testicular volumes of RT per age, related to reference values.



age (yrs)	N (boys)	mean (ml)	std. dev.
1	8	0,43	0,09
2	23	0,38	0,11
3	27	0,43	0,17
4	30	0,40	0,19
5	31	0,44	0,16
6	42	0,47	0,16
7	30	0,56	0,19
8	33	0,56	0,26
9	27	0,54	0,17
10	7	0,53	0,11
11	16	0,74	0,12
12	2	1,23	0,29
total	276		

Scrotal versus inguinal RT

Of the 276 RT 156 were measured in inguinal position (56.5%, volume range 0.18 to 1.44 ml, mean 0.44) and 120 in a scrotal position (43.5%, volume range 0.22 to 1.49 ml, mean 0.57). The differences in volume were statistically significant (independent t test $p < 0.001$). Figures 2 shows volumes per age for scrotal and inguinal measured RT relative to normative values. The boys in whom the testis was measured in inguinal position had a mean age of 5.6 years (range 1.0 to 11.5) vs 6.5 years (range 0.8 to 11.2) for those with measurements in scrotal position. These differences were statistically significant (independent t test $p = 0.006$).

Unilateral versus bilateral RT

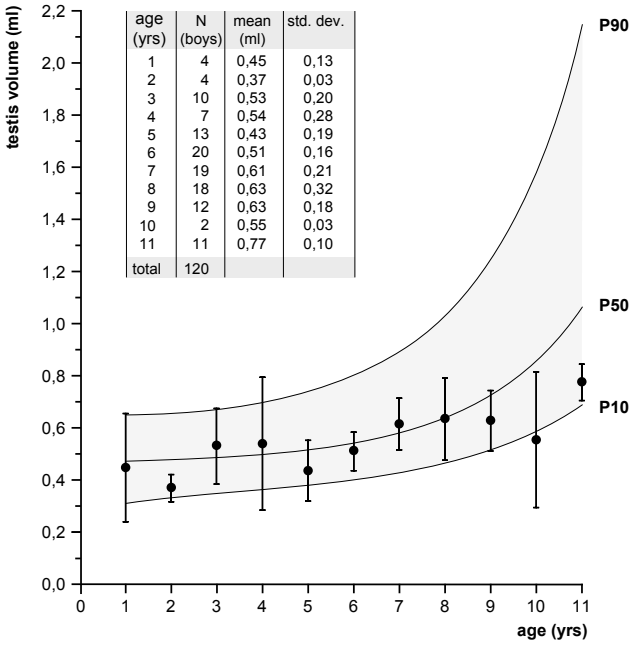
Of the 157 boys included in the study 119 had bilateral RT (75.8%), and 38 boys had unilateral RT (24.2%). In the 238 bilateral RT the volume ranged from 0.18 to 1.49 ml (mean 0.50) and in the 38 unilateral RT from 0.27 to 0.99 ml (mean 0.51). There was no significant difference in unilateral and bilateral RT (independent t-test $p = 0.618$). In the 38 boys with unilateral RT 23 testes were measured in inguinal position (60.5%) and 15 in scrotal position (39.5%). Of the 238 bilateral RT 133 testes were measured in inguinal position (55.9%) and 105 in scrotal position (44.1%).

Figure 2

Testicular volumes per age for RT measured in scrotal (A) and inguinal (B) positions, related to reference values.

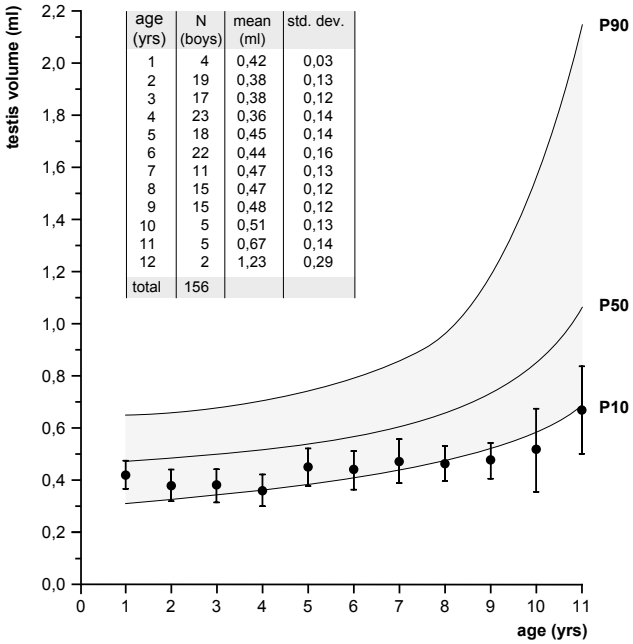
A

age (yrs)	N (boys)	mean (ml)	std. dev.
1	4	0,45	0,13
2	4	0,37	0,03
3	10	0,53	0,20
4	7	0,54	0,28
5	13	0,43	0,19
6	20	0,51	0,16
7	19	0,61	0,21
8	18	0,63	0,32
9	12	0,63	0,18
10	2	0,55	0,03
11	11	0,77	0,10
total	120		



B

age (yrs)	N (boys)	mean (ml)	std. dev.
1	4	0,42	0,03
2	19	0,38	0,13
3	17	0,38	0,12
4	23	0,36	0,14
5	18	0,45	0,14
6	22	0,44	0,16
7	11	0,47	0,13
8	15	0,47	0,12
9	15	0,48	0,12
10	5	0,51	0,13
11	5	0,67	0,14
12	2	1,23	0,29
total	156		



Bilateral, inguinal measured RT were significantly smaller than scrotal measured testes. Since we found a significant difference in the age of the boys with inguinal measured testes vs scrotal measured testes, we subdivided these boys into 2 age groups. In 135 boys younger than 6 years old volume ranged from 0.18 to 1.05 ml, (mean 0.42) and in 141 boys 6 years or older from 0.23 to 1.49 ml (mean 0.57). In both age groups the difference in volumes for inguinal vs scrotal measurements remained significant (independent t test less than 6 years old $p = 0.005$, 6 years or older $p < 0.001$). We analysed the 38 unilateral RT and found that the mean testicular volume was 0.51 ml (range 0.27 to 0.99) vs 0.57 ml (range 0.27 to 1.80) for the contralateral testis. There was no significant difference between the volume of the RT and the contralateral testes (paired t test $p = 0.117$).

Discussion

We presumed that testicular volume in boys with RT is comparable to normative values. However, this study demonstrated that boys with RT have significantly smaller testicular volumes compared to reference values. Furthermore, the testes scanned in an inguinal position were also significantly smaller than those scanned in a scrotal position. Also, testicular volume scanned in the scrotal or the inguinal position were significant smaller than reference values.

The prevalence of RT varies between 0.2 and 41% in prepubertal children.[3,12-15] In general, RT is regarded as a variant of normal and is not associated with impairment of future fertility. Normal testicular structure is supported by previous histological studies which showed no abnormalities.[16,17] Conversely, a few studies report on the occurrence of poor spermiograms in infertile adults in whom RT was the only remarkable feature.[4,18-20]

Several studies have shown an association between TM and infertility. TM is a condition in which multiple small calcifications of 1 to 3 mm are present in the seminiferous tubules.[21] As far as we could ascertain, no studies have reported on the TM rate in RT. In this study we found TM in 2 patients (1.1%), which is not higher than the prevalence of TM in asymptomatic boys.[22] This finding may indicate that the testes develop normally in patients with RT.

In this study we found testes measured in an inguinal position were smaller than testes measured in a scrotal position. The inguinal position might hamper the development of the testes due to a higher environmental temperature. These inguinal positioned testes might be more retractile than testes in a scrotal position and, therefore, the latter might be more a physiological variant of the RT. However, a more plausible explanation for the difference in the volume of the testes may be that measurement in the inguinal region is less accurate than in the scrotal position. Unfortunately it was not possible to measure all RT in a scrotal position due to an active cremasteric reflex. If we found inguinally

measured testes to be smaller than scrotally measured testes due to less accurate measurement, the actual volumes of RT would be higher than the volumes presented in this study.

Most authors agree that therapy for RT is not warranted since a definitive spontaneous scrotal position is likely to occur at puberty. Nevertheless, some authors suggest orchidopexy. A smaller and softer RT is then considered to be an indication for surgery, as well as rapid retraction and tightness of the cord during manipulation of the testis into the scrotum.[15,19]

In recent years, annual or biannual followup of RT has been advised because many boys with acquired UDT have a history of RT.[12,15,23,24] Some studies suggest that initially RT become secondarily ascended in 2.6%, 3.2% or even 32% of the boys.[12,25,26] It may be hypothesized that retractility is not the cause but rather a symptom of a situation in which the spermatic cord fails to elongate adequately.

In this study we found RT to be smaller than normally descended testes, which suggests that RT may not be a variant of normal. Therefore, hormonal or surgical treatment may be indicated for RT. However, we believe that treatment should not be recommended until further research shows more evidence for the abnormality of RT. We do recommend annual or biannual followup of boys with RT to determine testicular growth because the testes are at risk of becoming secondarily ascended.

This study has some limitations. Volume measurement of the RT was performed only once in 86% of the boys and at different ages. It is possible that the testes of some boys had become retractile only a short time before measurement so that the possible negative effects on testicular growth had not yet occurred. Furthermore, we do not know whether RT has a negative effect on future testicular growth because there was no followup into the adulthood of boys with RT.

Another limitation is that we found no difference in the testis volume of unilateral RT and normally descended testis, and we could not compare contralateral volumes of unilateral RT with normative values because there was a significant difference between the ages of the boys in both groups. If we had representative group of boys with unilateral RT we could have addressed whether having a RT put the contralateral normal descended testicle at risk for decreased growth.

Finally, it was impossible to measure some testes in an inguinal and a scrotal position. Due to an active or just weaker cremasteric reflex, the testis will not persist in a scrotal or inguinal position during 3 volume measurements. Therefore, it was not possible to determine whether inguinally measured testes were really smaller or whether that measurement of the same testis was different when taken in an inguinal or a scrotal position.

Further research should be provided on boys with a history of RT comparing the volumes with normative values during puberty. Moreover it would be interesting to assess testicular volume, and analyze spermatogenesis and paternity into adulthood.

Conclusions

This study shows that the volume of RT measured by ultrasound is smaller than that of normally descended testes. Furthermore, the volumes of RT measured in an inguinal position are smaller than those measured in a scrotal position. In addition, testicular volume scanned in a scrotal or inguinal position is significant smaller than reference values.

References

1. Farrington, G. H.: Histologic observations in crytorchidism: the congenital germinal-cell deficiency of the undescended testis. J Pediatr Surg, **4:** 606, 1969

2. Cinti, S., Barbatelli, G., Pierleoni, C. et al.: The normal, cryptorchid and retractile prepuberal human testis: a comparative morphometric ultrastructural study of 101 cases. Scanning Microsc, **7:** 351, 1993

3. Inan, M., Aydiner, C. Y., Tokuc, B. et al.: Prevalence of cryptorchidism, retractile testis and orchiopexy in school children. Urol Int, **80:** 166, 2008

4. Nistal, M. and Paniagua, R.: Infertility in adult males with retractile testes. Fertil Steril, **41:** 395, 1984

5. Han, S. W., Lee, T., Kim, J. H. et al.: Pathological difference between retractile and cryptorchid testes. J Urol, **162:** 878, 1999

6. Caroppo, E., Niederberger, C., Elhanbly, S. et al.: Effect of cryptorchidism and retractile testes on male factor infertility: a multicenter, retrospective, chart review. Fertil Steril, **83:** 1581, 2005

7. Sakamoto, H., Yajima, T., Nagata, M. et al.: Relationship between testicular size by ultrasonography and testicular function: measurement of testicular length, width, and depth in patients with infertility. Int J Urol, **15:** 529, 2008

8. Goede, J., Hack, W. W., Sijstermans, K. et al.: Normative Values for Testicular Volume Measured by Ultrasonography in a Normal Population from Infancy to Adolescence. Horm Res Paediatr, 2011

9. Hack, W. W., Van Der Voort-Doedens LM, Goede, J. et al.: Natural history and long-term testicular growth of acquired undescended testis after spontaneous descent or pubertal orchidopexy. BJU Int, 2010

10. Diamond, D. A., Paltiel, H. J., DiCanzio, J. et al.: Comparative assessment of pediatric testicular volume: orchidometer versus ultrasound. J Urol, **164:** 1111, 2000

11. Fredriks, A. M., van Buuren, S., Burgmeijer, R. J. et al.: Continuing positive secular growth change in The Netherlands 1955-1997. Pediatr Res, **47:** 316, 2000

12. Agarwal, P. K., Diaz, M., and Elder, J. S.: Retractile testis--is it really a normal variant? J Urol, **175:** 1496, 2006

13. Cour-Palais, I. J.: Spontaneous descent of the testicle. Lancet, **1:** 1403, 1966

14. Okeke, A. A. and Osegbe, D. N.: Prevalence and characteristics of cryptorchidism in a Nigerian district. BJU Int, **88:** 941, 2001

15. Wyllie, G. G.: The retractile testis. Med J Aust, **140:** 403, 1984

16. Elder, J. S.: The undescended testis. Hormonal and surgical management. Surg Clin North Am, **68:** 983, 1988

17. Trammer, A., Hecker, W. C., Fuchs, E. et al.: [About the question of indication for surgery of retractile testis]. Z Kinderchir, **44:** 234, 1989

18. Alexandre, C. L.: [Pendulum testes: a degraded from of cryptorchism]. J Gynecol Obstet Biol Reprod (Paris), **6:** 71, 1977

19. Caucci, M., Barbatelli, G., and Cinti, S.: The retractile testis can be a cause of adult infertility. Fertil Steril, **68:** 1051, 1997

20. Mieusset, R., Bujan, L., Massat, G. et al.: Clinical and biological characteristics of infertile men with a history of cryptorchidism. Hum Reprod, **10:** 613, 1995

21. Thomas, K., Wood, S. J., Thompson, A. J. et al.: The incidence and significance of testicular microlithiasis in a subfertile population. Br J Radiol, **73:** 494, 2000

22. Goede, J., Hack, W. W., van der Voort-Doedens LM et al.: Prevalence of testicular microlithiasis in asymptomatic males 0 to 19 years old. J Urol, **182:** 1516, 2009

23. Guven, A. and Kogan, B. A.: Undescended testis in older boys: further evidence that ascending testes are common. J Pediatr Surg, **43:** 1700, 2008

24. Keys, C. and Heloury, Y.: Retractile testes: A review of the current literature. J Pediatr Urol, 2011

25. Wohlfahrt-Veje, C., Boisen, K. A., Boas, M. et al.: Acquired cryptorchidism is frequent in infancy and childhood. Int J Androl, **32:** 423, 2009

26. Stec, A. A., Thomas, J. C., DeMarco, R. T. et al.: Incidence of testicular ascent in boys with retractile testes. J Urol, **178:** 1722, 2007

Supplementary material

Testicular volumes per age for all retractile testes, scrotal and inguinal measured retractile testes and for reference values.

	Retractile testes - all					Retractile testes - scrotal				
Age (years)	n (boys)	mean (ml)	min (ml)	max (ml)	*p**	n (boys)	mean (ml)	min (ml)	max (ml)	*p**
1	8	0,43	0,29	0,61	ns	4	0,45	0,29	0,61	"-"
2	23	0,38	0,24	0,63	0,00	4	0,37	0,33	0,40	"-"
3	27	0,43	0,22	1,01	0,02	10	0,53	0,39	1,01	ns
4	30	0,40	0,18	1,05	0,01	7	0,54	0,27	1,05	ns
5	31	0,44	0,22	0,75	<0,001**	13	0,43	0,22	0,75	0,018
6	42	0,47	0,23	0,99	0,001**	20	0,51	0,33	0,99	0,034
7	30	0,56	0,28	1,24	0,031**	19	0,61	0,42	1,24	ns
8	33	0,56	0,31	1,49	0,051**	18	0,63	0,36	1,49	ns
9	27	0,54	0,30	0,91	<0,001	12	0,63	0,35	0,91	ns
10	7	0,53	0,40	0,73	0,03	2	0,55	0,53	0,57	"-"
11	16	0,74	0,49	0,95	<0,001	11	0,77	0,65	0,95	0,003
12	2	1,23	1,03	1,44	"-"	0				"-"
Total	276				<0,001**	120				<0,001**

	Retractile testes - inguinal					Reference values			
Age (years)	n (boys)	mean (ml)	min (ml)	max (ml)	*p**	n (boys)	mean (ml)	min (ml)	max (ml)
1	4	0,42	0,40	0,47	"-"	40	0,48	0,25	0,80
2	19	0,38	0,24	0,63	0,003	38	0,46	0,32	0,78
3	17	0,38	0,22	0,62	0,003	36	0,51	0,23	1,00
4	23	0,36	0,18	0,85	<0,001	38	0,51	0,30	1,00
5	18	0,45	0,23	0,73	0,003	48	0,58	0,31	0,97
6	22	0,44	0,23	0,91	0,001	42	0,63	0,29	1,36
7	11	0,47	0,28	0,74	0,001	62	0,65	0,30	1,30
8	15	0,47	0,31	0,69	<0,001	59	0,66	0,34	1,48
9	15	0,48	0,30	0,77	<0,001	54	0,79	0,37	3,52
10	5	0,51	0,40	0,73	0,003	49	0,97	0,37	3,41
11	5	0,67	0,49	0,85	<0,001	61	1,33	0,33	6,70
12	2	1,23	1,03	1,44	"-"	55	2,33	0,55	9,13
Total	156				<0,001**	582			

** difference with reference values; Mann Whitney test*

*** difference with reference values; independent t-test*

ns: no significancy

"-" : to few values