Designing and Usage of a Low-cost Penile Model for Male Medical Circumcision Skills Training in Rakai, Uganda

Godfrey Kigozi, James Nkale, Maria Wawer, Margaret Anyokorit, Stephen Watya, Fred Nalugoda, Joseph Kagaayi, Noah Kiwanuka, Joshua Mwinike, Nehemiah Kighoma, Grace K. Nalwoga, Gertrude F. Nakigozi, Henry Katwalo, David Serwadda, and Ronald H. Gray

OBJECTIVE To describe the designing and usage of a locally made low-cost penile model used for male medical circumcision (MMC) skills training.

MATERIAL AND METHODS The Rakai MMC training team has experienced a number of challenges during conduct of MMC skills training, one of which was the lack of a model to use for MMC skills training. To address this challenge, the Rakai MMC skills training team has designed and developed a low-cost penile model for use in MMC skills training.

RESULTS The model has been successfully used to demonstrate external penile anatomy, to describe the biological mechanisms through which male circumcision (MC) prevents HIV acquisition, and for demonstration and practice of the MMC procedures.

CONCLUSIONS With an initial cost of only $10 and a recurrent cost of $5, this is a cost-efficient and useful penile model that provides a simulation of normal penile anatomy for use in MC training in resource-limited settings. It has also been used as a visual aid in preoperative education of patients before receiving male circumcision. The model can be improved and scaled up to develop cheaper commercial penile models. UROLOGY 77: 1495–1497, 2011. © 2011 Elsevier Inc.

Male circumcision (MC) reduces the risk of HIV infection in men by 50% to 60%[1-3] and has been recommended by the World Health Organization (WHO) as a proven HIV preventive strategy.[4] There is a need to train MC providers, including surgeons, MC counselors, and operating room assistants to provide safe services. Because of a lack of medical officers to perform MC, there is also a need to promote task shifting and task sharing to clinical officers and/or nurses.

The Rakai Health Sciences Program received funding from WHO and the President's Emergency Plan for AIDS Relief (PEPFAR) to provide male circumcision training to teams of MC providers. One of the challenges faced by the trainers was a lack of models that could be used to demonstrate MC procedures to trainees before they conducted surgery. Upon review of the literature, no information was available on penile models that could be used for adult MC skills training. To address this challenge, the Rakai Health Sciences Program training team designed a cheap penile model that can be made locally at low cost. The objective of this paper is to describe the training model and how it can be used for the MC providers training.

DESIGNING THE TRAINING MODEL

A wooden penile model was made locally and its size approximates that of an average adult penis (approximately 12-15 cm in length, and 12 cm in circumference). The pieces of cloth used to mimic the skin of the shaft and foreskin are made of a semi-elastic material to allow proper fit over the shaft and glans while remaining retractable.

The initial cost of the model inclusive of labor was about $10, and the recurrent cost for this penile model was $5 USD because the wooden piece is reusable.

Below is a description of steps taken in designing the MC skills training model. Figure 1 shows parts used to construct the model, as well as a completed model.

The wooden penile model (A) is curved out of hard wood by local carpenters and is reusable. An inner layer of cloth (B) extending from the base of the shaft to the coronal sulcus is wrapped around the wooden model and fastened with threads. This inner layer of cloth is used to anchor the external layer made of 2 pieces of cloth, one

From the Rakai Health Sciences Program, Entebbe, Uganda; Bloomberg School of Public Heath, Johns Hopkins University, Baltimore, MD; Department of Surgery, Urology Unit, Makerere University, Mulago Hospital, Uganda; and Institute of Public Health, Makerere University, Kampala, Uganda

Reprint requests: Godfrey Kigozi, M.D., M.P.H., Rakai Health Sciences Program, 279, Kalisizo, Uganda. E-Mail: gkigozi@rhsp.org

Submitted: August 6, 2010, accepted (with revisions): November 19, 2010

0090-4295/11/$36.00

doi:10.1016/j.urology.2010.11.031

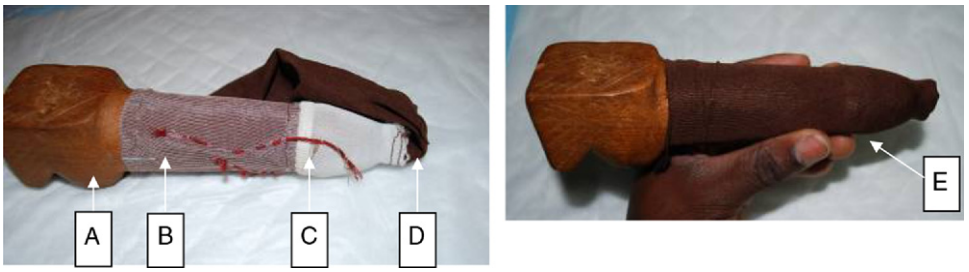

Figure 1. Materials used to construct the penile model and a completed model. **(A)** Wooden penile model piece; **(B)** inner piece of cloth used for anchoring blood vessels and the prepuce; **(C)** light-colored cloth sewn around the glans whose inner side forms the inner mucosal layer; **(D)** the dark piece of cloth, which is pulled back and fixed to the base of the shaft to form "skin," attached to the light cloth; and **(E)** the completed model.

of a light color and the other of a darker color, which form the penile shaft skin, the prepuce, and the inner mucosa. The inner layer also contained red threads representing the main penile blood vessels.

CONSTRUCTING THE PREPUCE

To make a "prepuce," 2 pieces of cloth made of semi-elastic material—one of a light white or light pink color (C) to represent the inner mucosal layer, and the other a dark brown color (D) to represent the outer keratinized layer of the prepuce and skin covering the shaft—were sewn together end to end.

The length of the light-colored cloth forming the "inner preputial mucosa" is equivalent to the length measured from a half centimeter (0.5 cm) proximal to the coronal sulcus of the wooden model to 1 cm distal to the tip of the model glans penis. The length of the dark-colored, "keratinized" piece of cloth needed to cover the penile model from the base to the tip of the glans penis was measured from the base of the penile model to 1 cm distal to the tip of the glans.

The 2 pieces of cloth sewn together were trimmed to size. The light-colored edge of the now combined piece of cloth was sewn to the proximal edge of the inner cloth, around the shaft of the model at the coronal sulcus and at about 0.5 cm proximal to the sulcus. The distal flap of cloth was then folded toward the tip of the glans penis to form a fold at about 0.5 cm distal to the sulcus. The light-colored cloth should reach about 1 cm distal to the glans after folding the flap. The edges of the light-colored cloth are then apposed and sewn at the midline, leaving an opening at the tip of the penis to represent the urethral meatus. The inner surface of the light-colored cloth forms the "mucosal surface" of the prepuce.

FIXING THE OUTER DARKER LAYER (SKIN)

The dark piece of cloth representing the skin of the shaft is firmly held by hand-sewing, or by use of Velcro, and fixed at the base of the shaft with pins or Velcro. The formed "prepuce" is retracted back and forth to ensure that the outlet is adequate. Figure 1(E) shows a picture of a completed model ready for use.

A need for more models arose because of an increase in the number of providers trained, so the Rakai team sought an easier and faster way of making the MC skills training models.

The same materials of similar measurements as described above were used. However, the 3 pieces of cloth, each cut to size, were tailored together end to end with the piece of cloth that forms the inner layer (B) coming first, followed by the light-colored cloth (C) that forms the inner layer of the prepuce, and lastly the darker piece of cloth (D) that forms the outer layer of the prepuce and the shaft skin. The edges of the cloth were joined together and apposed to form a tubular piece.

With the tubular piece inside-out, the end of the "tube" that forms the inner layer (B) was mobilized to cover the wooden penile shaft and fixed to the shaft with threads or glue. The light-colored piece of cloth was then mobilized to cover the glans penis, after which the darker piece of cloth (D) was mobilized back toward the base of the penile model and fixed to the inner layer to form the outer keratinized layer of the prepuce and the shaft skin.

UTILIZATION OF THE PENILE MODEL DURING MMC SKILLS TRAINING

This model greatly facilitated the transition from theory to practical surgery. During theory sessions, the model was used to demonstrate external penile anatomy, including the shaft, glans, coronal sulcus, urethral meatus, and the inner (mucosal) and outer (cutaneous) surfaces of the prepuce (in the resting and retracted positions).

The model can be used to describe the biological mechanisms through which MC prevents HIV acquisition. This includes the large surface area exposed to vaginal fluids during intercourse; the vulnerability of the inner mucosal surface to micro-tears when retracted over the shaft; moisture under the subpreputial space, which can prolong survival of the HIV virus; and to demonstrate the inner mucosal surface with high densities of HIV target cells.

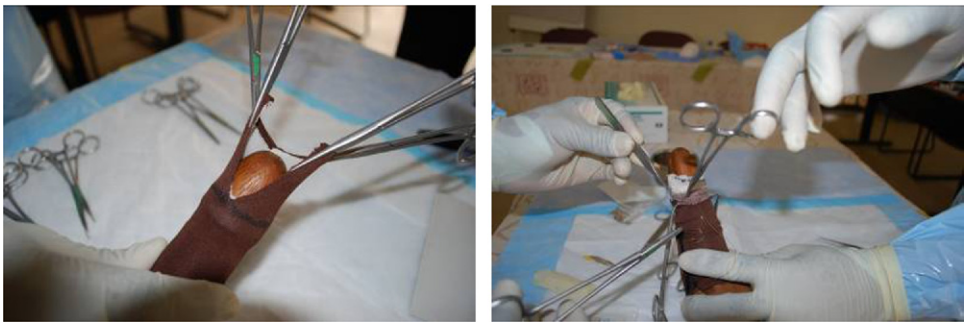

Figure 2. A penile model being used for practical sessions using the dorsal slit procedure in Rakai, Uganda.

The demonstration sessions helped build trainees' confidence and anatomic understanding before performing actual surgery. Use of the model also provided an opportunity for trainers to demonstrate techniques for local anesthesia, safe use of surgical instruments, hemostasis and proper handling of tissues, suturing techniques, and dressing. Thus, this model facilitates acquisition of practical skills for MC.

Because of the close approximation to penile anatomy, the model can be used for demonstration and practice for all 3 common methods of the adult MC procedure (forceps guided, dorsal slit, sleeve methods) as described in the WHO manual for MC skills training. Figure 2 shows the penile model being used for practical skills training on the dorsal slit procedure.

Detailed photographic illustrations of steps taken in designing the model (Supplementary Table 1) and photographs illustrating how the model can be used for practical skills training (Supplementary Table 2) can be found on the Urology web page (add link to Urology web).

CONCLUSIONS

With an initial cost of only $10 and a recurrent cost of $5, this is a cost-efficient and useful penile model that provides a simulation of normal penile anatomy for use in MC training in resource-limited settings. It has also been used as a visual aid in preoperative education of patients before undergoing male circumcision. The model can be improved and scaled up to develop cheaper commercial penile models.

Acknowledgments. We acknowledge all Rakai Health Sciences Program staff who contributed to development of this model; the World Health Organization and PEPFAR for providing funds for MC skills training in Rakai, Uganda; and FORGATY International funded training for most of the authors of this manuscript.

References

1. Auvert B, Taljaard D, Lagarde E, et al. Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 Trial. *PLoS Med*. 2005;2:e298.
2. Bailey RC, Moses S, Parker CB, et al. Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomized controlled trial. *Lancet*. 2007;369:643-656.
3. Gray RH, Kigozi G, Serwadda D, et al. Male circumcision for HIV prevention in men in Rakai, Uganda: a randomized trial. *Lancet*. 2007;369:657-666.
4. WHO, UNAIDS. WHO, UNAIDS press release on recommendations for male circumcision on prevention of HIV infection; 2007.

APPENDIX

SUPPLEMENTARY DATA

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.urology.2010.11.031.