

Male circumcision decreases penile sensitivity as measured in a large cohort

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What's known on the subject? and What does the study add?

- The sensitivity of the foreskin and its importance in erogenous sensitivity is widely debated and controversial. This is part of the actual public debate on circumcision for non-medical reason. Today some studies on the effect of circumcision on sexual function are available. However they vary widely in outcome.
- The present study shows in a large cohort of men, based on self-assessment, that the foreskin has erogenous sensitivity. It is shown that the foreskin is more sensitive than the uncircumcised glans mucosa, which means that after circumcision genital sensitivity is lost. In the debate on clitoral surgery the proven loss of sensitivity has been the strongest argument to change medical practice. In the present study there is strong evidence on the erogenous sensitivity of the foreskin. This knowledge hopefully can help doctors and patients in their decision on circumcision for non-medical reason.

Objectives

- To test the hypothesis that sensitivity of the foreskin is a substantial part of male penile sensitivity.
- To determine the effects of male circumcision on penile sensitivity in a large sample.

Subjects and Methods

- The study aimed at a sample size of ≈1000 men.
- Given the intimate nature of the questions and the intended large sample size, the authors decided to create an online survey.
- Respondents were recruited by means of leaflets and advertising.

Results

- The analysis sample consisted of 1059 uncircumcised and 310 circumcised men.
- For the glans penis, circumcised men reported decreased sexual pleasure and lower orgasm intensity. They also stated more effort was required to achieve orgasm, and a higher percentage of them experienced unusual sensations (burning, prickling, itching, or tingling and numbness of the glans penis).

- For the penile shaft a higher percentage of circumcised men described discomfort and pain, numbness and unusual sensations.
- In comparison to men circumcised before puberty, men circumcised during adolescence or later indicated less sexual pleasure at the glans penis, and a higher percentage of them reported discomfort or pain and unusual sensations at the penile shaft.

Conclusions

- This study confirms the importance of the foreskin for penile sensitivity, overall sexual satisfaction, and penile functioning.
- Furthermore, this study shows that a higher percentage of circumcised men experience discomfort or pain and unusual sensations as compared with the uncircumcised population.
- Before circumcision without medical indication, adult men, and parents considering circumcision of their sons, should be informed of the importance of the foreskin in male sexuality.

Keywords

male circumcision, foreskin, penile sensitivity

Introduction

Except for religion- and ritual-based circumcisions, modern-day motivations for routine circumcisions without medical indications have not been well documented. Discouraging masturbation and removing excess sexual pleasure are some of the reasons put forward in the literature [1]. Since the prohibition of circumcision in Palestine by Antiochus Epiphanes, the circumcision debate has continued over the millennia, with proponents promoting circumcision for health benefits, and opponents arguing against the barbaric nature of the procedure [2–4].

Sexual arousal is based on anatomical, neural, hormonal, and genetic elements, and is also influenced by effects of culture and of contexts that are specific to each individual. Penile sensory activation is similar in all male vertebrates and is based on somatosensory information from the foreskin, glans, and urethra [5,6]. The strongest somatosensory contribution to male (penile) sensitivity is mediated through the dorsal penile nerve. The glans, densely innervated by the terminal branches of the dorsal penile nerve, appears to be structured as a primary source of sensory information to the CNS for the induction of sexual reflexes [5,7,8]. Research on both animals and humans support this theory. Animals show impaired erectile and ejaculatory function after desensitization of the glans [9,10]. The area of the preputium ridged band is considered the most sensitive part of the human penis [11]. The sensory role of the foreskin has not been thoroughly investigated and results of the few studies conducted in small samples are conflicting.

Worldwide circumcision prevalence rates are ≈30% of the total male population, making circumcision one of the most frequently performed surgical procedures in the world [12]. Nevertheless, only few studies address the effects of this procedure on sexual penile sensitivity, and the results of these studies are contradictory. Some reports show an increase in penile sensitivity after circumcision, whilst others describe a decrease in sexual function [13–19]. In the literature there is no large-sample study that evaluates extensively the effects of circumcision on penile sensitivity.

Kinsey et al. [20] and Masters and Johnson [21] concluded that observational studies on human sexual behavior were unfeasible, as most individuals favour privacy during sexual stimulation. Therefore, self-assessment was the chosen method for the present study. Given the intimate nature of the questions and the number of respondents intended, the authors decided to create an online version of the Self-assessment of Genital Anatomy, and Sexual Function, Male questionnaire (SAGASF-M) [22].

The present study tests the hypothesis that sensitivity of the foreskin plays a substantial role in male penile sensitivity.

Subjects and Methods

Respondents were recruited by means of leaflets that were randomly distributed by medical students at railway stations all over Belgium. The leaflet explained that Ghent University was conducting a study on genital sensitivity in males and females and provided a Uniform Resource Locator (URL) for more information about the study. The online questionnaire started with the informed consent page apprising respondents of the purpose to determine penile sensitivity in males and procedure of the study. Anonymity was assured. The minimum age required for participation was 18 years. After signing the informed consent by clicking the 'I agree' button, the respondent was given access to the SAGASF-M. The survey was kept online for ≈9 months.

Respondents reporting congenital genital abnormalities or penile surgery, except circumcision, were excluded from analysis. Quality control was assured by repetitive questions. Men with gross inconsistencies on these check questions were excluded from analysis.

Differences between uncircumcised (groups A) and circumcised (group B) in demographic, anatomical, and functional differences were tested for statistical significance with the non-parametric Mann–Whitney *U*-test, chi-square, and, instead of the latter, when >20% of cells on contingency tables had an expected count of <5, Fisher's exact test or its extension for polynomial distributions. Statistical tests were considered significant at a (two-sided) $P \leq 0.05$. The study was approved by the institutional ethical board of Ghent University.

The SAGASF-M was used to compare anatomical and functional ratings. The original questionnaire was translated into Dutch and retest-reliability established for online assessment.

The SAGASF-M measures genital sensitivity on 5-point Likert scales. Aided by genital graphs, participants evaluated the dorsal (upper), ventral (under), and lateral (left and right) sides of the glans and, separately, shaft of their penis on four key dimensions: sexual pleasure, discomfort/pain, orgasm intensity, and effort required to achieve orgasm when stimulated by themselves or partners. For the translated Dutch version of the SAGASF-M, the retest reliability was established in a sample of 25 men using internet administration with a test-retest interval of 2 weeks. This was a subsample of the main study sample and consisted of men aged 18–49 years with a wide range of social and educational demographics.

Table 1 Demographic characteristics of participants.

Characteristic	Uncircumcised, n (%)	Circumcised, n (%)
Ethnicity:		
Caucasian	1041 (98.3)	294 (94.8)
Asian	6 (0.6)	3 (1)
African	0	4 (1.3)*
Arabic	3 (0.3)	2 (0.6)
Marital status:		
Married	359 (33.9)	129 (41.6)
Living together	227 (21.4)	56 (18.1)
Separated/divorced	42 (4)	16 (5.2)
Widowed	2 (0.2)	3 (1)
Single (never married)	324 (30.6)	69 (22.3) [†]
Other	105 (9.9)	37 (11.9)
Education level:		
None	3 (0.3)	2 (0.6)
First level	14 (1.3)	1 (0.3)
Secondary level	340 (32.1)	105 (33.9)
Bachelor degree	203 (19.2)	56 (18.1)
Master's degree	499 (47.1)	146 (47.1)
Gender of actual sex partner(s):		
Female	758 (71.6)	229 (73.9)
Male	127 (12)	39 (12.6)
Both	20 (1.9)	9 (2.9)
Neither	154 (14.5)	33 (10.6)
Number of children:		
None	630 (59.5)	171 (51.8)
1	90 (8.5)	29 (8.8)
2	190 (17.9)	65 (25.8)
≥3	149 (14.1)	45 (13.6)

*Circumcised Africans, expected 0.9, Fisher's exact probability $P < 0.001$; [†]Circumcised singles, expected 90, Fisher's exact probability $P < 0.005$.

Results

Informed consent was signed by 1963 men of whom 1464 answered questions related to penile sensitivity. Based on the medical history, which was limited to questions on penile malformations and on circumcision and other penile surgeries, 39 men with congenital genital abnormalities or history of penile surgery other than circumcision were excluded, leaving 1425 men. Another 56 men were excluded because they did not indicate their circumcision status or showed inconsistencies on check questions. The final analysis sample consisted of 1369 men of whom 1059 were uncircumcised (Group A) and 310 (22.6%) circumcised (Group B).

Uncircumcised men (Group A) had a mean (range) age of 39 (18–78) years and circumcised men (Group B) a mean (range) age of 37 (18–79) years. Caucasians constituted the largest ethnic group of participants (1335 men or 98%). Most respondents held a master's degree as their highest degree (47.1%). In all, 987 men (72.1%) reported a heterosexual relationship, 12.1% were homosexual, 2.1% had bisexual relationships, and 13.7% had no active sexual relationship, at the time they took the survey. There were only two statistical differences in demographic characteristics between Groups A and B. The circumcised men of Group B included significantly more African men

and significantly fewer single men as compared with Group A (Table 1). Most men were circumcised in childhood with the present age between 20 and 29 years (Table 2).

Of the men in Group A, 90.6% rated the sexual pleasure provided when the foreskin was stimulated by themselves or their partners from 'mild' to 'very strong' and 61.9% the respective orgasm from 'mild' to 'very strong'.

For the glans penis, men in Group B reported significantly less sexual pleasure than men in Group A at the dorsal side ($P \leq 0.001$), and the lateral ($P \leq 0.001$) and ventral sides ($P = 0.02$). Orgasm was less intense in Group B at the dorsal side ($P = 0.006$) and at the lateral sides ($P = 0.02$). Group B required more effort in achieving orgasm at the lateral sides ($P = 0.04$). Furthermore, a larger percentage of men in this group reported numbness at the dorsal, lateral, and ventral sides (all $P \leq 0.001$), as well as unusual sensations (burning, prickling, itching, or tingling) at the lateral sides ($P = 0.02$) and at the ventral side ($P = 0.003$) of the glans.

For the penile shaft, a higher percentage in Group B than Group A reported discomfort or pain at the dorsal, lateral, and ventral sides (all $P \leq 0.001$). Higher orgasm intensity was found in Group B at the ventral side ($P = 0.009$). A higher percentage of men in Group B reported numbness

Table 2 Time of circumcision and present age of circumcised men.

	Time of circumcision, <i>n</i>				
	Birth	Childhood	Adolescence	Adulthood	Total
Present age, years					
<19	4	8	0	1	13
20–29	6	49	15	13	83
30–39	2	29	3	34	68
40–49	4	27	8	24	63
50–59	5	28	3	22	58
60–69	1	9	1	7	18
70–79	1	2	0	4	7
Total	23	152	30	105	310

Table 3 Comparison of uncircumcised (A) and circumcised (B) men in penile sensitivity by Mann–Whitney *U*-test.

	Dorsal			Lateral			Ventral		
	A	B	<i>P</i>	A	B	<i>P</i>	A	B	<i>P</i>
Glans									
Sexual pleasure	3.72	3.31	<0.001	3.57	3.31	<0.001	3.85	3.70	0.017
Discomfort and pain	1.27	1.26	ns	1.21	1.27	ns	1.24	1.28	ns
Orgasm intensity	3.37	3.13	0.006	3.31	3.14	0.020	3.55	3.45	ns
Orgasm effort	3.11	2.99	ns	3.10	2.95	0.038	3.18	3.09	ns
Numbness	1.97	1.85	<0.001	1.98	1.89	<0.001	1.98	1.93	<0.001
Unusual sensations	1.96	1.94	ns	1.99	1.96	0.022	1.97	1.93	0.003
Unusual sensations intensity	3.19	3.42	ns	3.00	3.11	ns	3.11	3.25	ns
Penile shaft									
Sexual pleasure	3.17	3.16	ns	3.22	3.18	ns	3.27	3.29	ns
Discomfort and pain	1.05	1.17	<0.001	1.05	1.17	<0.001	1.06	1.22	<0.001
Orgasm intensity	2.87	3.00	ns	2.92	3.00	ns	2.92	3.15	0.009
Orgasm effort	2.85	2.87	ns	2.91	2.91	ns	2.94	2.95	ns
Numbness	1.98	1.96	0.040	1.99	1.95	0.001	1.99	1.96	0.003
Unusual sensations	1.99	1.97	0.045	2.00	1.98	0.005	2.00	1.96	<0.001
Unusual sensations intensity	3.67	2.33	0.039	4.00	2.75	ns	2.00	3.00	ns

The table lists means and *P* values.

at the dorsal ($P = 0.04$), lateral ($P \leq 0.001$), and ventral sides ($P = 0.003$) as well as unusual sensations at the dorsal ($P = 0.04$), lateral ($P = 0.005$), and ventral sides ($P \leq 0.001$). The intensity of the unusual sensations at the dorsal side ($P = 0.04$) of the penile shaft was significantly higher for the circumcised men (Table 3).

Compared with men circumcised in childhood, men circumcised during adolescence (10–19 years) or later, reported less sexual pleasure by stimulation at the dorsal side of the glans ($P = 0.005$). They also reported more discomfort or pain ($P = 0.03$), and more unusual sensations at the dorsal side ($P = 0.04$) of the penile shaft (Table 4).

Discussion

The present study shows that uncircumcised men experience mild to very strong sexual pleasure from the foreskin when stimulated by themselves or partners. They reported that stimulation of their foreskin also generates a

moderate to strong orgasm intensity, and very few reported discomfort or numbness of the prepuce.

Glans Sensitivity

Circumcised men (Group B) showed a significantly lower level of sexual pleasure sensation of the glans. Compared with the strong significant group differences at the dorsal site of the glans, the difference at the ventral side was smaller. This can probably be explained by the presence of the frenulum, which is preserved with circumcision. Sorrells et al. [23] confirmed the high-density nerve content of the frenulum, when they conducted a Semmes-Weinstein monofilament test comparing circumcised and uncircumcised men. A significant lower mean was found for the glans vibration threshold in the circumcised men. In both groups the most sensitive area was the frenulum.

The circumcised men indicated lower orgasm intensity at the dorsal and lateral sides of the glans and needed a stronger effort to obtain orgasm than those who were

Table 4 Comparison of men circumcised in childhood and adulthood by Mann–Whitney *U*-test

	Dorsal			Ventral			Lateral		
	Child	Adult	<i>P</i>	Child	Adult	<i>P</i>	Child	Adult	<i>P</i>
Glans									
Sexual pleasure	3.48	3.20	0.005	3.70	3.72	ns	3.25	3.41	ns
Discomfort and pain	1.17	1.36	ns	1.23	1.33	ns	1.19	1.36	ns
Orgasm intensity	2.99	3.27	ns	3.44	3.49	ns	3.06	3.22	ns
Orgasm effort	3.02	2.98	ns	3.16	3.02	ns	2.98	2.91	ns
Numbness	1.85	1.85	ns	1.94	1.92	ns	1.90	1.88	ns
Unusual sensations	1.96	1.93	ns	1.94	1.92	ns	1.97	1.95	ns
Unusual sensations intensity	3.00	3.71	ns	3.50	3.00	ns	2.25	3.80	ns
Penile shaft									
Sexual pleasure	3.17	3.14	ns	3.37	3.17	ns	3.22	3.13	ns
Discomfort and pain	1.09	1.28	0.026	1.17	1.27	ns	1.18	1.15	ns
Orgasm intensity	2.98	3.01	ns	3.21	3.05	ns	2.99	3.01	ns
Orgasm effort	2.91	2.85	ns	2.97	2.95	ns	2.90	2.93	ns
Numbness	1.97	1.94	ns	1.96	1.95	ns	1.97	1.93	ns
Unusual sensations	1.99	1.95	0.037	1.97	1.95	ns	1.99	1.98	ns
Unusual sensations intensity	4.00	2.00	ns	3.50	2.60	ns	3.50	2.00	ns

The table lists means and *P* values. Child: circumcised at birth or childhood; adult: circumcised in adolescence or adulthood.

uncircumcised. In addition, a significantly larger percentage of circumcised men reported numbness and unusual sensations at the glans. The most plausible explanation for all the differences listed here is the absence of the foreskin. The removal of the highly innervated foreskin might diminish strong somatosensory sensation, particularly located in the ridge band.

The decreased erotic sensitivity after removal of the foreskin is self-evident. However, the decrease in glans erotic sensitivity is more difficult to understand. It is thought that after circumcision the mucosa of the glans is constantly exposed to friction and irritation. This constant stress provides long-term keratinisation of the mucosa, making it thicker and dryer. Furthermore, sensitive nerve endings get covered by the thicker mucosal layer and become less sensitive [24]. This concept of keratinisation of the glans is still controversial. In a small population study by Szabo *et al.* [25], no increased keratinisation of the glans was found in circumcised men. Another reason for differential sensory changes after circumcision might be a 'pruning effect', with arborisation or new branching of nerves that have been severed causing a shift in the dermatome [26]. It may also be that covering of the glans with foreskin prevents direct sensory stimulation in the flaccid state; direct stimulation in the erect, uncovered state then becomes more novel, and thus more sensitive.

Bleustein *et al.* [27] evaluated glans sensitivity using the Erectile Function Domain of the self-report questionnaire, International Index of Erectile Function (IIEF), as well as somatosensory testing to compare 62 uncircumcised and 63 neonatally circumcised men. Quantitative somatosensory testing (including vibration, pressure, spatial perception, and warm and cold thermal thresholds) was used on the

dorsal midline glans of the penis. After standardisation of the variables no significant somatosensory differences were found. However, decreased orgasm intensity was reported in the circumcised group at the dorsal side of the glans. The somatosensory tests were done on the dorsal midline of the glans with the foreskin retracted in uncircumcised men. By this method the sexual sensitivity of the foreskin and the ridged band were ignored. Disregard of possibly confounding variables and the lack of randomisation to treatment may have biased the results.

Masters and Johnson [21] compared sensitivity of the ventral and dorsal surfaces of the penis. They found no difference in penile or glans sensitivity between circumcised and uncircumcised men. However, the sensitivity of the prepuce was not evaluated. The tendency of Masters and Johnson to support the practice of circumcision and to ignore the sensory function of the prepuce may have biased their results. Sorrels *et al.* [23] included sensitivity of the foreskin in their assessment and found a clear link between tactile penile sensitivity and sexual pleasure. They stressed the importance of the prepuce as the most erogenous part of the male sexual anatomy.

Penile Shaft Sensations

The present study showed a marked increase in the percentage of circumcised men who reported pain sensations at the penile shaft. Such pain can be due to traction of the penile shaft skin, or of the area of the circumcision scar, during erection, masturbation and intercourse, and would probably correlate with the extent of the circumcision [28–30]. Besides protecting the glans, the foreskin facilitates penetration and sexual stimulation

during intercourse and masturbation. Circumcision eliminates this 'gliding' mechanism, thereby causing discomfort and pain during self-stimulation or penetration. Depending on the extent of skin removed, the skin of the penile shaft becomes tenser and loses its flexibility. A significantly higher percentage of circumcised men in the present study reported discomfort or pain and numbness at the dorsal, lateral and ventral sides of the penile shaft. Although the data do not allow further subdivision based on the extent of skin removed, it appears plausible to assume that the circumcision technique can influence penile sensitivity: the more skin is removed, the higher is the risk of discomfort and numbness. Circumcised men reported higher orgasm intensity related to stimulation of the ventral side of the penile shaft. This observation might endorse the importance of the dense nerve content of the frenulum and prepuce.

Overall Penile Sensitivity

The present results contrast with the findings of the study by Krieger et al. [16], in which circumcised men reported increased overall sensitivity and increased ease of reaching orgasm. The latter study was prospective; it randomised men 1 : 1 to either immediate circumcision or to circumcision delayed by 2 years (control group). Both groups were evaluated at 1, 3, 6, 12, 18, and 24 months after baseline (circumcision in the case of the target group) with a questionnaire consisting of six questions on sexual function and sexual pleasure. Overall penile sensitivity was assessed by means of only a single variable. By contrast, the respondents in the present study rated the sensitivity of different areas of the penis as illustrated in detailed graphs, which may have enhanced the reporting accuracy. In addition, one needs to consider that a 2-year follow-up period may be too short to detect possible long-term desensitisation of the glans nerves.

In the present study, orgasm was assessed by two different variables, 'orgasm intensity' and 'effort to reach orgasm'. Circumcised and uncircumcised men did not differ in the rating of 'effort needed to reach orgasm'. Krieger et al. [16] assessed orgasm by means of one single variable, 'ease of reaching orgasm', which yielded a significant difference compared with before they were circumcised, 64.0% of circumcised men reported their penis was 'much more sensitive', and 54.5% rated their ease of reaching orgasm as 'much more' at month 24. In a similar randomised clinical trial involving 2210 immediately circumcised men and 2246 men circumcised after a delay of 24 months, Kigozi et al. [31] found that men reported increased penile erotic sensitivity shortly after circumcision, but the authors did not assess long-term effects. Different, conflicting results of circumcision were also reported by studies using the Brief Male Sexual Function Inventory (BMSFI), possibly due to

the limitations of the BMSFI [32–34]. The five domains of the BMSFI (sexual drive, erections, ejaculation, problem assessment and overall satisfaction) may be too unspecific for the assessment of somatosensory differences between circumcised and uncircumcised men. The more specific items of a questionnaire like the SAGASF-M are more likely to capture inter-individual variations in penile sensitivity.

Compared with previous studies where no effects between childhood and adult circumcision were found, in the present study, men circumcised after puberty reported less sexual pleasure at the dorsal side of the glans penis and more discomfort and pain at the penile shaft [13]. The large sample size and detailed assessment of the present study may have accentuated this result. The loss of sexual pleasure could be explained by the desensitisation of the dorsal glans penis nerves. In men circumcised before puberty, the subsequent pubertal growth process possibly compensates post-circumcision shortages of the penile skin.

In addition to the above mentioned differences in assessment technique (including the number of variables assessed) and in study design (prospective vs retrospective), there are also differences in the study populations. Krieger et al. [16] conducted their study in Kenya, while the present study took place in Belgium. Cultural differences, particularly in views on sexuality, may influence the interpretation of questions. The fact that circumcision is traditional in most Kenyan populations is likely to create a major cultural bias. Circumcision is considered a rite of passage in Kenya and distinguishes man from boy. This probably biases how men perceive sexuality.

The present study describes a decrease in erotic sensitivity with increasing age in both circumcised and uncircumcised men. Taylor et al. [35] confirms the present finding of a reduction in penile sexual pleasure with increasing age. This is attributed to the fact that in older men the ridged band becomes smoother. Activation of the bulbocavernosus and bulbospongiosus reflex by stretching of the ridged band of the foreskin has been described and could improve sexual pleasure. Since in older men this structure is smoother, there is less possibility of the structure to stretch and activate this reflex. In the present study the same ageing effect was also seen in circumcised males. A general decline in somatosensory nerve activity with ageing has been described and could be responsible for this observation [36]. In the present study, the same ageing effect was also seen in circumcised males.

A major strength of the present study is its large sample size. However, the sample is not representative of the general male population, but biased towards highly educated men. We do not yet know whether the findings would persist in a sample of men with a lower education

level, who may find a lengthy written self-report questionnaire more challenging. Yet, we would expect that the ample use of illustrations in the SAGASF-M would greatly support accuracy of reporting also by men of lower educational level and avoid problems such as those noted by Risser et al. [37]. Many participants in their self-evaluation survey could not identify correctly whether or not they were circumcised.

In future research, adding questions about frequencies and type of sexual practices, as well as the time needed to reach orgasm, may further refine our understanding of the effects of circumcision. Self-report by way of the SAGASF-M along with somatosensory testing of the same subjects would possibly constitute an ideal set of complementary tools for assessing penile erotic sensitivity. Future longitudinal pre- and post-circumcision designs may further strengthen the results of the present study. Such a combination of methods is planned for a future investigation.

The findings from the present study underline the important role played by the foreskin for penile sensitivity and functioning and for men's overall sexual satisfaction. Adult men, as well as parents considering circumcision of their sons, should always be informed of the role of the foreskin in male sexuality, before their decision for surgery. The present findings should also be taken into consideration in the evaluation of the recently introduced practice of circumcision for the prevention of sexually transmitted infections, e.g. HIV and penile cancer [38].

Conflict of Interest

None declared.

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Abbreviations: BMSFI, Brief Male Sexual Function Inventory; SAGASF-M, Self-assessment of Genital Anatomy, Sexual Sensitivity and Function, Male (questionnaire).