

ORIGINAL RESEARCH ARTICLE

Non-surgical Adult Male Circumcision Using the PrePex Device: Task-Shifting from Physicians to Nurses

Vincent Mutabazi^{1*}, Jean P. Bitega², Leon M. Ngeruka³, Theobald Hategekimana⁴, Steven A. Kaplan⁵, Corine Karema⁶ and Agnes Binagwaho⁷

¹Head of Research, Rwanda Biomedical Center/Institute of HIV/AIDS and Disease Prevention and Control/HIV Division, Ministry of Health, Kigali, Rwanda. ²Head of Clinical Affairs, Kanombe Military Hospital, Kigali, Rwanda. ³Surgeon, Kanombe Military Hospital, Kigali, Rwanda. ⁴Director General, Urologist, Surgeon, Kigali University Teaching Hospital, Rwanda Central Hospital. ⁵Professor of Urology, Weill Cornell Medical Center, New York, New York, USA. ⁶Director, Rwanda Biomedical Center/Institute of HIV/AIDS and Disease Prevention and Control/Malaria Division, Ministry of Health, Kigali, Rwanda. ⁷Minister of Health, Ministry of Health, Republic of Rwanda, Visiting Lecturer, Harvard University, Boston, Massachusetts, USA

* For Correspondence: E-mail: mutabazivincent@yahoo.com; Phone: +250788410827

Abstract

The Republic of Rwanda is implementing a program of voluntary male circumcision (MC) to reduce HIV transmission but lacks the infrastructure for conventional surgical MC on a nationwide scale. Nonsurgical MC using the PrePex device was first assessed in 5 subjects on an inpatient basis. Subsequent procedures were on an outpatient basis. Physicians performed 100 outpatient procedures (Phase 1 of this study) and trained nurses in the technique; the nurses then independently performed 47 procedures (Phase 2). All subjects achieved complete circumcision and healing within 6 weeks. There were no cases of infection or bleeding. In Phase 1, one case of transient moderate diffuse edema occurred. In Phase 2, no adverse events were reported. Thus, outcomes of MC performed by nurses using the PrePex device were not inferior to outcomes achieved by physicians, suggesting that task-shifting MC by this method from physicians to nurses is feasible in Rwanda. (*Afr J Reprod Health* 2014; 18[1]: 61-70).

Keywords: Circumcision, device, nurses, Rwanda, safety, task-shifting

Résumé

La République du Rwanda met en œuvre un programme de circoncision masculine volontaire (CM) pour réduire la transmission du VIH, mais n'a pas l'infrastructure pour la CM chirurgicale classique à l'échelle nationale. CM non chirurgicale en utilisant le dispositif PrePex a été évaluée pour la première fois en cinq sujets en milieu hospitalier. Les procédures postérieures ont été basées sur une consultation externe. Les médecins ont effectué 100 interventions basées sur les consultations externes (phase 1 de cette étude) et ont formé les infirmières formés dans la technique ; les infirmières, à leur tour, ont effectuées indépendamment 47 procédures (phase 2). Tous les sujets atteints une circoncision complète et la guérison dans 6 semaines. Il n'y avait aucun cas d'infection ou de saignement. Dans la phase 1, un cas d'œdème modéré diffuse transitoire s'est produit. Dans la phase 2, aucun effet indésirable n'a été signalé. Ainsi, les résultats de CM effectuées par des infirmières à l'aide du dispositif PrePex n'étaient pas inférieurs aux résultats obtenus par les médecins, ce qui suggère que la délégation des tâches des CM par cette méthode de la part des médecins aux infirmières est possible au Rwanda. (*Afr J Reprod Health* 2014; 18[1]: 61-70).

Mots clés: circoncision, dispositif, infirmières, Rwanda, sécurité, délégation des tâches

Introduction

Randomized controlled studies have shown that male circumcision (MC) can reduce the risk of transmission of human immunodeficiency virus (HIV) by 53%–60%¹⁻³ and meta-analyses of available data have confirmed the risk reduction with MC⁴⁻⁷. The World Health Organization (WHO) and Joint United Nations Programme on

HIV/AIDS recommend consideration of MC as a means of HIV prevention⁸. Over 38 million adolescent and adult males in Africa would be candidates for MC for this purpose^{9,10}, and WHO estimates that at least 20 million procedures must be performed to achieve the desired impact¹¹.

In 2010, the government of Rwanda initiated a program of voluntary MC to reduce the incidence of HIV. However, conventional surgical MC

would not be cost-effective in Rwanda, because the HIV prevalence is relatively low compared to many other African nations¹² and the nation has only about 300 physicians (2.4 per 100,000 people), among whom only 48 are surgeons; moreover, the population is largely rural and lacks easy access to surgical facilities. It was therefore decided that the most practical approach would be task-shifting MC from a surgical procedure performed by physicians at a hospital to a nonsurgical procedure that could be performed by nurses using a device that entails no need for anesthesia, suturing, or sterile surgical setting. (In contrast, a task-shifting program in Kenya involves training nurses to perform surgical MC¹³.)

Among the MC devices considered by the Rwandan Ministry of Health, the PrePex™ device seemed most suitable, and a formal assessment program under the guidelines of WHO was instituted. The initial investigation demonstrated that the device fulfills the goal of achieving MC safely and effectively, with no need for injected local anesthesia, suturing, or sterile settings. An initial evaluation in the inpatient setting assessed feasibility and safety in 5 volunteers, all of whom were successfully circumcised with no adverse events. Thereafter, the main part of the study commenced, in which the procedures were performed on an outpatient basis. From the initial group of volunteers, 50 men underwent the procedure performed by physicians, and all achieved complete circumcision with only 1 reported adverse event, which quickly resolved with conservative management, as previously reported¹⁴.

In view of these favorable results, the WHO Technical Advisory Group on Innovations in Male Circumcision evaluated and approved the use of the device in Rwanda, recommending phased implementation with active surveillance of the first 1000 clients¹⁵. Accordingly, it was decided to enrol a second group of volunteers, to include 100 subjects, with outpatient MC to be performed in the first 50 men by physicians and in the remainder by nurses.

Methods

The study (clinicaltrials.gov identifier NCT 01150370) was approved by the Republic of Rwanda National Ethics Committee in March 2010; the amendment to perform additional procedures with the PrePex device, including procedures to be performed by nurses, was approved in April 2011.

The study protocol invited healthy, HIV-seronegative, uncircumcised men, ages 18 to 54 years, to have MC performed with the PrePex device. The procedures would be performed at Kanombe Military Hospital (which also serves civilians) in Kigali. Volunteers were screened according to inclusion/exclusion criteria (Table 1). Individuals who did not meet the criteria for participation were offered alternative treatment (surgical MC for men with narrow foreskin or paraphimosis; or medical treatment for men with penile lesions, fever, or other disease, with the option of surgical MC following resolution of the condition).

Table 1: Criteria for participation

Inclusion Criteria	Exclusion Criteria
Uncircumcised male, age 18–54 years	Already circumcised; outside age range
HIV seronegative	HIV seropositive
Generally healthy	Active genital infection; phimosis or paraphimosis; warts under the prepuce; torn or tight frenulum; narrow opening of the prepuce; hypospadias; any other penile condition that would preclude circumcision; diabetes mellitus
Able to understand and comply with study procedures and requirements such as providing written signed consent, abstaining from sexual intercourse and masturbation for up to 6 weeks post-procedure, and returning to the facility for follow-up visits as instructed for up to 6 weeks post-	Unable to understand study procedures and requirements

procedure

Considered likely to comply with study requirements

Considered to be an unsuitable candidate for the study

After the initial assessment of feasibility in 5 inpatients, the study of outpatient MC using the PrePex device was conducted in two phases, and in two groups of subjects; the second group spanned both phases (see Figure 1). In Phase 1, voluntary MC using the PrePex device was performed by physicians, who then taught the procedure to nurses; in Phase 2, nurses performed the procedure. The sequential nature of the study (Phase 1 procedures performed by physicians, followed by Phase 2 procedures performed by nurses) was dictated by safety concerns: the physicians had to practice the procedure and optimize their techniques before they could teach it to the nurses. Consequently, outcomes from Phase 1 and Phase 2 could not be assessed in the manner of a randomized parallel-group study. In summary, Phase 1 of the study, in which subjects were seen by physicians, comprised the first 100 outpatient procedures performed (on 50 subjects from the first group of volunteers and 50 from the second group); Phase 2, in which subjects were seen by nurses, comprised the next 47 outpatient procedures performed (all on subjects from the second group).

Candidates received a detailed verbal and photographic depiction of the procedure, including the fact (for subjects in Phase 2) that nurses would perform the procedure. Subjects received HIV counseling and were instructed to abstain from sexual activity for 8 weeks following device removal. It was emphasized that MC reduces but does not eliminate the risk of HIV infection, and that condoms are still recommended. Enrolled subjects provided signed informed consent; counseling and the consent form were in the local language (Kinyarwanda).

The Device

The PrePex device consists of an Inner Ring, an Elastic Ring, and a Placement Ring, as well as a Sizing Plate (the device comes in 5 sizes). The foreskin is compressed between the rigid Inner Ring and the Elastic Ring, cutting off circulation distally to initiate ischemic necrosis; later, the

necrotic distal foreskin is easily removed along with the device. The PrePex devices, designed for single use, were donated by the manufacturer (Circ MedTech Ltd, Tortola, British Virgin Islands).

The Procedure

A detailed description of the procedure, with photographs at each step, has previously been published¹⁴. Briefly, the bloodless nonsurgical procedure began with device placement (day 0). Sizing was determined by placing the Sizing Plate under the coronal sulcus. The penis was washed with dilute chlorhexidine solution and dried. The circumcision site, a line corresponding to the coronal sulcus, was marked on the foreskin.

In Phase 1, petroleum jelly was used as a lubricant to facilitate insertion of the Inner Ring. However, because some subjects experienced mild pain in the first few hours after placement of the device¹⁴, dermal anesthetic cream (5% lidocaine), which also serves as a lubricant, was used in Phase 2. (This decision was made based on interim assessment of the experience with all 100 procedures performed in Phase 1.)

The Elastic Ring was loaded onto the Placement Ring, which was then placed around the base of the penis. With the foreskin held stretched out, the Inner Ring was inserted and slid down on the glans. The Placement Ring then deployed the Elastic Ring directly above the marked circumcision line, clamping the foreskin against the Inner Ring. Subjects received 1 gram of oral paracetamol (acetaminophen) immediately after placement of the device and were examined 1–4 hours post-placement; they were then discharged with instructions not to move or touch the device.

On day 7 (1 week after device placement), the dry, necrotic foreskin was removed using scissors and forceps; there was no bleeding and no need for suturing. The Elastic Ring was then removed using a #10 scalpel, after which the Inner Ring was extracted.

A sterile gauze dressing was applied around the circumcision site. In Phase 1, an antibiotic cream was applied after device removal; however,

because the site was not open or bleeding at any time during healing after device removal, this step was skipped in Phase 2. Subjects were instructed not to touch the dressing or allow it to get wet, and to return in 2 days and then weekly until the end of the study (days 14, 21, 28, 35, 42, 49, 56, and 63).

Thus, the key differences between the procedures performed by physicians in Phase 1 and by nurses in Phase 2 were the type of topical agent applied to the foreskin prior to insertion of the Inner Ring (petroleum jelly in Phase 1, dermal anesthetic cream in Phase 2) and the use of antibiotic cream after device removal in Phase 1 versus non-use in Phase 2. In addition, a more vigorous definition of complete healing was adopted after the first 50 subjects in Phase 1, and this new criterion applied to the remaining subjects in Phase 1 and all subjects in Phase 2.

Assessments

At each visit, subjects' perspectives were elicited by interview, photographs for documentation photographs were obtained, and specific information on safety, pain, and findings on genital examination was recorded on a clinical report form.

Efficacy assessments included achievement of complete circumcision (glans fully exposed) and time to complete healing (complete epithelialization with no scab, crust, or drainage). Device-related and procedure-related adverse events were recorded at each visit. Pain was reported using a standard visual analog scale (VAS) on which scores of 0 to 10 represent no pain to the most severe pain; ratings were obtained during device placement, 1–4 hours post-placement, prior to device removal, during foreskin removal, during device removal, 1 minute post-removal, and at every weekly follow-up visit.

Rigorous statistical analysis for hypothesis testing (whether outcomes with nurses performing the procedure would be inferior to outcomes achieved by physicians) was not feasible given the design of the study. Phases 1 and 2 were conducted sequentially rather than in parallel (for reasons of safety, as previously mentioned); consequently, there could be no randomization (because patients were seen consecutively; the first 100 were seen by physicians, the next 47 by

nurses); and there could be no blinding (because subjects as well as staff personnel were aware of who was performing the procedure in each participant). However, to assess the key question—could the task of performing MC using the PrePex device be shifted from physicians to nurses?—post hoc *t* tests were utilized to compare the results from Phases 1 and 2. Post hoc testing was considered warranted in this study, given that the same MC procedure was followed in both phases. (Because the feasibility assessment was done on an inpatient basis for purposes of safety, data from those 5 subjects could not be combined with data from the outpatient procedures done in Phase 1; however, as previously reported¹⁴, all 5 inpatient procedures resulted in successful circumcision with no adverse events.) Although the results of post hoc testing should be interpreted cautiously, these data can provide at least some indication of whether outcomes with nurses are comparable to or inferior to the outcomes achieved by physicians.

Results

A total of 190 volunteers were prescreened. Of 81 volunteers in the first group, 23 were excluded at prescreening, including 2 volunteers who had phimosis, which would make insertion of the Inner Ring difficult; other reasons included HIV-positive status and inability to come for follow-up visits due to geographic distance from the study site. Of the remaining 58 volunteers in the first group, 3 were subsequently excluded based on late discovery of phimosis or HIV-positive status, leaving 55 men in the first group (67.9% of 81). Of 109 volunteers in the second group, 12 were excluded at prescreening, leaving 97 in this group (89.0% of 109).

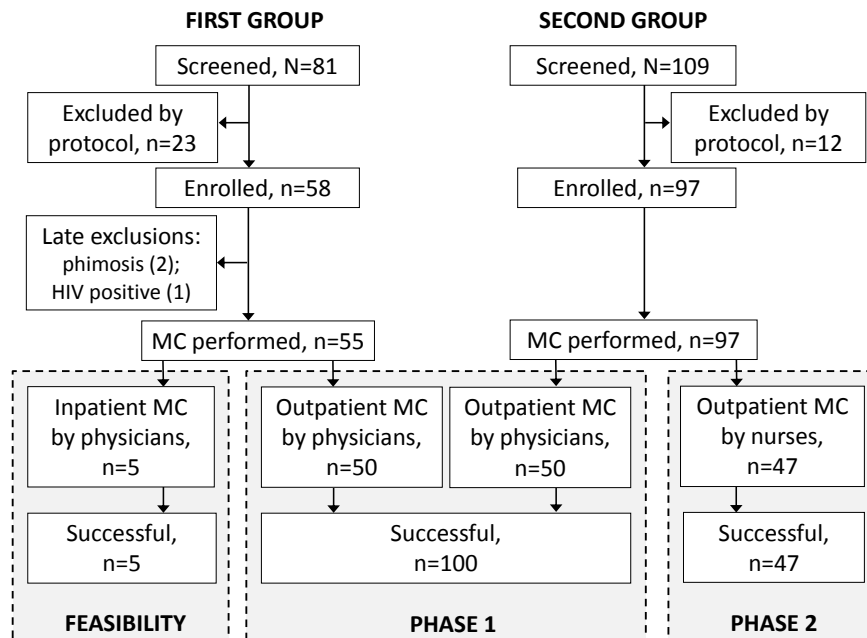
Phase 1 (MC performed by physicians, March–December 2010) included the 55 men from the first group and the first 50 men from the second group. Phase 2 (MC performed by nurses, May–July 2011) included the remaining 47 men in the second group. Figure 1 shows patient disposition for both groups through both phases of the study.

The enrolled population comprised healthy, uncircumcised male volunteers, all civilians, ages 18 to 40 years; mean age was 24.3 years (standard deviation [SD] 4.1) among the 100 subjects seen

by physicians in Phase 1 and 23.8 years (SD 3.9) among the 47 subjects seen by nurses in Phase 2 (post hoc *t*-test, $P=0.0721$).

In all 147 outpatient-subjects, the PrePex device was successfully placed, and all subjects

achieved complete circumcision and complete healing. Thus, the rate of success was 100% with both physicians and nurses.



CAPTION:

Disposition of patients in both groups, in both study phases. MC=male circumcision.

Figure 1: Patient disposition

No adverse events or device-related incidents (e.g., dislocation) were reported while the device was in place. Among the initial 50 subjects in Phase 1, the only adverse event reported after device removal was a case of diffuse edema, which resolved in 2 days with minimal intervention¹⁴. No adverse events were reported in Phase 2. There were no instances of bleeding or infection in any patient at any time in either phase of the study. In an unusual incident in Phase 2, a subject removed the device himself, 3 days after placement; when he returned on day 7, the necrotic foreskin, still attached, was removed by the nurse, after which circumcision and healing ensued without complication.

Among expected mild events, light oozing after removal of the foreskin occurred in 7/100 subjects (7.0%) in Phase 1 and in 5/47 subjects (10.6%) in Phase 2, all cases resolving with 10 seconds of applied pressure; and mild and painless localized

edema of the frenulum occurred in 16/100 subjects (16.0%) in Phase 1 and in 11/47 subjects (23.4%) in Phase 2, all cases resolving spontaneously within a few days. There was no significant difference in the incidence rates for these events in Phase 1 versus Phase 2 (post hoc Fisher's exact test, $P=0.5222$ for light oozing; $P=0.3609$ for localized edema). Thus, overall safety seemed similar with nurses or physicians performing the procedure.

Patients' VAS ratings of pain were recorded for each step of the procedure and later converted to the nearest whole-number rating (Table 2). During both phases of the study, mean pain scores were <1 (minimal pain) at all assessments except 1–4 hours after placement of the device and during removal of the device. At all assessments, mean pain scores were higher in Phase 1 (when petroleum jelly was applied before placement) than in Phase 2 (when dermal anesthetic cream

was used); the difference between Phase 1 and Phase 2 was significant at placement (post hoc *t*-test, $P=0.0013$), post-placement ($P<0.0001$), and Inner Ring extraction ($P<0.0001$). Inner Ring extraction was the only procedural step associated with notable pain; the incidence of VAS score 8

(the highest score recorded during the study) was 23.5% in Phase 1 versus 2.3% in Phase 2 (post hoc Fisher's exact test, $P=0.0012$). Pain at this procedural step was transient (5–10 seconds), ending when extraction was completed.

Table 2: Patients' VAS ratings of pain at key steps in the procedure

Day	Procedural Step	Phase 1 (n=100): MC by physicians			Phase 2 (n=47): MC by nurses		
		Range	Mean (SD)	Median*	Range	Mean (SD)	Median*
0	Placement of device	0-6	1.1 (1.38)	0 (0, 2)	0-2	0.4 (0.79)	0 (0, 0)
	1-4 h after placement	0-8	2.4 (2.55)	2 (0, 4)	0-2	0.3 (0.73)	0 (0, 0)
7	Removal of foreskin	0-8	1.4 (2.02)	0 (0, 2)	0-4	0.7 (1.24)	0 (0, 2)
	Extraction of Inner Ring**	2-8	5.1 (2.12)	5.5 (4, 6)	0-8	3.0 (1.75)	2 (2, 4)
	Immediately after removal	0-8	0.8 (1.56)	0 (0, 2)	0-6	0.5 (1.43)	0 (0, 0)

*Median with interquartile range (25th, 75th percentiles)

**Pain during device removal was associated almost entirely with 1 step: extraction of the Inner Ring (time for this step, 5–10 seconds).

MC=male circumcision; SD=standard deviation; VAS=visual analog scale (0=absence of pain, 10=most severe pain; each individual rating was recorded as the nearest whole number).

In determining time to complete healing, 12 of the 100 subjects in Phase 1 missed at least 1 follow-up visit and then returned after complete healing had occurred; time to complete healing in those cases was taken as the date of return to the clinic. Nine of the 47 subjects in Phase 2 failed to return after healing was almost complete and were excluded from computation of time to complete

healing. Mean time to complete healing was 29.3 days after device removal (SD 7.2) among 100 subjects in Phase 1 and 31.2 days (SD 5.6) among 38 subjects in Phase 2. Median times were 21 days in Phase 1 versus 28 days in Phase 2 (Kaplan-Meier analysis log-rank test, $P<0.0001$). The incidence of complete healing week by week is shown in Table 3.

Table 3: Week-by-week incidence of complete healing (non-cumulative)

Time after device placement (day 0)	Phase 1 (n=100*): MC by physicians		Phase 2 (n=38**): MC by nurses	
	Number	%	Number	%
Week 1 (day 7)	0	0.0	0	0.0
Week 2 (day 14)	0	0.0	0	0.0
Week 3 (day 21)	52	52.0	0	0.0
Week 4 (day 28)	36	36.0	17	44.7
Week 5 (day 35)	6	6.0	14	36.8
Week 6 (day 42)	6	6.0	7	18.4
Week 7 (day 49)	0	0.0	0	0.0
Week 8 (day 56)	0	0.0	0	0.0
Week 9 (day 63)	0	0.0	0	0.0
Total	100	100.0	38	100.0

*Includes 12 subjects who missed ≥ 1 follow-up and returned when healing was complete; time of healing was taken as day of return to clinic.

**Excludes 9 subjects (of 47 enrolled) who did not return after a visit in which healing was noted to be almost complete.

MC=male circumcision.

Discussion

For resource-poor areas, WHO considers innovative methods of MC suitable if they are

simpler, less resource-intensive, usable by non-physician providers, acceptable to clients and providers, and as safe as surgical MC. Thus, the WHO Technical Advisory Group on Innovations

in Male Circumcision approved the PrePex device for use in Rwanda¹⁵.

In addition to the PrePex device used in the present study, several other MC devices are available. Devices may be classified as those that crush the foreskin immediately upon placement (and therefore require anaesthesia) and those that induce necrosis over several days (the PrePex device is in this category). The Shang Ring crushes the foreskin between concentric rings; in a study of MC using the Shang Ring in Kenya, 40 men were successfully circumcised, with 6 adverse events reported (3 penile skin injuries, 2 cases of edema, 1 infection)¹⁶. Other crush devices include the Gomco clamp, the AlisKlamp, and the SmartKlamp. In contrast, the Plastibell (like the PrePex device) induces gradual necrosis; however, whereas the PrePex device employs an Elastic Ring, the Plastibell employs a string tied tightly around the foreskin to press in against a bell-shaped component that fits over the glans.

WHO recommendations for use of MC devices reflect the problems associated with conventional surgery in resource-poor areas: inadequate availability of qualified personnel and surgical facilities¹³. Surgical MC also incurs a variable risk of adverse events. In 2 studies from Kenya, adverse event rates of 1.5%² and 17.7%¹⁷ were reported, and a systematic review of 8 randomized controlled trials of nontherapeutic MC reported an overall adverse event rate of 4.8%¹⁸.

In resource-limited areas where HIV is prevalent, task-shifting of HIV/AIDS services is warranted when shown to be feasible¹⁹. Our study provides preliminary evidence that task-shifting MC using the PrePex device from physicians to nurses can be accomplished without compromising outcome. The minor procedural differences in Phase 1 and Phase 2 do not alter the assessment of safety, which was our main focus.

Certain details of the present study merit further comment.

Pain

The experience gained by the physicians in Phase 1 of the study led to improved management of pain by the nurses in Phase 2. In Phase 1, the mean VAS pain score was <1 at all assessments except

1–4 hours after device placement and at extraction of the Inner Ring during device removal. Based on subjects' reports of the mild nature of pain 1–4 hours post-placement, we replaced the petroleum jelly used in Phase 1 with a dermal anaesthetic cream in Phase 2. Consequently, mean VAS pain score at 1–4 hours post-placement fell from 2.4 in Phase 1 to 0.3 in Phase 2.

Pain during the extraction of the Inner Ring (mean VAS score 5.1 in Phase 1 and 3.0 in Phase 2) was brief, ending when extraction was accomplished. Initially, we administered paracetamol prior to device removal; however, the oral analgesic did not prevent pain at this step¹⁴ and we therefore no longer recommend its use. It is reasonable to ask whether dermal anaesthetic cream might be helpful in this step; our view is that topical anaesthetic is not a sterile product and should not be applied to a wound site. The best way to minimize pain during Inner Ring extraction is to reduce the brief time required for this step, and we have noted that extraction time was reduced as personnel gained experience.

Risk of Infection

In Phase 2, we discontinued use of antibiotic cream immediately after removal of the necrotic foreskin and the PrePex device. The fact that there were no cases of infection in either phase of the study and that the healing process was identical in both phases supports our view that the use of antibiotic cream is unnecessary because it does not alter clinical outcomes of MC using the PrePex device.

Procedure time

Because the primary aim of this study was to assess the safety of MC using the PrePex device, procedure time was not a pre-specified endpoint. However, we can report anecdotally that total procedure time (device placement time and removal time combined, but not including preparation time) became shorter for both the physicians in Phase 1 and the nurses in Phase 2 as they gained experience over the course of the study. There was no significant difference in mean procedure time in Phase 2 versus Phase 1. Procedure time with the PrePex device is

substantially shorter than the 25–36 minutes mean procedure time reported with conventional surgical MC²⁰⁻²²; this difference was verified in a randomized controlled trial directly comparing PrePex MC and conventional surgical MC, for which the procedure times were 3.1 and 15.4 minutes, respectively ($P < 0.0001$)²³.

Healing time

In the initial report on the first 50 subjects in Phase 1 of the study¹⁴, mean time to complete healing was 25.3 days after device removal, whereas mean times reported here for Phase 1 and Phase 2 were 29.3 and 31.2 days, respectively. However, this difference should be considered in light of the fact that a more rigorous definition of complete healing was adopted after the first 50 subjects in Phase 1. All subjects in both phases of study achieved complete healing by day 42 (35 days after device removal). Mean time to complete healing in this study was consistent with the mean time of 31 days following device removal reported in the comparative trial of MC with the PrePex device versus conventional surgery²³. All subjects in our study reported compliance with the instruction relating to abstinence of sexual activity until complete healing was achieved.

Study limitations

This study was not prospectively designed for formal statistical verification of our main finding, that outcomes achieved when the procedure is performed by nurses are not inferior to outcomes achieved when the procedure is performed by physicians. Also, our study provides no long-term verification of outcomes (1 year after complete healing) and no insight into the medical and social consequences of performing MC in subjects under age 18 years.

Future research should also address other gaps in the evidence relevant to task-shifting of adult MC from physicians in the hospital setting to nurses in the rural clinic setting. However, although this study was conducted at Kanombe Military Hospital in the city of Kigali, the procedures were performed in a plain non-sterile consultation room with a bed and a table for the

device and the required implements, similar to the settings available at rural clinics.

It remains to be demonstrated whether nurses at rural clinics would be as adept at learning and performing MC with the PrePex device as the nurses at our district hospital have been. A formal training program for nurses is currently under development. As more data are accumulated, it will also be possible to compare costs of procedures performed at rural clinics with costs at the district hospital.

Finally, the optimal strategy for men with phimosis, in whom insertion of the Inner Ring would be difficult, remains to be determined. The prevalence of phimosis is uncertain; a 13% rate was reported among 351 males ages 4–58 in a study of MC using the Shang Ring device²⁴, whereas the rate we encountered in Phase 1 of our study was 5% (4 of 81 screened volunteers), which is consistent with a report from the British Association of Paediatric Urologists showing a 5% prevalence of non-retractable foreskin among boys age 16–17 years²⁵. Such subjects might be managed by introducing a slit in the foreskin prior to device placement (which would transform the PrePex procedure from nonsurgical to surgical) or by resorting to conventional MC surgery.

Conclusions

Our study suggests that both physicians and nurses can safely perform adult MC using the PrePex device. The simplicity of this bloodless nonsurgical procedure (no need for injected anaesthesia, suturing, or sterile setting) obviates many of the problems associated with implementing a surgical MC scale-up program in resource-limited settings. Pending the outcome of larger studies with more formal assessments, the positive results we report here support the hypothesis that task-shifting adult MC using the PrePex device from physicians in the hospital setting to nurses in the clinic setting is feasible in Rwanda.

Competing Interests

None of the authors has any potential conflict of interest to declare.

Contribution of Authors

Vincent Mutabazi participated in the conception and design of the study, acquisition of data, coordination of work by other authors, and critical revision of the manuscript. Jean Paul Bitega, Leon Muyenzi Ngeruka, and Corine Karema participated in the conception and design of the study, acquisition of data, and critical revision of the manuscript. Theobald Hategekimana and Steven A. Kaplan participated in the conception and design of the study and critical revision of the manuscript. Agnes Binagwaho participated in the conception and design of the study, coordination of work by other authors, and critical revision of the manuscript. All authors have read and approved the final manuscript before submission.

Acknowledgments

This study was sponsored by the Government of Rwanda. PrePex devices were donated by the manufacturer, Circ MedTech Ltd. Circ MedTech Ltd was not involved in the design of this study, data collection and analysis, or the preparation of this manuscript. Editorial assistance in the preparation of this manuscript was provided on a pro bono basis by Steven Tiger, with the cooperation of his employer, Complete Healthcare Communications, Chadds Ford, Pennsylvania, United States of America.

References

1. Gray RH, Kigozi G, Serwadda D, Makumbi F, Watya S, Nalugoda F, Kiwanuka N, Moulton LH, Chaudhary MA, Chen MZ, Sewankambo NK, Wabwire-Mangen F, Bacon MC, Williams CF, Opendi P, Reynolds SJ, Laeyendecker O, Quinn TC and Wawer MJ. Male circumcision for HIV prevention in men in Rakai, Uganda: a randomised trial. *Lancet* 2007; 369(9562): 657-66.
2. Bailey RC, Moses S, Parker CB, Agot K, Maclean I, Krieger JN, Williams CF, Campbell RT and Ndinya-Achola JO. Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial. *Lancet* 2007; 369(9562): 643-56.
3. Auvert B, Taljaard D, Lagarde E, Sobngwi-Tambekou J, Sitta R and Puren A. Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 Trial. *PLoS Med* 2005; 2(11): e298.
4. Byakika-Tusiime J. Circumcision and HIV infection: assessment of causality. *AIDS Behav* 2008; 12(6): 835-41.
5. Mills E, Cooper C, Anema A and Guyatt G. Male circumcision for the prevention of heterosexually acquired HIV infection: a meta-analysis of randomized trials involving 11,050 men. *HIV Med* 2008; 9(6): 332-5.
6. Siegfried N, Muller M, Deeks JJ and Volmink J. Male circumcision for prevention of heterosexual acquisition of HIV in men. *Cochrane Database Syst Rev* 2009; (2): CD003362.
7. Uthman OA, Popoola TA, Yahaya I, Uthman MM and Aremu O. The cost-utility analysis of adult male circumcision for prevention of heterosexual acquisition of HIV in men in sub-Saharan Africa: a probabilistic decision model. *Value Health* 2011; 14(1): 70-9.
8. WHO/UNAIDS. New data on male circumcision and HIV prevention: policy and programme implications: policy and programme implications. [WHO/UNAIDS Technical Consultation] Male circumcision and HIV prevention: research implications for policy and programming Montreux, 6- 8 March 2007. Available at: http://data.unaids.org/pub/Report/2007/mc_recommendations_en.pdf. Accessed August 15, 2010.
9. Dickson KE, Reed J and Rech D. World Health Organization: Considerations for implementing models for optimizing the volume and efficiency of male circumcision services. February 2010. World Health Organization; February, 2010.
10. World Health Organization. Manual for male circumcision under local anesthesia, version 2.5C. January 2008. World Health Organization; January 2008, 2008.
11. WHO/UNAIDS. Progress in scale-up of male circumcision for HIV prevention in eastern and southern Africa: focus on service delivery - 2011, revised. WHO Press: Geneva, Switzerland. Available at: http://www.malecircumcision.org/publications/documents/MC_country_update_2011.pdf. Accessed December 26, 2011.
12. Njeuhmeli E, Forsythe S, Reed J, Opuni M, Bollinger L, Heard N, Castor D, Stover J, Farley T, Menon V and Hankins C. Voluntary medical male circumcision: modeling the impact and cost of expanding male circumcision for HIV prevention in eastern and southern Africa. *PLoS Med* 2011; 8(11): e1001132.
13. Herman-Roloff A, Llewellyn E, Obiero W, Agot K, Ndinya-Achola J, Muraguri N and Bailey RC. Implementing voluntary medical male circumcision for HIV prevention in Nyanza Province, Kenya: lessons learned during the first year. *PLoS One* 2011; 6(4): e18299.
14. Bitega JP, Ngeruka ML, Hategekimana T, Asimwe A and Binagwaho A. Safety and efficacy of the PrePex device for rapid scale up of male circumcision for HIV prevention in resource-limited settings. *J Acquir Immune Defic Syndr* 2011; 58(5): e127-e34.

15. World Health Organization HIV Department. Use of devices for adult male circumcision in public health HIV prevention programmes: Conclusions of the WHO Technical Advisory Group on Innovations in Male Circumcision, Executive Summary. Geneva: February, February 2012.
16. Barone MA, Ndede F, Li PS, Masson P, Awori Q, Okech J, Cherutich P, Muraguri N, Perchal P, Lee R, Kim HH and Goldstein M. The Shang Ring device for adult male circumcision: a proof of concept study in Kenya. *J Acquir Immune Defic Syndr* 2011; 57(1): e7-e12.
17. Kim HH and Goldstein M. High complication rates challenge the implementation of male circumcision for HIV prevention in Africa. *Nat Clin Pract Urol* 2009; 6(2): 64-5.
18. Perera CL, Bridgewater FH, Thavaneswaran P and Maddern GJ. Safety and efficacy of nontherapeutic male circumcision: a systematic review. *Ann Fam Med* 2010; 8(1): 64-72.
19. Price J and Binagwaho A. From medical rationing to rationalizing the use of human resources for AIDS care and treatment in Africa: a case for task shifting. *Dev World Bioeth* 2010; 10(2): 99-103.
20. Li HN, Xu J and Qu LM. [Shang Ring circumcision versus conventional surgical procedures: comparison of clinical effectiveness]. *Zhonghua Nan Ke Xue* 2010; 16(4): 325-7.
21. Krieger JN, Bailey RC, Opeya JC, Ayieko BO, Opiyo FA, Omondi D, Agot K, Parker C, Ndinya-Achola JO and Moses S. Adult male circumcision outcomes: experience in a developing country setting. *Urol Int* 2007; 78(3): 235-40.
22. Decastro B, Gurski J and Peterson A. Adult template circumcision: a prospective, randomized, patient-blinded, comparative study evaluating the safety and efficacy of a novel circumcision device. *Urology* 2010; 76(4): 810-4.
23. Mutabazi V, Kaplan SA, Rwamasirabo E, Bitega JP, Ngeruka ML, Savio D, Karema C and Binagwaho A. HIV Prevention: male circumcision comparison between a nonsurgical device to a surgical technique in resource-limited settings: a prospective, randomized, nonmasked trial. *J Acquir Immune Defic Syndr* 2012; 61(1): 49-55.
24. Peng YF, Yang BH, Jia C and Jiang J. [Standardized male circumcision with Shang Ring reduces postoperative complications: a report of 351 cases]. *Zhonghua Nan Ke Xue* 2010; 16(11): 963-6.
25. Management of Foreskin Conditions. Statement from the British Association of Paediatric Urologists on behalf of the British Association of Paediatric Surgeons and The Association of Paediatric Anaesthetists. Available at: http://www.baps.org.uk/documents/Circumcision_2007. Accessed July 27, 2011.