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Digital photographic measurement in hypospadias: Validation and comparison to intraoperative measurement

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KEYWORDS

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Abstract *Background:* We propose a standardized method of photographing the hypospadias penis to capture penile dimensions that may be relevant for surgery. We also validate the use of digital imaging software for calculating penile dimensions as a substitute for intraoperative caliper-based measurements.

Methods: Photographs were taken of hypospadias penises in four different views after placement of a traction stitch and retraction of the preputial hood. Intraoperative measurements were obtained with a caliper. Digital measurements were taken of the same parameters post-operatively. All measurements were obtained in triplicate by multiple participants, and averages were tested for equivalency by determining the correlation coefficient for each parameter. Inter-observer correlation was also calculated for each parameter.

Results: 180 intraoperative and 180 digital measurements were taken from 60 dimensions on 10 hypospadiac penises. Strong correlation existed between most digital and intraoperative measurements. Average inter-observer correlations ranged from 0.91 to 0.99 for each of the intraoperative measurements, and 0.90 to 1.00 for each of the digital measurements.

Conclusions: Standardized imaging is effective in capturing penile dimensions and measurements during hypospadias surgery. When compared with intraoperative measurements, digital measurements are reliable and precise; digital photography has the potential to both aid in surgical planning and improve documentation.

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Introduction

With an incidence of 0.4% in the USA, hypospadias is one of the most prevalent conditions treated by pediatric urologists [1]. Despite this frequency, there is a lack of high-quality, reproducible outcomes data. The reason is likely, in part, because of the overall heterogeneity of hypospadias penises as well as the lack of an objective standardized assessment protocol. No two hypospadias penises are identical; without a standardized method of quantifying and documenting discrete characteristics of patients' penises, the literature on hypospadias outcomes has limited generalizability and practitioners have struggled to determine which published outcome is applicable to each unique patient [2–4,5].

To document penile anatomy and standardize measurements, our group has utilized digital photography as a substitute for intraoperative measurements. In this pilot study, we propose and evaluate a standardized protocol for photographing the hypospadias penis and use computer-based image software to digitally measure penile dimensions; digital measurements were assessed for reliability among users and validated by comparing values with intraoperative caliper-based measurements.

Materials and methods

Institutional review board approval was obtained (IRB 14595). All patients undergoing hypospadias repair between September, 2012 and January, 2013 at Seattle Children's Hospital were eligible for inclusion. Patients who had undergone prior hypospadias repair were excluded. Prior to photography, all patients were induced under general anesthesia and placed in the supine position. All children were surgically sterilized and draped according to standard surgical practice. Photographs were taken of the penis in four different views following retraction of the preputial hood and placement of a traction stitch in the glans penis. Views included: ventral stretched penis (Fig. 1); ventral with the urethral plate spread wide (Fig. 2); from above the



Figure 1 Ventral stretched penis view. Glans height is measured from the midline of the distal mucosal collar to the tip of the penis.

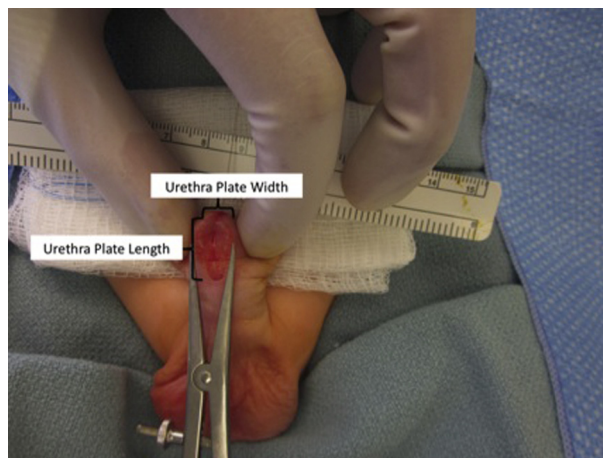


Figure 2 Ventral stretched penis with urethra spread wide view. The glans is pinched and retracted maximally. The urethral plate length is measured from the urethral meatus to the tip of the plate. The urethral plate width is measured as the widest point on the exposed urethral plate.

tip of the glans (Fig. 3); side of the stretched penis (Fig. 4). A single camera, the 12.1 megapixel PowerShot SD1300 IS digital camera (Canon, Tokyo, Japan) was used for all photographs. During photography, the camera was held 6 inches away from the penis; all external overhead spot-lighting was aimed away from the field of view. No zoom or flash was used. A ruler and caliper (Aesculap, Center Valley, PA, USA) were included in each photograph as size references. Immediately following each photograph, the following measurements were obtained with the caliper in triplicate using three blinded scorers: glans height (Fig. 1), urethral plate width and length (Fig. 2), and glans width and depth (Fig. 3). Penile length was obtained using a ruler (Fig. 4). Scorers included urology attendings, trainees, and medical student volunteers.

Postoperatively, the images were uploaded to a computer, where three blinded scorers used the freeware software ImageJ (Bethesda, MD, USA) to obtain digital

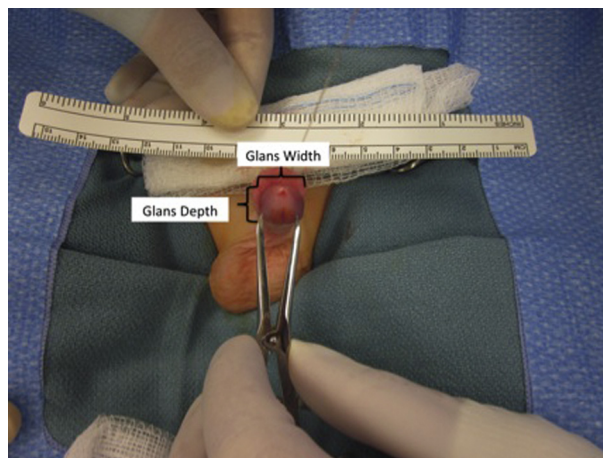


Figure 3 Tip of glans view. The penis is stretched perpendicularly anterior and a straight-on image of the tip of the penis is obtained. The glans width and depth are measured as the widest points in each dimension.

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