Reference standard of penile size and prevalence of buried penis in Japanese newborn male infants

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Abstract. The present study set forth the reference values for penile size and determined the prevalence of buried penis in Japanese full-term newborns. The stretched penile length was measured and the presence of buried penis was assessed at 1–7 days of age in 547 Japanese full-term newborn infants born between 2008 and 2012 in Tokyo. The stretched penile lengths were compared at 1–12 hours and 1–7 days of age in 63 infants and by two observers in 73 infants to estimate postnatal changes and interobserver variation, respectively. The mean stretched penile length was 3.06 cm (SD, 0.26; 95% confidence interval [CI], 3.04–3.08) and the mean ratio of penile length to body length was 6.24×100\(^{-1}\) (SD, 0.55×100\(^{-1}\)), both of which were significantly smaller than those in Caucasian newborn infants. Buried penis was identified in 20 of 547 infants (3.7%; 95% CI, 2.1–5.2%). The first measurements of penile length at 1–12 hours were significantly smaller than the next measurements at 1–7 days (95% CI of the difference, 0.22–0.34). The 95% CI for the limits of agreement in the penile lengths measured by the two observers was -0.58 to -0.40 for the lower limit and 0.33 to 0.51 for the upper limit. These findings indicate that the penile length should be assessed after 24 hours of age by the reference standard of the same ethnicity for identifying micropenis and that buried penis is not uncommon in Japanese full-term newborns.

Key words: Stretched penile length, Buried penis, Full-term neonate, Reference value, Ethnicity

Subjects and Methods

A total of 1,210 consecutive full-term newborn infants (610 male and 600 female) were born between January 1, 2008 and December 31, 2012 in a regional hospital in Tokyo. The stretched penile length was measured in 547 of the 610 full-term male newborn infants (Table 1). The inclusion criteria for the study were: (1) 37–42 weeks gestation, (2) 1–7 days of age at measurement, (3) parents of Japanese ethnicity, (4) no cryptorchidism or hypospadias, and (5) no major malformation or chromosomal abnormality. Measurements of stretched penile length were made as a part of the routine physical examination, and the length, weight, head circumference, and placental weight of each infant were measured by the midwives in the nursery. Buried penis was defined as the penis for which the shaft was buried below the surface of the prepubic skin and the stretched length was unmeasurable accurately even with compressing suprapubic fat pad. Baseline demographic data including parity of birth, parental age, parental height and weight, and medical history were also obtained.

Penile length was determined from the pubic ramus to the tip of the glans penis by placing the end of a measuring tape against the pubic ramus and applying traction along the length of the phallus to the point of increased resistance. The stretched penile length...
standardized penile length was 6.24×10^{-1} for Japanese infants, whereas it was 6.16×10^{-1} for Canadian Chinese, 6.58×10^{-1} for Canadian Caucasian, 6.74×10^{-1} for Danish and Finnish, and 7.00×10^{-1} for Jewish Israeli infants (unfortunately, body length at birth was not provided for the US Caucasian study).

The coefficient of variation for penile length was 8.5% for Japanese full-term newborn infants, whereas it was 11.4% for Jewish Israeli [5], 11.5% for Danish and Finnish [2], 13.3% for Hong Kong Chinese [6], and 20.0% for American Caucasian [4] full-term newborn infants. This indicates that data on Japanese infants are relatively less spread out as compared to those on infants of other ethnicities.

There was no apparent relationship between gestational age and penile length at 37–42 weeks (Fig. 2), although the correlation coefficient between the weeks of gestation (37–42 weeks) and stretched penile length was 0.12 (p = 0.004). We combined the data to derive the reference standard of penile length for Japanese full-term newborn infants.

Interobserver variation

Stretched penile length was measured in 73 infants by two observers to estimate interobserver variation. Differences in the measurements of penile length were plotted against mean penile length by the two observers, with mean difference and 95% limits of agreement indicated (Fig. 3). There was no obvious relationship between the differences and the mean. The differences showed mean and SD values of -0.03 and 0.23, respectively, with the 95% limits of agreement being -0.49

was measured only for the penis that was fully flaccid. Interobserver agreement was investigated for stretched penile length measurements, using the 95% limits of agreement method by Bland and Altman [8, 9]. Our preliminary study suggested that penile length was shorter if measured soon after birth, since edematous prepubic skin hinders sufficient stretching of the penis. To study the magnitude of the effect of postnatal age of newborn infants on penile size, comparisons were made in 63 infants by using a paired t-test for the first measurements obtained within 12 hours of age and the second measurements obtained at 1–7 days of age, each made by the same measurer.

This study was conducted in accordance with the ethical principles set out in the Declaration of Helsinki, and with the ethical guidelines for epidemiological studies issued by the Ministry of Health, Labor and Welfare in Japan.

Results

Mean and SD of penile length

A histogram of penile lengths of Japanese full-term newborn infants is shown in Fig. 1. The mean penile length was 3.06 cm (SD, 0.26 cm), and the 95% confidence interval (CI) was 3.04–3.08 cm. The lower limit of the normal range (-2.5 SD) was 2.40 cm. Thus, micropenis was defined as a penis measuring <2.4 cm in stretched length.

The mean penile length (cm) was divided by the mean body length (cm) at birth to obtain the standardized penile length for full-term newborn infants. The standardized penile length was 6.24×10^{-1} for Japanese infants, whereas it was 6.16×10^{-1} for Canadian Chinese, 6.58×10^{-1} for Canadian Caucasian, 6.74×10^{-1} for Danish and Finnish, and 7.00×10^{-1} for Jewish Israeli infants (unfortunately, body length at birth was not provided for the US Caucasian study).

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| Table 1 | Stretched pen lengths and demographic characteristics of study subjects (N=547) |
|---------|---------------------------------|------------------|-------------------|
|         | Mean (SD) | Median (SE) | 95 % CI |
| Gestational age (weeks) | 39.6 (1.2) | 39.7 (0.1) | 39.5-39.7 |
| Birth parity | 1.6 (0.7) | 1 (0.03) | 1.5-1.6 |
| Maternal age (years) | 31.0 (4.9) | 31 (0.2) | 30.6-31.4 |
| Paternal age (years) | 33.3 (5.7) | 33 (0.2) | 32.8-33.7 |
| Mid-parental age (years) | 32.2 (4.8) | 32.3 (0.2) | 31.8-32.6 |
| Maternal height (cm) | 159.0 (5.4) | 159.0 (0.2) | 158.6-159.5 |
| Paternal height (cm) | 172.3 (5.8) | 172.0 (0.2) | 171.8-172.7 |
| Mid-parental height (cm) | 165.6 (4.1) | 165.0 (0.2) | 165.3-166.0 |
| Birth weight (g) | 3,118 (325) | 3,115 (14) | 3,091-3,146 |
| Birth length (cm) | 49.0 (1.8) | 49.0 (0.08) | 48.9-49.2 |
| Birth BMI | 12.9 (0.9) | 13.0 (0.04) | 12.9-13.0 |
| Placental weight (g) | 582 (103) | 570 (4) | 574-591 |
| Penile length (cm) | 3.06 (0.26) | 3.1 (0.01) | 3.04-3.08 |
| Standardized penile length (cm/50cm length) | 3.12 (0.28) | 3.1 (0.01) | 3.10-3.14 |
Penile size in Japanese neonates

Fig. 1  Histogram of stretched penile length of 547 Japanese full-term newborn infants

Fig. 2  Stretched penile length according to gestational age. Horizontal axis indicates gestational age in weeks, and vertical axis demonstrates penile length. Dots represent individual measurements

Fig. 3  Differences in stretched penile length (observer 1 - observer 2) vs. mean penile length measurements made by two different observers
to 0.42. The standard error of the limits was 0.047, as based on the formula $\sqrt{3s^2/n}$, where $s$ is the standard deviation of the differences and $n$ is the sample size. Thus, the 95% CI for the limits of agreement was -0.58 to -0.40 for the lower limit and 0.33 to 0.51 for the upper limit.

**Postnatal age at measurement**

In 63 full-term newborn infants, penile length was measured first within 12 hours after birth and then at 1–7 days postnatally by the first author. The results are shown in Table 2, which indicate that the first measurements are significantly smaller than the next measurements. Based on these findings, we determined the penile reference standard for full-term newborn infants, as measured at 1–7 days of age.

**Buried penis**

In buried penis that is obvious at birth, little penile skin is evident and the penile shaft is below the surface of the prepubic skin, which prevents accurate measurement of penile length in infants. Buried penis was diagnosed in 20 of 547 (3.7%) full-term newborn infants, with the 95% CI being 2.1–5.2%. In those 20 infants, the penis was normal in size by palpation, but the stretched penile lengths ranged from 2.3 to 3.1 cm (mean, 2.57). Of the 20 infants diagnosed with buried penis at 1–7 days of age, 12 had buried penis at 1 month, and 8 were lost to follow-up. The 12 infants underwent follow-up for various lengths of time, with 10 having improved or outgrown the condition by 3–4 years of age. The remaining 2 infants continued to have buried penis at 4–5 years of age (0.3%; 95% CI, 0.0–0.9%). We estimate that the prevalence of congenital buried penis in Japanese infants is approximately 2–5% at 1–7 days of age and 0.3% at 4–5 years of age.

**Discussion**

As derived from the present data, the mean stretched penile length for full-term newborn infants was 3.06 cm (SD, 0.26). The lower cutoff limit was calculated to be 2.4 cm (-2.5 SD). These subjects with no sign of disorders of sex development are likely representative of contemporary Japanese newborns, although mild form of androgen insensitivity syndrome [10] or 5α-reductase deficiency [11] cannot be excluded. Thus, micropenis is defined as a penis with a stretched penile length of less than 2.4 cm in contemporary Japanese full-term newborn infants.

The results indicate that the mean penile length is significantly shorter in Japanese newborn infants than in Caucasian newborn infants. The standard reference for penile size has previously been established for American term newborn infants by Feldman and Smith [4], with the mean stretched penile length being 3.5 cm (SD, 0.4). Boas et al. [2] also have recently determined new reference ranges for flaccid penile length in Nordic Caucasian newborn infants, with the mean length being 3.49 cm (SD, 0.4). Our finding is in accordance with that of Cheng and Chanoine [3], who documented that the mean penile length is significantly shorter in Canadian newborn infants of Chinese origin than in Canadian newborn infants of Caucasian and East-Indian origins. The mean (SD) was 3.1 (0.3) cm for infants of Chinese ethnicity, 3.4 (0.3) cm for those of Caucasian ethnicity, and 3.6 (0.4) cm for those of East-Indian ethnicity. Fox et al. [6] also reported similar data (mean stretched length, 3.0 cm; SD, 0.4 cm) in Hong Kong Chinese full-term newborn infants.

There is no consensus among investigators regarding the standardized method for penile length measurement, i.e., flaccid vs. stretched penile length measurements. Schonfeld and Beebe [12] showed that stretched penile length is the most consistent measure of phallic length and that it closely correlates with erect penile length [12]. On the other hand, Boas et al. [2] found that flaccid penile length is a reliable measure of phallic length, as an erection is avoided in most cases. Each method obviously has its advantages and disadvantages, as demonstrated by various investigators, but more importantly, Boas et al. [2] showed that the standard deviation between the two methods (flaccid vs. stretched penile length measurements) was ±0.36 cm, which is comparable to the interobserver variation of ±0.34 cm. This observation indicates that measurements should be repeated in borderline or technically difficult cases, irrespective of whichever method is adopted.

In addition to interobserver variation, we showed that postnatal age at measurement was another source
of measurement variability. The mean penile length measured within 12 hours after birth was 0.31 cm shorter than that re-measured at 1–7 days of age in the 63 infants studied (Table 2). We suspect that smaller penile length readings measured within 12 hours of age reflect edematous prepubic tissue preventing the separation of penopubic tissue from the penis in infants.

To our knowledge, no previous study has addressed the prevalence of buried penis in children or adults. Here, we report that buried penis is not uncommon in Japanese full-term newborn infants, and it occurred in as many as 3–4% of the newborn infants studied. Nevertheless, most newborn infants presented with a mild form of buried penis. They had apparently small penises, but on palpation and by gross estimation, we found that the penises had a normal shaft of normal length. Of the 20 newborn infants with buried penis, only 2 had features of buried penis that lasted till at least 4–5 years of age. Flaccid penile length measurement may be technically problematic in newborn infants with buried penis. Stretched penile length measurement can be performed in such infants, and ultrasound evaluation of penile length may offer a more accurate assessment of functional penile length [13].

We conclude that the micropenis needs to be defined according to ethnicity and a separate penile length be considered as the lowest limit for the definition of micropenis in each population.

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Disclosure

All the authors have no conflict of interest to declare.

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