

Foreskin development in 10 421 Chinese boys aged 0-18 years

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Background: Few studies on foreskin development and the practice of circumcision have been done in Chinese boys. This study aimed to determine the natural development process of foreskin in children.

Methods: A total of 10 421 boys aged 0 to 18 years were studied. The condition of foreskin was classified into type I (phimosis), type II (partial phimosis), type III (adhesion of prepuce), type IV (normal), and type V (circumcised). Other abnormalities of the genitalia were also determined.

Results: The incidence of a completely retractile foreskin increased from 0% at birth to 42.26% in adolescence; however, the phimosis rate decreased with age from 99.7% to 6.81%. Other abnormalities included web penis, concealed penis, cryptorchidism, hydrocele, micropenis, inguinal hernia, and hypospadias.

Conclusions: Incomplete separation of foreskin is common in children. Since it is a natural phenomenon to approach the adult condition until puberty, circumcision should be performed with cautions in children.

World J Pediatr 2009;5(4):312-315

Key words: abnormalities;
circumcision;
external genitalia;
foreskin

Introduction

The foreskin is a simple fold of skin composed of an outer keratinized layer and an inner mucosal layer, lining a preputial sac. It has a protective function by internalizing the glans penis and urethral meatus, similar to the eyelid covering the globe of the eye. Circumcision, one of the oldest surgeries, is a most controversial one, as many circumcisions are performed without medical indications. Neonatal circumcision is common in some western countries but uncommon in oriental countries.^[1] There are many uncircumcised boys in China, whose parents are anxious about their irretractile foreskin and consider unretractability of the prepuce as an indication for circumcision. However, there have been few studies on foreskin development and the practice of circumcision in Chinese boys. This study aimed to assess the external genitalia status especially foreskin retractability of 10 421 boys aged from 0 to 18 years, attempting to get information about the natural development of foreskin, and suggest the appropriate time and indication for circumcision.

Methods

We observed 10 421 Chinese boys who presented at the in-patient and out-patient departments (excluding those who came to the urology department) of the Children's Hospital of Chongqing Medical University from 0 to 18 years old between February 2008 and November 2008. The hospital provides secondary and tertiary pediatric care in Chongqing and is also a major pediatrics referral center in Southwest China. The boys were divided into six groups according to their ages: group 1, neonates (below 28 days, $n=667$); group 2, infants (1-12 months, $n=1349$); group 3, toddlers (1-2 years old, $n=1737$); group 4, preschool children (3-6 years old, $n=2109$); group 5, school children (7-10 years old, $n=2342$); group 6, adolescents (11-18 years old, $n=2217$). Informed consent was obtained from the parents of the boys. With the boy relaxing and lying down, the foreskin was retracted gently without traumatic force and the degree of foreskin retractability was observed. The foreskin status was classified into five types:

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doi:10.1007/s12519-009-0060-z

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type I (phimosis), no retraction of foreskin at all, and the urethral meatus and glans penis were invisible after foreskin retraction; type II (partial phimosis), the urethral meatus was visible only after retraction of the foreskin; type III (adhesion of prepuce), the urethral meatus and part of the glans penis were visible after retraction of the foreskin; type IV (normal), easy to exposure of the whole glans after retraction of the foreskin; and type V (circumcised), circumcised foreskin.

Other abnormalities of external genitalia such as web penis, concealed penis, micropenis, cryptorchidism, hydrocele, inguinal hernia, and hypospadias were also recorded. The criteria of external genitalia abnormalities were based on the *Campbell's Urology*, 7th edition.^[2,3] All boys were observed by the same urologist.

Statistical analyses were performed using SPSS software version 13.0 (SPSS Inc. Chicago, IL, USA). The Chi-square test was used to analyze the foreskin distribution in each group. Pearson's product-moment correlation coefficient was used to assess the association between phimosis and age. A *P* value <0.05 was considered statistically significant.

Results

The phimosis rate was 99.7%, 84.43%, 48.13%, 27.12%, 12.04%, and 6.81% in group 1 to group 6, respectively, and it decreased significantly with age

(*P*<0.01). In contrast, the proportion of normal foreskin increased from 0% in neonates to 42.26% in adolescents (Table 1). The children who had circumcision accounted for 55% of preschool children, and 87% of them were operated on before puberty. In type IV boys, 30.1% had redundant foreskin. Of all children 13.49% had foreskin dilation previously, 30.23% had fully retracted foreskin, 12.58% had phimosis still, and most of whom had scar in the distal foreskin. Foreskin dilations were performed before school-age, accounting for 76.8% of all forced foreskin dilations. The incidence of phimosis decreased significantly with increasing age (*r*=-0.828, *P*<0.0001). Other abnormalities included micropenis (1.48%), web penis (1.02%), concealed penis (0.89%), hydrocele (1.48%), inguinal hernia (1.54%), cryptorchidism (1.41%), and hypospadias (0.17%) (Table 2). The total abnormality rate in this series was 7.98%.

Discussion

The foreskin is the retractile covering of the glans penis. Non-retractile foreskins are common among young boys and a normal part of preputial development. More than fifty years ago, it was shown that the foreskin of newborns were non-retractile, while at the age of 3, up to 90% of foreskins were retractable.^[4] But the conclusion was suspected in the later studies, as it was found that about 50% foreskin can not be retracted at the age of 3 years.^[5] Our study showed that no neonate

Table 1. Analysis of the shape and retractability of the pepuce in 10 421 boys aged from 0 to 18 years [*n* (%)]

Group	Number	Type I	Type II	Type III	Type IV	Type V
1	667	665 (99.70)	2 (0.30)	0 (0.00)	0 (0.00)	0 (0.00)
2	1349	1139 (84.43)	183 (13.57)	18 (1.33)	9 (0.67)	0 (0.00)
3	1737	836 (48.13)	558 (32.12)	307 (17.67)	36 (2.07)	0 (0.00)
4	2109	572 (27.12)	578 (27.41)	521 (24.70)	226 (10.72)	212 (10.05)
5	2342	282 (12.04)	469 (20.03)	678 (28.95)	555 (23.70)	358 (15.29)
6	2217	151 (6.81)	192 (8.66)	554 (24.99)	937 (42.26)	383 (17.28)

Type I (phimosis): The urethral meatus and glans penis were invisible after foreskin retraction; type II (partial phimosis): The urethral meatus was visible but not the glans penis after retraction of the foreskin; type III (adhesion of prepuce): The urethral meatus and part of the glans penis were visible after retraction of the foreskin; type IV (normal): The entire glans penis was visible after retraction of the foreskin; type V (circumcised): circumcised foreskin.

Table 2. External genitalia abnormalities found in the children [*n* (%)]

Condition	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Total
Micropenis	14 (2.10)	29 (2.15)	31 (1.78)	26 (1.23)	29 (1.24)	25 (1.13)	154 (1.48)
Web penis	10 (1.50)	14 (1.04)	29 (1.67)	12 (0.57)	25 (1.07)	16 (0.72)	106 (1.02)
Inguinal hernia	17 (2.55)	40 (2.97)	35 (2.01)	18 (0.85)	23 (0.98)	27 (1.22)	160 (1.54)
Hydrocele	44 (6.60)	59 (4.37)	34 (1.96)	17 (0.81)	0 (0.00)	0 (0.00)	154 (1.48)
Cryptorchidism	60 (9.00)	27 (2.00)	29 (1.67)	19 (0.90)	6 (0.26)	6 (0.27)	147 (1.41)
Concealed penis	10 (1.05)	9 (0.67)	29 (1.67)	13 (0.62)	16 (0.68)	16 (0.72)	93 (0.89)
Hypospadias	3 (0.45)	6 (0.44)	6 (0.35)	2 (0.10)	0 (0.00)	1 (0.04)	18 (0.17)
Total	158 (23.54)	184 (13.64)	193 (11.11)	107 (5.07)	99 (4.23)	91 (4.10)	832 (7.98)

had a completely retractile foreskin, while with age increasing, the proportion of retractile foreskin became larger. On the other hand, the prevalence of phimosis decreases with age. In the group aged 10 to 18 years, the phimosis rate was only 6.81%. These findings are in agreement with the previous study by Kayaba et al.^[5] The spontaneous resolution of phimosis with age increasing may be due to the foreskin development secondary to the penis intermittent erection and keratinization of the inner epithelium,^[6] which indicate that phimosis may be a physiologic status in children. While pathologic phimosis that existed when failure to retract was secondary to distal scarring of the foreskin and some foreskin diseases such as balanitis xerotica obliterans (BXO), which was regarded as an indication for circumcision. Thus, more attention should be paid to re-recognize physiological and pathologic phimosis by all clinical doctors to avoid over-diagnosis and over-circumcision.

With foreskin development, the phimosis rate decreased from 54.8% before school age to 6.81% at puberty. However, among all children who had circumcision and foreskin dilation, 55% had circumcision and 76.8% had foreskin dilation before school age, and 87% had circumcision before puberty. There may be a large number of children who underwent unnecessary circumcision or foreskin dilation. On the other hand, surgical intervention may affect the normal development of foreskin, and even lead to pathological phimosis. Concepción et al^[7] reported 43.1% of boys with previous prepuce forced dilation had acquired new balanopreputial adhesions by the time of examination. In our study, we found only 30.2% had fully retractable foreskin in the boys who had foreskin dilation before, 12.6% had still phimosis, and most of whom had scarring in the distal foreskin. We consider that circumcision or forced dilation of the prepuce should be cautiously applied in most boys before puberty.

The appropriate age and indication for circumcision is widely discussed. Circumcision may decrease the risk of urinary tract infection (UTI), and sexually transmitted diseases including heterosexually acquired HIV infection, and protect against penile cancer. It also can reduce the risk of penile human papillomavirus (HPV) infection, cervical cancer in female partners.^[8] But these benefits for men are of questionable relevance. The actual incidence of UTI in the first year of life is low, even a 10-fold reduction in infection rates equates to changing the incidence of UTI from 1 in 100 to 1 in 1000 male babies.^[9] The absolute risk of penile cancer is negligible (1 in 100 000).^[10] Utilizing circumcision to prevent penile cancer is ridiculous, as the breast is removed to prevent breast cancer. A recent

meta-analysis on HPV and circumcision concluded that the medical literature does not support the claim that circumcision reduces the risk of genital HPV infection.^[11] And circumcision is an invasive procedure with risk and with a complication rate ranging from 0.2% to 34%.^[12] There are generally more cost-effective and lower-risk ways of treating these infections than circumcision. Furthermore, routine circumcision may result in a burden of costs to the health care system in the form of unnecessary urological referrals or surgery. Circumcision is indicated absolutely in 0.6% of boys with a peak incidence at 11 years, and is rarely encountered before the age of 5 years.^[13] We consider that routine circumcision in neonates or before adolescence was unnecessary, and only phimosis after adolescence, recurrent UTI, severe balanoposthitis, BXO, or vesicourethral reflux due to phimosis are indicators for circumcision.

Although the prevention of HIV infection by circumcision has been highly stressed in the past decade, we must be cautious to interpret the results of any trial. By the end of December 2007, the HIV infection rate in the Chinese population was 0.05% (range 0.04%-0.07%), and the transmission mode was via injecting drug and former blood and plasma collection,^[14] which was significantly different from Uganda, Kenya and south Africa, which have a HIV infection rate of 6%-19%.^[15] The sexual transmission is the predominant transmission mode. Moreover, there is no evidence of susceptibility to HIV target cells in the inner foreskin of Chinese people, which is the proposed protective mechanism of male circumcision.^[16,17] The predominant HIV subtypes A, C, and D in Africa are still unclear in China. The different binding avidity of HIV subtypes for CCR5 receptors is one of the important mechanisms for entry into Langerhans cells—the predominant HIV-1 co-receptor in foreskin immune cells.^[17,18] Thus we doubt whether circumcision has the similar protective effect in China. In our opinion, more evidence is needed before taking circumcision as a national measure.

In this study, we also observed the abnormalities of external genitalia. Hydrocele and cryptorchidism were found to be related to phimosis, a similar trend of self-resolution with age increasing. We found 9% of neonates had cryptorchidism in this study, the incidence was higher than the reported before (1.6%-5.8%).^[19,20] The higher incidence of cryptorchidism may be attributed to the portion of early birth neonates (In the neonatal group, 208 in 667 newborns were premature infants) and more severe environmental contamination than in the past. Environmental factors with estrogenic or anti-androgenic effects have been proposed to play a role in the increasing frequency of male reproductive

disorders.^[21] Some studies supported the hypothesis that environmental factors are linked to cryptorchidism by an association between human cryptorchidism and exposure to environmental chemicals.^[22,23]

Incomplete separation of foreskin is common in Chinese newborns. In school boys, the degree of preputial separation and exposure of the glans penis is increased with age and progresses even more rapidly in adolescence. Very few boys are suffering from unretractable prepuce until puberty. With the knowledge of normal preputial development, unnecessary circumcision and forced dilation may be avoided in pre-school boys.

Acknowledgements

We would like to thank the collaborators from the Department of Urology of Chongqing Children's Hospital, who participated in the coordination of the physical check-up program for children.

Funding: None.

Ethical approval: This study was approved by the Ethics Committee of the university.

Competing interest: None declared.

Contributors: Yang C proposed the study and wrote the first draft. Liu X analyzed the data. All authors contributed to the design and interpretation of the study and to further drafts. Wei GH is the guarantor.

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Received December 12, 2008

Accepted after revision March 9, 2009