

**Circumcision and Reduced Risk of Self-Reported Penile Coital Injuries:
Results from a Randomized Controlled Trial in Kisumu, Kenya**

Running Title: Circumcision Reduces Penile Coital Injuries

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Abstract

Purpose: Injuries to the penis during intercourse represent one hypothesized mechanism by which uncircumcised men are at increased risk for HIV. There are no published, systematically collected data regarding mild penile coital trauma. We identified risks for self-reported penile coital injuries in men aged 18-24 in our randomized trial of circumcision to prevent HIV in Kisumu, Kenya.

Materials and Methods: Each participant underwent standardized interview, medical history, and physical examination, at baseline and 6, 12, 18, and 24 months after enrollment. Self-reported penile coital injuries were assessed at each visit: penis feels sore during sex; penis gets scratches, cuts or abrasions during sex; skin of the penis bleeds after sex. Generalized estimating equation analysis estimated odds ratios (OR) for penile coital injuries.

Results: February 2002-September 2005, 2,784 participants were randomized. At baseline, 1,775 (64.4%) men reported any coital injury: 1,313 (47.6%) soreness; 1,328 (48.2%) scratches, abrasions, or cuts; 461 (16.7%) bleeding. In multivariable analysis, coital injury risk was lower for circumcised than uncircumcised men: soreness [OR=0.71, 95% CI 0.64-0.80], scratches/abrasions/cuts [OR=0.52, 95% CI 0.46-0.59], bleeding [OR=0.62, 95% CI 0.51-0.75], any coital injury [OR=0.61, 95% CI 0.54-0.68]. Other significant risks ($p<0.05$) included: increasing age, multiple recent sex partners, HSV-2 seropositivity, and genital ulcers. Condom use, cleaning the penis soon after intercourse, and being married/cohabiting were protective ($p<0.05$, each).

Conclusions: Self-reported penile coital injuries were common in these healthy young men. Circumcised men were at lower risk for coital injuries. Verifying penile coital injuries, mechanism of acquisition, and association with HIV risk is needed.

Introduction

Penile cuts, abrasions, and tears are cited as occurring more frequently in uncircumcised men¹⁻². Such mild injuries represent one potential mechanism by which uncircumcised men are at increased risk for HIV acquisition compared to circumcised men¹⁻², through disruption of epithelial and mucosal barriers at anatomic sites with a high density of HIV-1 target cells³⁻⁶. However, there are no published, systematically collected data regarding mild penile coital trauma. Available data include case reports or series of patients with severe injuries, such as penile fractures⁷⁻¹², urethral disruptions¹³, and fistulas¹³. Many men sustain milder trauma that does not require surgery or a physician visit. In our cohort of sexually active men in a clinical trial of male circumcision to reduce HIV risk, self-reported penile coital injuries (defined as scratches, cuts, abrasions, or soreness of the penis during sex) increased risk for incident *Neisseria gonorrhoeae* infections by 1.6-fold in multivariable analyses¹⁴. To increase understanding of the prevalence and risk factors for penile coital injuries and how this may be related to sexually transmitted infection (STI) and HIV acquisition, we evaluated the effect of adult male circumcision and behavioral risks three types of penile coital injuries.

Methods

Study Design and Participants

The study included men aged 18-24 participating in a randomized, controlled trial of adult male circumcision to reduce HIV incidence in Kisumu, Kenya¹⁵. Trial design and primary outcome (HIV infection) have been previously described¹⁵. For inclusion men were: uncircumcised, HIV-negative, sexually active in the last 12 months, aged 18-24 years; with hemoglobin \geq 9.0 mmol/L; and resident in Kisumu District. Exclusion criteria included: foreskin

covering less than half of the glans, bleeding disorder, conditions that might increase elective surgery risk, congenital penile abnormality, or medical indication for circumcision. Institutional Review Boards of the University of Illinois at Chicago, Kenyatta National Hospital, RTI International, University of Manitoba, and University of Washington approved the study.

Data Collection

Participants were randomized 1:1 to either immediate circumcision or delayed circumcision (control group) after a 2-year follow-up. Both groups underwent intensive STI and HIV risk reduction counseling and were provided unlimited, free condoms. Detailed evaluations were conducted at baseline, 1, 3, 6, 12, 18 and 24 months from randomization for both study arms. At each planned visit, participants underwent standardized medical history and general physical and genital examination. At planned 6-month visits, subjects were interviewed to obtain information regarding socio-demographics and sexual behavior.

At baseline and 6-month planned follow-up visits, participants were tested for HIV, *Neisseria gonorrhoeae* (NG), *Chlamydia trachomatis* (CT), and *Trichomonas vaginalis* (TV), and herpes simplex virus type 2 (HSV-2). Testing methods have been detailed previously¹⁵. Men positive for NG, CT, or TV were traced and treated following Kenyan national STI treatment guidelines.

Explanatory Statistical Analyses

Three questions assessed penile coital injuries during the past 6 months: penis gets sore during sex; abrasions, scratches, or cuts to the skin of the penis during sex; and bleeding of the skin of the penis after sex. Each outcome was dichotomized as “ever” versus “never.” Selection of

variables for analysis was based on possible association with penile coital injury. Because reports of abrasions, scratches, or cuts to the penis might represent a misclassification of HSV-2 symptoms, we examined the association with baseline HSV-2 serostatus and genital ulcers on physical examination or by self-report. Condom use was hypothesized to provide a protective barrier for the skin. “Dry sex” might increase the risk of penile coital injuries due to friction, and substances applied to the penis or vagina before sex might increase risk due to astringent or irritant properties. Overall, 84% of men reported that their sex partners did not apply substances to their vaginas prior to sex, 1.1% reported that the woman did apply substances to the vagina, while 15% said they did not know. Due to the large proportion of responses answered as, “Don’t know,” we did not include this variable in statistical models. We examined abnormal findings on genital examination to attempt to verify self-reported penile coital injuries.

Generalized estimating equation (GEE) analysis was used to estimate the odds ratio (OR) of each measure and to incorporate the within-subject correlation among repeated measures, assuming binomial distributions with logit link. All explanatory variables, including circumcision status, were assessed as time varying covariates except for baseline HSV-2 serostatus, preference for wet or dry vaginal sex (assessed only at baseline), and age at baseline. Variables statistically significant at the $p < 0.05$ level in univariate analyses were entered into multivariable analyses. Statistical significance for retention of variables in each multivariable model was determined by Holm adjustment for multiple tests of significance¹⁶. Standard errors were obtained using an exchangeable correlation structure with robust estimation. Time proved significant in all models in both the linear and quadratic component and was treated as a categorical variable. Data were analyzed using STATA/SE 9.2 for Windows (Stata Corp., College Station, TX).

Results

Study Sample

Between February 2002 and September 2005, 2,784 participants were randomized, including 1,391 to the circumcision group and 1,393 to the control group. There was no difference in the timing of follow-up visits by group¹⁵. Among the 2,784 men enrolled, 3 were excluded who were outside the age range. Study arms were well balanced in socio-demographics and sexual behaviors (Table 1)¹⁵.

Baseline Penile Coital Injuries

Among the 2,781 participants, 2,757 answered all three questions about penile coital injuries at baseline, with no difference between treatment arms (Table 1). There were 1,775 (64.4%; 95% confidence interval [CI]: 62.6 – 66.2%) men reporting any injury including: 1,313 (47.6%) soreness; 1,328 (48.2%) abrasions, scratches, or cuts; and 461 (16.7%) bleeding of the skin of the penis. Among 461 men reporting bleeding of the penile skin at baseline, 439 (95.2%) also reported penile soreness; abrasions/scratches/cuts (26.0%), or both soreness and abrasions/scratches/cuts (62.9%). Thus, 290 (10.5%) men reported all 3 coital injuries; 747 (27.1%) reported 2 injuries, and 738 (26.8%) reported one injury type. Overall, abnormal findings were detected on genital examination at 235 study visits (2.1%), including 3.4% of visits at which penile coital injury was reported. Because nearly half (46%) of the abnormal genital examination findings were accounted for by genital ulcers, we did not include abnormal genital examination findings in our models.

Coital Injuries by Circumcision Status and Follow-Up Visit

During the 2-year period from randomization, the circumcision and the control groups both experienced significant decreases in reported penile coital injuries (Figures 1a-d; $p < 0.001$ each item). For the circumcision and control groups, respectively, reporting any coital injury decreased from 65.1% and 64.0% at baseline to 30.3% and 42.8% at month 24. The proportion of men with penile skin bleeding who also reported soreness or scratches, cuts, or abrasions, remained at 90-95% over the 6- through 24- month follow-up visits. For circumcised compared to uncircumcised men, the unadjusted OR of penile coital injuries over time was 0.73 [95% CI: 0.65 – 0.81] for soreness; 0.53 [95% CI: 0.47 – 0.60] for abrasions/scratches/cuts; 0.62 [95% CI: 0.51 – 0.75] for bleeding of the skin; and 0.62 [95% CI: 0.56 – 0.70] for any coital injury.

Coital Injuries by Socio-Demographics, Sexual Behaviors, and Genital Ulcers

The prevalence of any penile coital injury was lower among men reporting condom use at last sexual intercourse (Table 2). Men reporting multiple recent sex partners and those with genital ulcers had a greater prevalence of penile injuries. Washing one's penis within 1 hour after sex was associated with a lower prevalence of penile soreness and abrasions/scratches/cuts. Though only 2.1% of men reported applying substances to their penis prior to sex, this was more frequent among men reporting penile injuries. From open-ended descriptions of the 2.1% who reported applying substances, 61% reported applying "Vaseline" or "petroleum jelly" and 22% reported applying non-specified creams, lotions, or lubricants to their penis prior to sex [results not shown]. Penile soreness and abrasions/scratches/cuts increased with increasing age. The proportion of men who were HSV-2 seropositive at baseline was greater among men reporting

penile soreness or abrasions/scratches/cuts. Preference for dry sex was not associated with any outcome in univariate analyses.

Risks for Penile Coital Injuries in Multivariable Analyses

Circumcision remained protective, with adjusted ORs [aOR] ranging from 0.52 to 0.71 for each penile coital injury (Table 3). Reporting condom use at the last vaginal intercourse was also protective, with aORs ranging from 0.75 to 0.86 for each penile coital injury measure. Men who were married or living with a partner were less likely to report penile abrasions/scratches/cuts during sex (aOR=0.75; 95% CI: 0.64 – 0.87). Cleaning the penis within 1 hour after the last sexual intercourse remained protective of reporting penis ever felt sore or became abraded/scratched/cut during sex (aOR=0.85 and aOR=0.87, respectively).

Factors associated with an increased likelihood of reporting each penile coital injury type included: having 2 or more sex partners in the past 30 days, applying substances to the penis prior to sex, and genital ulcers by report or on examination (Table 3). The risk of soreness and abrasions/scratches/cuts increased with increasing age and HSV-2 seropositivity at baseline. Incident non-ulcerative STI during follow-up was associated with any coital injury and penile soreness in univariate analyses ($p<0.05$), but not statistically significant in multivariable analyses. Risks for individual measures of coital injuries were similar to those associated with reporting any penile coital injury (Table 3).

Discussion

Circumcised men were less likely to report penile coital injuries, with significantly decreased risk as early as 6 months after surgery. Thus, recent circumcision did not increase

penile coital injury risk. Although coital injuries decreased over time in both arms, at 24 months, 31% of circumcised men and 42% of uncircumcised men still reported penile coital injuries in the past 6 months. As nearly all men who reported penile skin bleeding were a subset of those reporting soreness and abrasions/scratches/cuts, bleeding may reflect injury progression or a more severe manifestation, even if it did not merit medical attention.

Our study provides a needed counterweight to the literature describing penile injuries that usually require surgery. In an extensive literature review, we could identify only two comparable studies. A cross-sectional survey of general population men aged 18-67 in Mbale Town, Uganda, found a similarly high prevalence of self-reported penile coital injuries that did not differ by circumcision status: 15% soreness, 33% scratches or abrasions, 8% bleeding¹⁷. Recent re-analysis of these data found a statistically significant association between STI history and any reported coital-injury in multivariable analysis, adjusted for condom use and number of sex partners [unpublished data; results available from authors]. In a cross-sectional survey of general population residents of Cape Town, South Africa, 21% of men and 16% of women reported coital bleeding in the past 3 months, although 75% was attributed to menses by participants¹⁸. In multivariable analysis adjusting for number of sex partners and condom use, history of STI was associated with a 3.4 OR for recent coital bleeding¹⁸. These cross-sectional studies are consistent with our prospective assessment. The frequent rate of these mild penile coital injuries could be of substantial importance because of potential associations with STI and HIV infection risk^{1-2, 18-19}.

The increased risk of gonorrhoea found in our prospective analysis¹⁴ is unlikely to result directly from abrasions/scratches/cuts or bleeding of the penile skin. Nevertheless, penile coital injuries causing dermal compromise should be considered potential risks for HIV acquisition. There is a 2-4 fold increased risk of HIV infection among men and women with genital ulcer

disease²⁰⁻²². Epithelial or mucosal barrier disruption enables increased HIV accessibility to target cells³⁻⁶. We found a statistically and clinically significant increased risk of penile dermal injuries among uncircumcised men that may in part explain their increased HIV infection risk compared to circumcised men. Furthermore, the high frequency of coital injuries among uncircumcised men could place sex partners of HIV-positive uncircumcised men at greater risk of HIV acquisition.

While HSV-2 seropositivity and genital ulcers increased the likelihood self-reported penile injuries, injuries were still reported at 44% of visits by HSV-2 seronegative men and genital ulcers were present in only 2.5% of visits at which injuries were reported. Thus, ulcerative genital syndromes and HSV-2 did not explain most self-reported penile coital injuries.

It is possible that some reported penile coital injuries were symptoms of allergen or irritant dermatitis, resulting from the application of spermicides, lubricants, feminine hygiene deodorant sprays, industrial or other contact agents transferred by hand²³. Men who applied substances to their penises had increased risk of each type of penile coital injury. If penile coital injuries were, in part, explained by such mechanisms, then it is plausible that condom use and washing the penis soon after sex would be protective of “injury”.

Married men were less likely to report penile abrasions/scratches/cuts, while men with multiple recent sex partners had increased risk for each injury type. Marital status and number of sex partners may be proxies for frequency of sex or range of sexual practices. Frequent or vigorous intercourse and uncommon sexual positions are suggested risk factors for coital injuries²⁴⁻²⁶. In this sample of young men, increasing age was associated with increased risk for reporting penile coital injuries, which might be associated with greater frequency of sex or a broader range of sexual practices. Reduced rates of reported penile coital injuries in both study

arms over time might reflect regression to the mean, increased familiarity with the study questions, or another effect of repeated assessment. In general, though, genitourinary health measures improved over time in the cohort: the prevalence of STIs decreased¹⁴, condom use increased, and reporting multiple sex partners decreased¹⁵.

Limitations

The disconnect between the recall period (past 6 months) and current examination may have limited the value of physical examination as a tool to verify penile coital injury reports. Self-reported injuries may represent misclassification of infectious or dermatologic syndromes, exacerbated or brought to the men's attention following intercourse. We do not have physical examination data verifying the location, duration, or severity of reported injuries. Additional information regarding the characteristics of intercourse, sexual positions, specific events prior to or at the time of injury, and whether there were concomitant injuries in sex partners may prove useful for understanding the mechanisms of injury. Although not extensively or methodologically studied in women either, minor coital injuries from consensual vaginal intercourse are reportedly associated with hurried coitus²⁵, male-to-female genital disproportion^{5,24,26}, uncommon sexual positions^{24,25-26}, and vaginal astringents or "tightening" agents²⁷. Further study is needed to verify the nature and causes of coital injuries in both males and females to identify potential mechanisms for increased risk for STIs and HIV.

Conclusions

Circumcision, condom use and penile hygiene, provided protection against reported penile coital injuries. Coital injury risks included: increasing age, multiple recent sex partners,

application of substances to the penis prior to sex, HSV-2 seropositivity and genital ulcers. The mechanisms by which circumcision confers protection against penile coital injuries remain unknown. The high frequency of penile coital injuries reported in our cohort supports the need to verify penile coital injuries, their correlates in female sex partners, and the mechanisms by which such injuries may increase risk for STIs and HIV infection.

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