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## ORIGINAL RESEARCH

# Comparative Analysis of Neonatal Clitoral Length Measurement Using Calliper Versus Spatula

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## Abstract

**Background:** Clitoral length measurement at birth is important for critical clinical decisions but when standard instruments are unavailable for this purpose, improvisation with locally available tools could be helpful.

**Objective:** To determine how a wooden spatula compares with a calliper in clitoral length measurement.

**Methods:** This was a comparative cross-sectional study involving 305 term female newborn infants who were recruited from multiple health facilities in Sagamu, Ogun State, Nigeria. The clitoral length was measured with a sliding digital calliper and a wooden spatula (tongue depressor) within the first 72 hours of life.

**Results:** The mean ( $\pm$  SD) clitoral lengths, using the sliding digital calliper and the spatula, were  $6.7 \pm 1.6$  mm and  $6.5 \pm 1.8$  mm respectively ( $t = 1.369$ ,  $p = 0.171$ ). Pearson's correlation analysis showed significant direct correlation between both measurements ( $r = 0.693$ ,  $p < 0.001$ ) and the spatula length was a moderate predictor of the calliper length (Coefficient of determination [ $R^2$ ] = 0.48 and  $p < 0.001$ ).

**Conclusion:** The findings of this study suggest that clitoral length measurement using a wooden spatula could be a proxy for clitoral length measurement using a digital calliper.

**Keywords:** Calliper, Clitoral length, Female external genitalia, Newborn, Spatula.

## Introduction

The sex of a baby is determined at fertilization by the chromosome on the cell, whether X or Y, from the father that fertilizes the ovum. The Y-chromosome which bears the testis-determining factor (TDF) SRY gene, is responsible for the development of the male phenotype (XY) while the presence of double X chromosomes gives rise to the female phenotype (XX).<sup>[1]</sup> The bipotential genital

tubercle gives rise to the penis in the male and the clitoris in the female.<sup>[1,2]</sup> Sex differentiation in the female is not dependent on any hormonal influence; rather, it develops by default in the absence of certain growth factors as well as testosterone.<sup>[1]</sup> However, exposure of the female foetus to excess androgenic substances in-utero may result in varying degrees of virilisation.<sup>[2,3]</sup> Therefore, examining and measuring the clitoris in every female newborn at birth is important and of great diagnostic

value as abnormalities of sizes, especially clitoromegaly may portend danger for the infant.

Standardisation and precision are key requirements for instruments used to measure small body parts such as the clitoris. However, in the absence of standard instruments, improvisation with locally available tools could be helpful and life-saving. The standards of clitoral sizes in the newborn have been previously published using different measuring devices such as a phallometer, [4] bow compass calliper, [2] ruler, [5] and sliding digital calliper. [3,6,7] Perhaps, the most widely acceptable device for measurement is the digital calliper. Variation in the instruments used is likely to produce different values and make comparisons difficult. Previous studies have shown that neonatal clitoral length appears longer in Nigerians than non-Nigerians despite the differences in the instruments used. [5,6] Regardless of the instrument used, clitoral length greater than 1 cm in the newborn is generally regarded as pathologic.[3]

Although normative data, using a sliding digital calliper, were previously generated for the location of the present study, [6] most births in developing countries take place outside specialist facilities, [7] where sliding callipers may not be available. Furthermore, the measurement of clitoral length at birth may facilitate early diagnosis of congenital adrenal hyperplasia, which may be life-threatening in the salt-wasting type. Therefore, a proxy for calliper must be available at the lowest levels of health care delivery. Presently, information on the comparison of two or more devices for the measurement of neonatal clitoral length in the same population is scarce. The purpose of this study was to determine how a wooden spatula compares with a calliper in the measurement of neonatal clitoral length.

## Methods

### *Study design and location*

This comparative, cross-sectional study was carried out in Sagamu from May 2014 to April 2015. Sagamu is a semi-urban town and the administrative headquarter of Sagamu Local Government Area (LGA) of Ogun State, southwest Nigeria. Sagamu LGA has a population of 255,885 people according to the 2006 Census. [8] The inhabitants of Sagamu are multi-ethnic in origin but are predominantly the Yoruba.

The sample size was derived using the formula  $N = (Z\sigma / E)^2$  where Z is the value from the standard normal distribution reflecting the confidence level ( $Z = 1.96$  for 95%),  $\sigma$  was the standard deviation in the reference study and E, the desired margin of error.[9] The mean standard deviation from the reference study [10] was 2.6 mm and the desired margin of error was 0.33mm. Therefore, the minimum calculated sample size was 239.

### *Inclusion and exclusion criteria*

All live healthy newborn babies delivered via uncomplicated spontaneous vaginal delivery from 37 weeks to 41 weeks of gestation and aged from zero to 72 hours were included to exclude bias from the effects of hormonal variations in the first week of life. Babies with obvious congenital anomalies or features suggestive of any chromosomal disorder and babies suspected to have been exposed to androgenic substances such as testosterone, in pregnancy were excluded. If one of the parents did not belong to any ethnic group in Nigeria, such baby was also excluded. [6]

For an adequate representation of the population, subjects were recruited from five health facilities from the two levels of healthcare (primary and tertiary) available in Sagamu. These included one teaching hospital, two specialist private hospitals and two primary health centres (PHC). The details of the methods of subject selection had earlier been

described. [6] The methods of measurement of body weight, body length, head and chest circumference in the subjects had earlier been described. [6, 11]

For the measurement of the clitoral length, the perineum was adequately exposed and held by an assistant in the dorsal decubitus position with the thighs and knees in a frog-like position. The labia majora were gently parted and the hood of the clitoris was retracted. The clitoral length was measured by placing a newly unpacked clean wooden spatula on the dorsal surface of the clitoris. The spatula is generally used as a tongue depressor. The spatula was used to depress the pubic fat to ensure that adequate measurement is taken. A mark was made on the surface of the spatula, adjacent to the dorsal clitoral surface and corresponding to the tip of the glans clitoris, thus ensuring a pubo-clitoral measurement. The mark on the spatula was read-off with a ruler calibrated in millimetres. For each subject, the clitoral length was measured twice and the average was recorded. A new spatula was used for each baby. The sliding digital calliper (VWR International, Model 62379-531) with an accuracy of  $\pm 0.02$  mm, was also used to measure the clitoral length on the dorsal surface. [6] All clitoral length measurements were done by the lead author and only the clitoris was exposed during measurement to avoid contact with the vaginal orifice. A representative of the family was present throughout examination and measurement.

### *Ethical considerations*

The study was approved by the Health Research and Ethics Committee of the Olabisi Onabanjo University Teaching Hospital, Sagamu, Ogun State, Nigeria (OOUTH/DA.326/T/24). Permission was also granted by the relevant authorities at the different health facilities used for recruitment of subjects. Written informed consent was obtained from the parents before examination and measurement.

### *Data analysis*

All data were analysed using the Statistical Packages for the Social Sciences (SPSS), version 20.0 (SPSS Inc., Chicago, IL, USA). Quantitative variables were summarised as mean  $\pm$  standard deviation (SD) while categorical variables were summarised as percentages. The means of continuous variables were compared using the Student's t-test and analysis of variance (ANOVA) as appropriate. Correlation analysis was also carried out to test the relationship between variables. Linear regression was also done to determine the predictability of the dependent variable (calliper length) from the independent variable (spatula length). P values less than 0.05 were considered statistically significant.

## Results

A total of 317 female babies were studied but 305 had full clitoral length data measured using the spatula. Therefore, the data for 305 babies were analysed. The maternal ages ranged from 17 years to 43 years with a mean ( $\pm$  SD) of  $28.7 \pm 5.0$  years. One hundred and fourteen (37.4%), 156 (51.1%), 30 (9.8%) and 5 (1.6%) of the mothers had post-secondary, secondary, primary and no formal education respectively. The mean gestational age at delivery was  $39.3 \pm 1.1$  weeks while the mean age of the babies at recruitment was  $21.3 \pm 9.1$  hours. The mean ( $\pm$  SD) values of the body weight, body length, head and chest circumferences were  $3.0 \pm 0.3$  kg,  $48.7 \pm 1.9$  cm,  $34.5 \pm 1.2$  cm and  $32.3 \pm 1.7$  cm respectively.

The mean clitoral lengths measured with the sliding digital calliper and the spatula were  $6.7 \pm 1.6$  mm and  $6.5 \pm 1.8$  mm respectively. The mean difference between the two measurements was  $0.2 \pm 1.4$  mm and this difference lacked statistical significance ( $t = 1.369$ ,  $p = 0.171$ ). Pearson's correlation analysis showed that the two groups of measurement variables were positively correlated with significance ( $r = 0.693$ ,  $p < 0.001$ ).

Table I shows the gestational age-based clitoral length measured with both instruments. There were fewer differences between the values in the calliper group but there were no statistically significant differences in the means of each group as analysed using ANOVA. The

differences in the mean values within each gestational age group lacked statistical significance. The 3rd, 25th, 50th, 75th and 97th percentiles for the clitoral lengths measured using the spatula and the calliper are shown in Table II.

**Table I: Gestational age-based clitoral length**

GA (weeks)	n (%)	CL spatula (mm) (Mean ± SD)	CL calliper (mm) (Mean ± SD)	Statistics
37	23 (7.5%)	6.0 ± 2.1	6.6 ± 1.6	t = 1.100, p = 0.278
38	60 (19.7%)	6.6 ± 1.5	6.7 ± 1.5	t = 0.620, p = 0.537
39	79 (25.9%)	6.5 ± 1.9	6.7 ± 1.8	t = 0.761, p = 0.448
40	103 (33.8%)	6.6 ± 1.9	6.6 ± 1.6	t = -0.001, p = 0.999
41	40 (13.1%)	6.3 ± 1.8	6.7 ± 1.3	t = 1.158, p = 0.250
		F = 0.615; p = 0.652	F = 0.126; p = 0.973	

GA - Gestational age; F - ANOVA test, CL - Clitoral length, SD - Standard deviation, t - t-test value, p - level of statistical significance.

**Table II: Percentiles for calliper and spatula-measured clitoral lengths**

Centiles	Calliper length (mm)	Spatula length (mm)
3 <sup>rd</sup>	3.7	3.5
25 <sup>th</sup>	5.5	5.2
50 <sup>th</sup>	6.5	6.2
75 <sup>th</sup>	8.0	7.5
97 <sup>th</sup>	9.6	10.3

There was no correlation between the spatula-measured clitoral length and the body weight (r = -0.046, p = 0.424), the body length (r = -0.015, p = 0.801), head circumference (r = -0.057, p = 0.323) and chest circumference (r = -0.041, p = 0.473). Similarly, the calliper-measured clitoral lengths did not correlate with the anthropometric parameters as depicted in Table III. However, linear regression analysis showed that the spatula-measured clitoral

length was a strong predictor of calliper-measured clitoral length as suggested by the equation:  $CL_{calliper} = 2.56 + 0.63 (CL_{spatula})$ . The coefficient of determination [R<sup>2</sup>] was 0.48 and p = 0.000 depicting that the spatula-measured clitoral length was a moderate predictor of the calliper-measured clitoral length. The relationship between the calliper and spatula-measured clitoral lengths is shown in Figure 1.

**Table III: Correlation between clitoral length and anthropometric parameters**

Anthropometric parameters	Calliper-measured clitoral length (r, p)	Spatula-measured clitoral length (r, p)
Body weight (kg)	-0.046, 0.424	-0.104, 0.071
Body length (cm)	-0.015, 0.801	0.013, 0.817
Head circumference (cm)	-0.057, 0.323	0.032, 0.572
Chest circumference (cm)	-0.041, 0.473	-0.079, 0.171

r - correlation coefficient; p - level of statistical significance

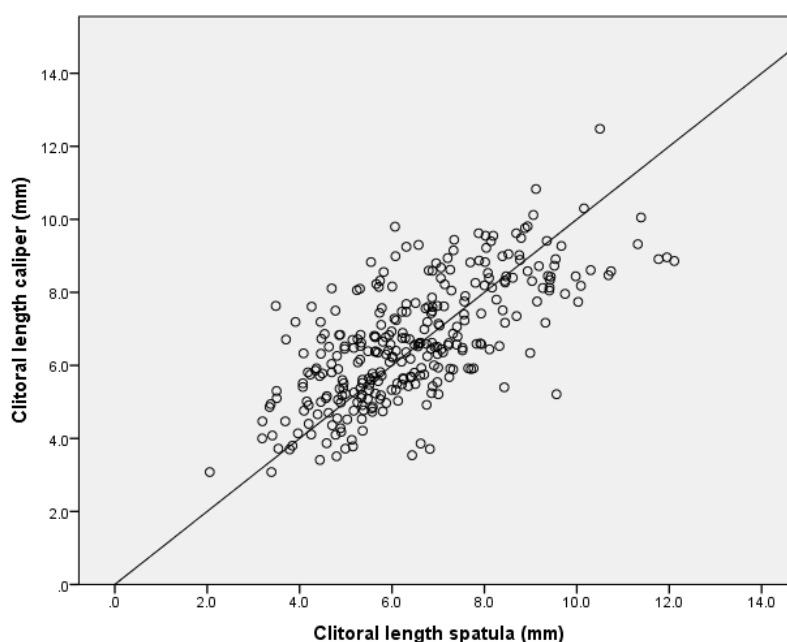


Figure 1: Scatter plot showing the relationship between calliper and spatula-measured clitoral lengths

## Discussion

The clitoris, being a small organ, requires accurate measurement for the determination of its dimensions to avoid misdiagnosis. [5,6] Also, the comparison of data across studies that is devoid of bias demands that the methodology, particularly the instrument of measurement be identical.

Indeed, it is challenging comparing the spatula-measured clitoral lengths in this study with other previous studies. The mean spatula-measured clitoral length in the present study is lower compared to  $7.7 \pm 1.37$  mm reported by Jarrett *et al.*, [5] using a ruler in Ibadan, southwest Nigeria. However, it is higher than  $5.87 \pm 1.48$  mm but comparable to  $6.61 \pm 1.72$  mm reported in Jewish and Bedouin term babies respectively by Philip *et al.* [12] The instrument used in the study by Philip *et al.* [12] could not be verified. Nevertheless, the differences noted may suggest ethnic variations in clitoral sizes as also previously documented. [12] The effect of sample size as well as the type of instrument, and technique used in the measurements could also

contribute to the differences in the values obtained. [5]

The lack of statistically significant difference in the mean clitoral lengths across and within the gestational ages shows that irrespective of the gestational age in weeks, the clitoral lengths are not remarkably different among term babies. This implies the same reference values can be applied once the baby is adjudged to be full term. Unfortunately, comparisons could not be made with other studies due to non-availability of such data.

The experience from this study shows that using the digital calliper to measure clitoral length is easier than the wooden spatula as the investigator has a better view of what is being measured and can easily manoeuvre. Unfortunately, the calliper is more expensive and not readily available in resource-constrained settings. Furthermore, with a digital calliper, the value observed is seen immediately on the display screen whereas the mark on the spatula still has to be read off. However, these differences do not limit the usefulness of the spatula as there is no

significant difference using the calliper or the spatula to measure the clitoral length based on the findings of this study. The availability of the wooden spatula at the lower tiers of health care makes it easy and perhaps obligatory for healthcare providers attending deliveries to measure the clitoral length in the newborn, to ensure early detection of abnormal clitoral sizes and properly evaluate identified babies for the possible causes.

The clinical relevance of the spatula measurement is corroborated by the fact that the 97<sup>th</sup> percentile value of 1.03 cm (similar to the corresponding value for calliper length) for the definition of clitoromegaly in the population studied is similar to the traditionally accepted cut-off of 1 cm for the evaluation of possible pathology.<sup>[3]</sup> Also, the percentile cut-off values for the definition of microclitoris for CLspatula and CLcalliper in this study are similar. Furthermore, the fact that the spatula-measured clitoral length is a significant predictor of calliper-measured clitoral length gives credence to the usefulness of the spatula as a reliable proxy for the calliper.

There was no significant relationship between clitoral lengths and anthropometric parameters similar to the observation earlier made by Jarrett *et al.* <sup>[5]</sup> The non-availability of studies comparing clitoral length in the newborn using both calliper and spatula limits the comparison of the findings of this study. Further studies of this nature are needed for elucidation.

## Conclusion

The determination of neonatal clitoral length using a spatula, which is usually available at the lower tiers of health care delivery, yielded similar values to digital calliper measurements. This implies that either a sliding calliper or a wooden spatula may be used for the identification of abnormal clitoral length in the newborn, which may be an early pointer to the

diagnosis of life-threatening conditions such as congenital adrenal hyperplasia.

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**Conflict of Interest:** None.

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