BJU Int 2022; **130:** 26–34 doi:10.1111/bju.15604

BJUI
BJU International

Review

Circumcision devices versus standard surgical techniques in adolescent and adult male circumcisions: a Cochrane review

Ameer Steven-Jorg Hohlfeld[1], Sumayyah Ebrahim[2], Muhammed Zaki Shaik[2] and Tamara Kredo[1,3]

[1]Cochrane South Africa, South African Medical Research Council, Cape Town, [2]Department of Surgery, School of Clinical Medicine, University of KwaZulu-Natal, Durban, and [3]Clinical Pharmacology Division, Department of Medicine, Stellenbosch University, Cape Town, South Africa

This article is based on a Cochrane Review published in the Cochrane Database of Systematic Reviews (CDSR) 2021, Issue 3. Art. No.: CD012250. DOI: 10.1002/14651858.CD012250.pub2. Cochrane Reviews are regularly updated as new evidence emerges and in response to feedback, and the CDSR should be consulted for the most recent version of the review.

Objectives

To assess the effects of device-based circumcisions compared with standard surgical techniques in adolescent and adult males (10 years old and above).

Methods

We performed a comprehensive search with no restrictions to the language of publication or publication status. We included randomised controlled trials (RCTs) of device-based circumcisions compared to standard surgical dissection-based circumcision conducted by health professionals in a medical setting. We reported study results as risk ratios (RRs) or mean differences (MDs) using 95% confidence intervals (CIs) and a random-effects model. We used the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) approach to evaluate the overall certainty of the evidence for each outcome.

Results

A total of 18 trials met the inclusion criteria. These trials did not report severe adverse events (AEs; 11 trials, 3472 participants). There may be a slight increase in moderate AEs for devices compared to surgical techniques (RR 1.31, 95% CI 0.55–3.10; I^2 = 68%; 10 trials, 3370 participants; low-certainty evidence); this corresponds to eight more (ranging from 15 fewer to 84 more) moderate AEs per 1000 participants. We are uncertain about the difference in mild AEs between groups when devices are used compared to surgical techniques (RR 1.09, 95% CI 0.44–2.72; I^2 = 91%; 10 trials, 3370 participants; very low-certainty evidence).

Conclusions

We found no serious AEs using a circumcision device compared to surgical techniques. Still, they may slightly increase moderate AEs, and it is unclear whether there is a difference in mild AEs. High-quality trials evaluating this intervention are needed to provide further certainty regarding the rates of AEs. Clinicians, patients, and policymakers can use these results combined with their contextual factors to inform the best approach that suits their healthcare settings.

Keywords

circumcision, male, meta-analysis, systematic review, #Andrology

Introduction

Circumcisions are among the most common surgical procedures performed in males [1]. The following foreskin conditions are usually indications for surgical or dissection technique-based. Phimosis is a congenital or acquired constriction of the prepuce, resulting in the inability of

the foreskin to completely retract and expose the glans [2]. Phimosis causes swelling, including difficult and painful erections, candidiasis, and numerous sexually transmissible infections [3]. Paraphimosis is when the foreskin is not pulled back over the glans after retracting, resulting in a tight constricting band that causes swelling of the distal penis and acute discomfort [1]. Balanoposthitis is erythema and oedema of the prepuce and glans, and balanitis is when inflammation is confined to the glans; the foreskin is usually non-retractile [1]. Males receive circumcisions for hygiene, personal, cultural, and ritual or religious reasons (in Jewish, Muslim and traditional African cultures) [2]. In addition, males may receive circumcisions to decrease the risk of sexually transmitted infections and HIV transmission [4]. Importantly, voluntary medical male circumcision (VMMC) is a key World Health Organization (WHO) HIV preventive intervention [5].

Over the last 20 years, researchers have developed circumcision devices that are an alternative to globally commonly used standard surgical techniques. The basis of circumcision devices (irrespective of the individual type of device) is crushing the foreskin at the proposed tissue apposition line and simultaneously obtaining haemostasis. The foreskin is then excised or allowed to slough off by ischaemic necrosis. The crushed apposed edges are suture reinforced, glued, or are sometimes left to heal [6]. Of the 20 identified male circumcision devices, three commonly used devices are the Gomco clamp, the Mogen clamp and the Plastibell [2,7,8]. These devices are further classified as ligature devices (i.e. they allow the foreskin to slough off by ischaemic necrosis with no suturing apposition needed) or crush devices (i.e. they provide crushing haemostasis and simultaneous apposition, the foreskin is excised, and edges are suture re-enforced) [9]. The dissection techniques involve using sharp dissection, cautery, or ligation of bleeding vessels and suturing these to the apposed edges. The types of dissection techniques are the traditional forceps-guided technique, the dorsal slit technique, and the inner ring-outer ring (sleeve) techniques.

Adverse events (AEs) may include bleeding, haematoma, wound infection, wound disruption, and penile injury. The WHO *Framework for Clinical Evaluation of Devices for Adult Male Circumcision* provides standardised definitions for grading AEs as mild, moderate, or severe [8,9]. In brief, AEs are categorised as mild if they require little or no intervention (e.g. mild wound disruption or slight bleeding), moderate if they require active treatment (e.g. antibiotics or suturing), or severe if they require transfusion or hospitalisation or result in permanent damage [10].

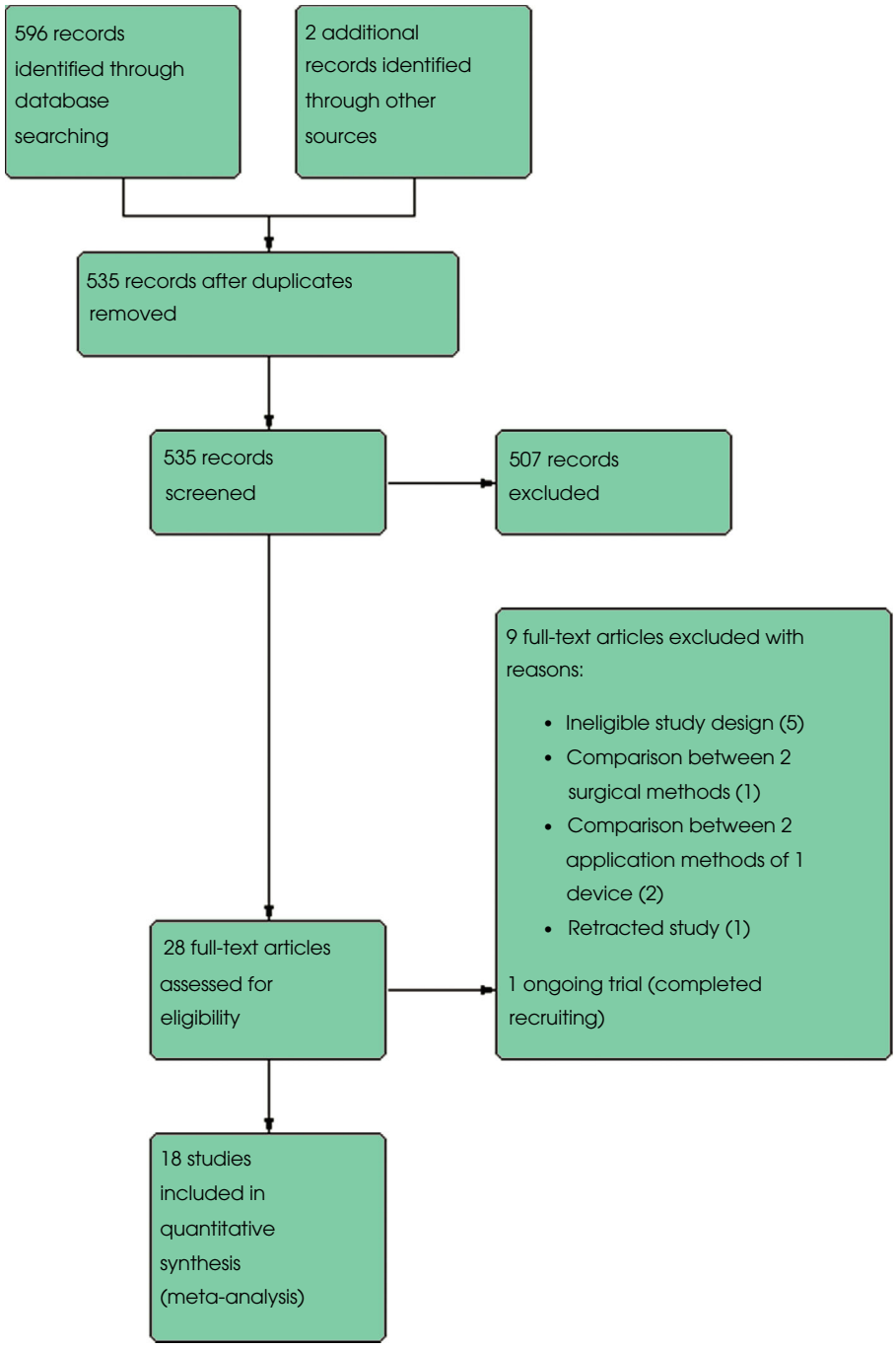
Circumcision devices have been developed to shorten the operative time, simplify techniques, and improve safety and cosmetic outcomes [11]. Device-based techniques generally provide protection to the glans. They reliably circumcise adequate foreskin and provide crush haemostasis. This technique is supposedly safer and easier to replicate than the standard dissection techniques [7]. Device-based techniques also allow for task-shifting, as nurses and other non-physician healthcare providers may safely perform them, thus allowing for rapid scale-up of VMMC for HIV prevention in resource-constrained settings [12,13]. It is important to note that device-based techniques are precluded in men with penile anatomical abnormalities, chronic paraphimosis, and active genital infection [11,14].

Several factors form part of the requirements that need to be considered when introducing a circumcision device to low-resource settings for policymakers. First, ease of use (with a short procedure time), easy and practical removal, and it should be suitable for mid-level providers to use. Second, it should be low cost or affordably priced, thus, having a cost advantage over standard surgical procedures. Third, it needs to meet regulatory and marketing criteria that support high-quality clinical data on its safety and effectiveness and preferably used in age groups relevant for the country intending to use it [8]. Research indicates that circumcision devices can reduce the complexity and duration of the male circumcision procedure; however, the high number of circumcisions performed can be demanding on both human and financial resources. One study reported a median (range) duration of 30 (18–63) min [15]. Therefore, an effective, safe, inexpensive, and easy-to-use device would assist in easing any burden [7,8,10]. With more types of devices being manufactured, albeit, with the same mechanism, it is essential to categorically compare the efficacy of circumcision devices with the dissection technique. To date, the WHO Medical Circumcision Technical Advisory Group has published guidelines on the use of PrePex® and Shang Ring® (SR) devices with recommendations made based on comparative and non-comparative studies [9,16]. This Cochrane Review assesses the effects of device-based circumcisions compared with standard surgical techniques in adolescent and adult males (aged ≥10 years). It considered the benefits and harms and followed the methodologic standards of a Cochrane Review, together with the application of Grading of Recommendations Assessment, Development, and Evaluation (GRADE) and the generation of a 'Summary of findings' table.

Material and Methods

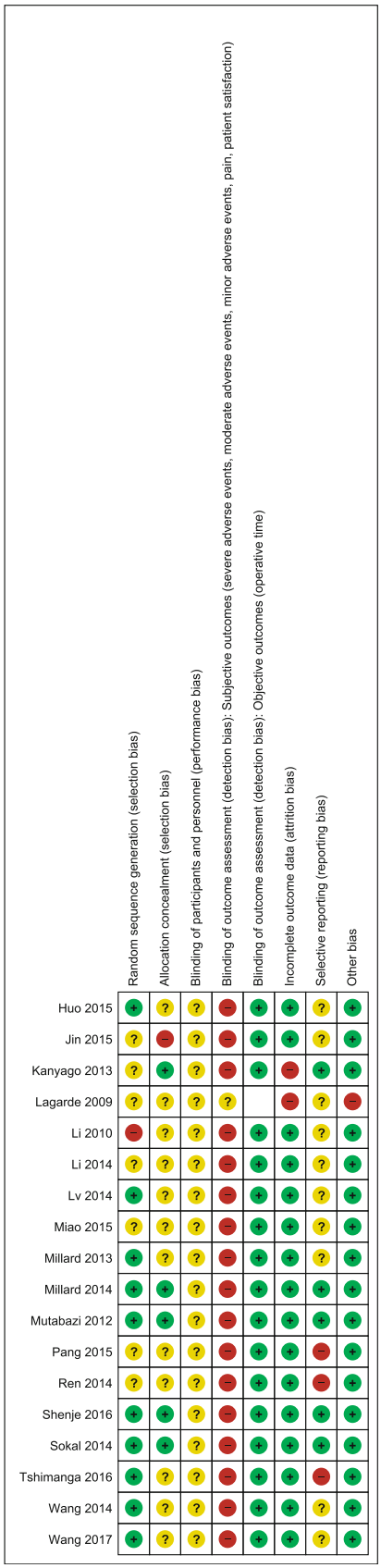
This is a published Cochrane Review that is based on a priori published protocol [17]. We used the search strategy detailed in the protocol to conduct our searches [17]. Our search was until 16 April 2020, with no restrictions to the language of publication or publication status. We searched Cochrane

Fig. 1 PRISMA flow diagram.



Library, MEDLINE (PubMed), Embase, Web of Science, trials' registries, grey literature sources, and conference proceedings. Further, we included potentially eligible trials or ancillary publications by searching included trials, reviews, meta-analyses, and health technology assessment reports' reference lists. We included randomised controlled trials (RCTs) regardless of their publication status or the publication language and included adult or adolescent men aged ≥10 years. The experimental intervention was any crush or ligature circumcision device used by a health professional compared to dissection-based circumcision, any recognised dissection technique (forceps-guided method, dorsal slit method, or the sleeve method). We had two primary outcomes, which were serious AEs and moderate AEs. Serious AEs were defined as events requiring a blood transfusion, hospitalisation or resulting in permanent damage (e.g. penile

Fig. 2 Risk of bias of the included studies.



injury occurring within the intraoperative and early postoperative period [30 days]). Moderate AEs were defined as events requiring active treatment such as suturing, antibiotics, and surgical haemostasis within the intraoperative and early postoperative period (30 days). Our secondary outcome was mild AEs. Mild AEs were defined as requiring little or no intervention (e.g. slight wound disruption, minor bleeding and occur within the intraoperative and early postoperative period [30 days]). The Cochrane review assessed a further four secondary outcomes [18]. Two reviewers independently screened the potentially relevant records that they classified, extracted the data, and assessed risk of bias according to the Cochrane Handbook for Systematic Reviews of Interventions [19]. We synthesised data using a random-effects meta-analysis. We performed statistical analyses and interpreted the findings according to the statistical guidelines in the Cochrane Handbook for Systematic Reviews of Interventions [19]. We used Review Manager 5 software to perform the analyses [20]. We assessed heterogeneity through visual inspection of the Forest plots to assess the amount of overlap of CIs and the I^2 statistic (which quantifies inconsistency across studies) to identify the impact of heterogeneity on the meta-analysis [21,22]. When assessing reporting biases, where possible, we assessed study protocols for selective outcome reporting. Where there were 10 trials that investigated a particular outcome, we used funnel plots to assess small-study effects. We graded the certainty of the evidence using the GRADE approach [23].

Results

Our search returned 596 records, of which we included 18 trials [10,14,24–39]. The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram details the reported search (Fig. 1).

The included trials were conducted in lower- and middle-income countries and are summarised in Table S1. Their risk of bias assessments are depicted in Fig. 2. Appendix S1 lists the excluded studies with reasons for ineligibility.

Effects of Interventions

Table 1 summarises the effects of the interventions for each of the following outcomes.

Primary outcomes

Trials did not report severe AEs. However, there may be a slight increase in moderate AEs when devices are used compared to standard surgical techniques (risk ratio [RR] 1.31, 95% CI 0.55–3.10; I^2 = 68%; 10 trials, 3370 participants; low-certainty evidence). This represents eight more moderate AEs per 1000 males circumcised with a device (95% CI from

Table 1 GRADE summary of findings for circumcision devices compared to standard surgical techniques in adolescent and adult male circumcisions.

Patient or population: adolescent and adult male circumcisions **Setting: outpatients** **Intervention: circumcision devices** **Comparison: standard surgical techniques**						
Outcomes	**No. of participants (studies)**	**Certainty of the evidence (GRADE)**	**Relative effect (95% CI)**	**Anticipated absolute effects (95% CI)**		**Comment**
				Risk with standard surgical techniques	**Risk difference with circumcision devices**	
Serious AEs	3472 (11 RCTs)	⊕⊕⊕⊖ MODERATE*,†	Not pooled	**Study population** Not pooled	Not pooled	No serious AEs reported. There is probably little to no difference between circumcision devices and standard surgical approaches.
Moderate AEs	3370 (10 RCTs)	⊕⊕⊖⊖ LOW*,†	**RR 1.31** (0.55–3.10)	**Study population** 27 per 1000	8 more per 1000 (12 fewer to 57 more)	There may be a slight increase in moderate AEs when using circumcision devices compared to surgical techniques.
Mild AEs	3370 (10 RCTs)	⊕⊖⊖⊖ Very Low*,‡,§	**RR 1.09** (0.44–2.72)	**Study population** 114 per 1000	10 more per 1000 (64 fewer to 195 more)	We are uncertain whether devices or surgery are different with respect to mild AEs.
Operative time (min)	4812 (14 RCTs)	⊕⊕⊕⊖ MODERATE*,¶	-	**Study population** The mean operative time (min) was 0	MD 17.26 lower (19.96 lower to 14.57 lower)	The use of circumcision devices probably reduces operative time by ~17 min compared to standard surgical techniques that take on average 24 min.
Pain during the first 24 h (VAS means)	3022 (9 RCTs)	⊕⊕⊖⊖ LOW*,§	-	**Study population** The mean pain during the first 24 h (VAS means) was 0	MD 1.3 lower (2.37 lower to 0.22 lower)**	There may be less pain during the first 24 h after the procedure when using circumcision devices compared to standard surgical techniques.
Pain during the first 7 days (VAS means)	1430 (4 RCTs)	⊕⊕⊖⊖ LOW*,§	-	**Study population** The mean pain during the first 7 days (VAS means) was 0	MD 0.11 higher (0.89 lower to 1.11 higher)**	There may be little to no difference between circumcision devices and standard surgical approaches for pain during the first 7 days.
Participant satisfaction	4501 (15 RCTs)	⊕⊕⊖⊖ LOW*,§	**RR 1.19** (1.04–1.37)	**Study population** 751 per 1000	143 more per 1000 (30 more to 278 more)	Participants may slightly prefer the device compared to standard surgical techniques

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

*‡Downgraded by one level for serious imprecision: the confidence interval is wide, including appreciable benefit and harm with low numbers of events in each arm. §There were no reports of serious AEs in any of the 11 trials reporting this outcome for either comparison. Thus, the best estimate of the relative risk would thus be one as there is probably no difference regardless of the method for circumcision. ¶Downgraded by one level for serious inconsistency: there is considerable unexplained heterogeneity. **Not downgraded for inconsistency: despite statistical heterogeneity, there was a consistent finding of reduced operation time in the intervention group of ≥10 min than standard surgical methods.*

12 fewer to 57 more). We downgraded the certainty of the evidence due to serious risk of bias and imprecision.

Secondary outcomes

We are uncertain about the difference in mild AEs between groups when devices are used compared to standard surgical techniques (RR 1.09, 95% CI 0.44–2.72; I^2 = 91%; 10 trials, 3370 participants; very low-certainty evidence). This represents 10 more mild AEs per 1000 males circumcised with a device (95% CI from 64 fewer to 195 more). We downgraded the certainty of the evidence for serious risk of bias, unexplained heterogeneity, and imprecision.

Operative time is probably about 17 min shorter when using a device rather than standard surgical techniques, which constitutes a clinically meaningful decrease in a procedure time (mean difference [MD] −17.26 min, 95% CI −19.96 to −14.57; I^2 = 99%; 14 trials, 4812 participants; moderate-certainty evidence). This represents a mean difference of 17.26 min less time spent when males are circumcised with a device (95% CI from 19.96 less to 14.57 less). We downgraded the certainty of the evidence one level for serious risk of bias. There was a high statistical inconsistency (I^2 = 99%), but all times indicated a reduction in procedure duration when a circumcision device was used compared to the standard surgical technique. Hence, we did not downgrade for inconsistency. Furthermore, we deemed it clinically important for an operative time under 10 min.

There may be less postoperative pain during the first 24 h when circumcision devices are used compared to standard surgical techniques (measured using a visual analogue scale [VAS]; MD 1.30 cm lower, 95% CI 2.37 lower to 0.22 lower; I^2 = 99%; nine trials, 3022 participants; low-certainty evidence). This represents a mean difference of 1.3 less pain on the VAS when males are circumcised with a device (95% CI from 2.37 less to 0.22 less). We downgraded the certainty of the evidence for serious methodological limitations and serious unexplained heterogeneity.

There may be little or no difference in postoperative pain experienced during the first 7 days when compared with standard surgical techniques (measured using a VAS; MD 0.11 cm higher, 95% CI 0.89 lower to 1.11 higher; I^2 = 94%; four trials, 1430 participants; low-certainty evidence). This represents a MD of 0.11 more pain on the VAS when males are circumcised with a device (95% CI from 0.89 less to 1.11 more). We downgraded the certainty of the evidence for serious methodological limitations and serious unexplained heterogeneity.

Lastly, participants may slightly prefer circumcision devices compared to standard surgical techniques (RR 1.19, 95% CI 1.04–1.37; I^2 = 97%; 15 trials, 4501 participants; low-certainty evidence). This represents 143 more participants per 1000 who were satisfied with circumcision devices (95% CI from 30 more to 278 more). We downgraded the certainty of the evidence for serious risk of bias and unexplained inconsistency.

Discussion

The present Cochrane review is currently the most rigorous and up-to-date systematic review that assesses the effects of circumcision devices to standard surgical techniques. While our findings may generally be recognised to be applicable to standard global clinical practice, it is important to note the following. Of the 18 included trials, all were exclusively conducted in China and sub-Saharan African countries. Thus, potentially affecting the applicability of our findings to other low-middle-income settings and high-income settings. Although these trials were conducted in resource constraint settings, where health systems differ in how they operate and how professionals who perform these procedures might be trained, there is no reason why these devices would work differently in other settings. The eligible trials comprised of medically trained doctors that performed device-based circumcision with varying levels of experience.

Interestingly, two trials consisting of nurses who carried out the device-based procedures. Thus, suggesting that this duty may potentially be shifted to nurses, thereby saving on costs in the long term. Further insight into the appropriate level of healthcare practitioner tasked to carry out these procedures and feasibility of task shifting or sharing requires evaluation through current and future trials of this nature.

The present review did not cover trials where traditional healers perform circumcisions in line with their cultural norms and practices. Furthermore, it was not within the scope of the present review. Therefore, we do not know how these circumcision devices would be implemented in traditional settings, i.e. non-health system settings. This consideration may have important implications for implementation across other settings.

Currently, there are no systematic reviews that have applied rigorous Cochrane methodology with GRADE evaluation to rate the certainty of the evidence. We only included RCTs that assessed a wide range of differing circumcision devices that compared situ and disposable devices to surgical techniques. Importantly, our search identified four systematic reviews and meta-analyses [40-43]. Unlike our present review, these did not combine all devices when comparing against standard surgical techniques, nor did they include a certainty of evidence rating. However, they highlighted the methodological limitations of their included studies. Even though three systematic reviews assessed AEs, they failed to classify them according to the WHO *Framework for Clinical Evaluation of Devices for Adult Male Circumcision*, which provides standardised definitions for grading AEs as mild,

moderate, or severe [8,13,40,42,43]. Contrary to our present results, three reviews reported that participants in the circumcision-device groups were less likely to have AEs than those that received the standard surgical technique. Although, one review compared disposable circumcision suture devices and SR separately to surgical techniques [42]. Those in the SR group are reported to have higher odds of developing AEs than those in the standard surgical technique group.

Three systematic reviews reported postoperative pain [41-43]. Of these, two reviews measured pain within 24 h [42,43]. One review did not specify a timeframe for measuring pain [41]. Similarly to our present findings, two reviews reported a statistically significant difference in participants reporting less pain in the circumcision-device groups [41,43]. In contrast, participants in one review reported having experienced pain similarly across groups [42].

All four reviews consistently reported shorter operative times with circumcision devices in their meta-analysis [40-43]. Notably, three reviews reported a >15 min decrease in operative time. Time-saving may be related to standardised procedures that make devices such as SR and PrePex easy to use.

Similarly to our present results, the four reviews that measured participant satisfaction for penile appearance indicated that participants in the device group were more satisfied than those that received the standard surgical technique [40-43].

The difference between our present review and the four reviews may be due to heterogeneous study populations; the difference in how devices were categorised in our study (crush vs ligature) as mechanisms of action; the need for injectable or topical anaesthesia; device placement and removal; time *in situ* and wound closure techniques may differ between devices within these generic categories [40-43]. One review differed in reporting outcomes such as follow-up times, pain scores, protocols for pain management, participant satisfaction rating and AEs or complications [41]. In our present review, healthcare practitioners performing the procedures did not have similar qualifications across all included trials. These differences may influence operative outcomes as a result of varying surgical skills and expertise.

Device-based circumcision procedures compared to standard surgical techniques are consistently reported to be significantly quicker to conduct and easier to learn and execute, thus, minimising surgical skills and requirements such as injected anaesthesia and suturing. This allows for task-shifting to other mid-level cadres of staff (nurses and medical officers) and has the potential for rapid scale-up of VMMC programmes for HIV prevention in resource-constrained settings [12,44]. Still, this does not eliminate the need for surgical VMMC services, as some patients may not be eligible for a device or would prefer a standard surgical circumcision. Understandably, surgical interventions would be needed for some patients with abnormal foreskin anatomy and in rare instances of device-related complications. Thus, should complications arise, healthcare providers delivering VMMC services must acknowledge their limitations in skills and expertise to know when to refer patients to more qualified clinicians [9].

Conclusion

We found no differences in serious AEs when circumcision was performed using a device, and there may be slightly more moderate AEs than standard surgical techniques. Encouragingly, circumcision devices probably reduce operative time by ~17 min. Patients may feel less postoperative pain within the first 24 h and may slightly prefer using a device rather than standard surgical procedures. Therefore, circumcision devices are an option for clinical practice and may enable task-shifting to different healthcare workers as they represent a simpler procedure. However, the results of our systematic review should be considered in conjunction with other contextual factors such as cost, patient preferences and values, and access to trained, skilled healthcare workers and healthcare in some settings.

Acknowledgements

The authors would like to acknowledge support received from Cochrane South Africa, South African Medical Research Council. Sumayyah Ebrahim received a travel allowance from Cochrane South Africa, South African Medical Research Council, for travel to Cape Town (22–23 May 2017) to work on the review. We thank Cochrane Urology, our Contact Editor Philipp Dahm and Managing Editor Robert Lane for the support we received. We acknowledge the support received from those contacted via task exchange Nai Ming Lai, Shenxing Du, Xun Li, Ruo-Wen Jiang and Yijun Cai and Joy Oliver and Elizabeth Pienaar who assisted us with developing the search strategy and conducting the searches.

Conflict of Interest

Tamara Kredo is partly supported by the Research, Evidence and Development Initiative (READ-It) project. READ-It (Project number 300342-104) is funded by UK aid from the UK government; however, the views expressed do not necessarily reflect the UK government's official policies. The remaining authors declare to having no conflict of interest or external funding to disclose.

References

1 **Malone P, Steinbrecher H.** Medical aspects of male circumcision. *BMJ* 2007; 335: 1206–90

2 **World Health Organization Department of Reproductive Health and Research Joint United Nations Programme on HIV AIDS (UNAIDS).**

Male Circumcision: Global Trends and Determinants of Prevalence, Safety and Acceptability. [Internet]. Geneva: World Health Organization and United Nations Programme on HIV/AIDS; 2007 [updated 2007]. Available at: https://www.who.int/reproductivehealth/publications/rtis/9789241596169/en/. Accessed July 2021

3 **Morris B**, **Kennedy S**, **Wodak A et al**. Early infant male circumcision: systematic review, risk-benefit analysis, and progress in policy. *World J Clin Pediatr* 2017; 6: 89–102

4 **Siegfried N**, **Muller M**, **Deeks JJ**, **Volmink J**. Male circumcision for prevention of heterosexual acquisition of HIV in men. *Cochrane Database Syst Rev* 2009; 2: CD003362

5 **World Health Organization/ United Nations Programme on HIV AIDS**. *Joint Strategic Action Framework to Accelerate the Scale-up of Voluntary Medical Male Circumcision for HIV Prevention in Eastern and Southern Africa, 2012–2016*. [Internet]. Geneva: World Health Organization; 2011 [updated 2011]. Available at: https://www.who.int/hiv/pub/strategic_action2012_2016/en/. Accessed July 2021

6 **Alanis MC**, **Lucidi RS**. Neonatal circumcision: a review of the world's oldest and most controversial operation. *Obstet Gynecol Surv* 2004; 59: 379–95

7 **Bakare N**, **Miller V**. *Meeting the Demand for Male Circumcision*. [Internet] Kampala, Uganda: Forum for Collaborative HIV Research; 2008 [updated 2008]. Available at: https://forumresearch.org/storage/documents/MaleCircumcisionDemand/final%20report.pdf. Accessed July 2021

8 **World Health Organization**. *Framework for Clinical Evaluation of Devices for Male Circumcision*. [Internet]. Geneva: World Health Organization; 2012. Available at: https://apps.who.int/iris/bitstream/handle/10665/75954/9789241504355_eng.pdf;jsessionid=C87C87E8411F3B5356FC8C23ECD763AD?sequence=1. Accessed July 2021

9 **World Health Organization**. *Guideline on the Use of Devices for Adult Male Circumcision for HIV Prevention*. [Internet]. Geneva: World Health Organization; 2012. Available at: https://www.who.int/publications/i/item/9789241506267. Accessed July 2021

10 **Millard PS**, **Wilson HR**, **Veldkamp PJ**, **Sitoe N**. Rapid, minimally invasive adult voluntary male circumcision: A randomised trial. *S Afr Med J* 2013; 103: 736–41

11 **Peng YF**, **Cheng Y**, **Wang GY et al**. Clinical application of a new device for minimally invasive circumcision. *Asian J Androl* 2008; 10: 447–54

12 **Ridzon R**, **Reed JB**, **Sgaier SK**, **Hankins C**. VMMC devices-introducing a new innovation to a public health intervention. *JAIDS* 2016; 72: S1–4

13 **World Health Organization**. *WHO Technical Advisory Group on Innovations in Male Circumcision: Evaluation of Two Adult Devices: Meeting report*. Geneva: Worls Health Organization: 2013

14 **Mutabazi V**, **Kaplan SA**, **Rwamasirabo E et al**. HIV prevention: Male circumcision comparison between a nonsurgical device to a surgical technique in resource-limited settings a prospective, randomized. Nonmasked Trial. *JAIDS* 2012; 61: 49–55

15 **Krieger JN**, **Bailey RC**, **Opeya J et al**. Adult male circumcision: results of a standardized procedure in Kisumu District. Kenya. *BJU Int* 2005; 96: 1109–13

16 **World Health Organization**. *WHO Technical Advisory Group on Innovations in Male Circumcision, Meeting report, 30 September-2 October 2014*, Geneva: World Health Organization: 2014

17 **Shaik MZ**, **Ebrahim S**, **Kredo T**. Circumcision devices versus standard surgical techniques in adolescent and adult male circumcisions. *Cochrane Database Syst Rev* 2016; 6: CD012250

18 **Hohlfeld A**, **Ebrahim S**, **Shaik MZ**, **Kredo T**. Circumcision devices versus standard surgical techniques in adolescent and adult male circumcisions. *Cochrane Database Syst Rev* 2021; 3:CD012250.

19 **Higgins J**, **Deeks JJ**, **Altman DG**. Special topics in statistics. In: **Higgins JP**, **Green S**, eds, *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0.*, Chapt 16. Oxford, UK: The Cochrane Collaboration; 2011.

20 **Nordic Cochrane Centre**. *The Cochrane Collaboration Review Manager 5 (RevMan 5)*. 5.3 edn. Copenhagen, Denmark: Copenhagen Nordic Cochrane Centre, The Cochrane Collaboration, 2014.

21 **Higgins JP**, **Thompson SG**, **Deeks JJ**, **Altman DG**. Measuring inconsistency in meta-analyses. *BMJ* 2003; 327: 557–60

22 **Higgins JP**, **Thompson SG**. Quantifying heterogeneity in a meta-analysis. *Stat Med* 2002; 21: 1539–58

23 **Guyatt GH**, **Oxman AD**, **Kunz R**, **Vist G**, **Falck-Ytter Y**, **Schunemann H**. GRADE: what is "quality of evidence" and why is it important to clinicians? *BMJ (Clinical Research Ed)* 2008; 336: 995–8

24 **Huo Z**, **Liu G**, **Wang W et al**. [Clinical effect of circumcision stapler in the treatment of phimosis and redundant prepuce] [Article in Chinese]. *Zhonghua Nan Ke Xue* 2015; 21: 330–3

25 **Jin X**, **Lu J**, **Liu W et al**. Adult male circumcision with a circular stapler versus conventional circumcision: A prospective randomized clinical trial. *Braz J Med Biol Res* 2015; 48: 577–82

26 **Kanyago S**, **Riding DM**, **Mutakooha E**. Shang Ring versus forceps-guided adult male circumcision: a randomized controlled effectiveness study in southwestern Uganda. *JAIDS* 1999; 2013: 130

27 **Lagarde E**, **Taljaard D**, **Puren A**, **Auvert B**. High rate of adverse events following circumcision of young male adults with the Tara KLamp technique: a randomised trial in South Africa. *S Afr Med J* 2009; 99: 163–9

28 **Li HN**, **Xu J**, **Qu LM**. [Shang Ring circumcision versus conventional surgical procedures: comparison of clinical effectiveness] [Article in Chinese]. *Zhonghua Nan Ke Xue* 2010; 16: 325–7

29 **Li S**, **Zhang L**, **Wang DW et al**. [Clinical application of the disposable circumcision suture device in male circumcision] [Article in Chinese]. *Zhonghua Nan Ke Xue* 2014; 20: 816–9

30 **Lv BD**, **Zhang SG**, **Zhu XW et al**. Disposable circumcision suture device: clinical effect and patient satisfaction. *Asian J Androl* 2014; 16: 453

31 **Miao H**, **Lu J**, **Lu F**, **Shen F**, **Yuan X**, **Liu H**. [Clinical effects of the circumcision stapler, foreskin cerclage, and traditional circumcision: a comparative study] [Article in Chinese]. *Zhonghua Nan Ke Xue* 2015; 21: 334–7

32 **Millard PS**, **Wilson HR**, **Goldstuck ND**, **Anaso C**. Rapid, minimally invasive adult voluntary male circumcision: a randomised trial of Unicirc, a novel disposable device. *S Afr Med J* 2014; 104: 52–7

33 **Pang G**, **Zheng D**, **Chen S**. Disposable circumcision suture device vs conventional circumcision of compare the clinical effect. *Mod Diagn Treat* 2015; 26: 210–1

34 **Ren Y**, **Gao X**, **Gong J**, **Wei C**, **An J**. Disposable circumcision suture device of curative effect analysis. *J Med Theory Pract* 2014; 27: 3147–9

35 **Shenje J**, **Millard PS**. Sutureless adult voluntary male circumcision with topical anesthetic: a randomized field trial of Unicirc, a single-use surgical instrument. *PLoS One* 2016; 11: e0157065

36 **Sokal DC**, **Li PS**, **Zulu R et al**. Randomized controlled trial of the shang ring versus conventional surgical techniques for adult male circumcision: safety and acceptability. *JAIDS* 2014; 65: 447–55

37 **Tshimanga M**, **Mangwiro T**, **Mugurungi O et al**. A phase II randomized controlled trial comparing safety, procedure time, and cost of the PrePex™ device to forceps guided surgical circumcision in Zimbabwe. *PLoS One* 2016; 11: e0156220

38 **Wang J**, **Zhou Y**, **Xia S et al**. Safety and efficacy of a novel disposable circumcision device: a pilot randomized controlled clinical trial at 2 centers. *Med Sci Monit* 2014; 20: 454

39 **Wang H**, **Chen N**, **Huo R**, **Yang J**, **Li X**, **Xing N**. Evaluation of clinical curative effects of disposable stitching instrument in redundant prepuce patients. *Exp Ther Med* 2017; 14: 298–302

40 **Cao D**, **Liu L**, **Hu Y et al**. A systematic review and meta-analysis of circumcision with Shang Ring vs conventional circumcision. *Urology* 2015; 85: 799–804

41 **Fan Y**, **Cao D**, **Wei Q et al**. The characteristics of circular disposable devices and in situ devices for optimizing male circumcision: a network meta-analysis. *Sci Rep* 2016; 6: 1–10

42 **Huang C**, **Song P**, **Xu C**, **Wang R**, **Wei L**, **Zhao X**. Comparative efficacy and safety of different circumcisions for patients with redundant prepuce or phimosis: a network meta-analysis. *Int J Surg* 2017; 43: 17–25

43 **Huo Z-C**, **Liu G**, **Li X-Y et al**. Use of a disposable circumcision suture device versus conventional circumcision: a systematic review and meta-analysis. *Asian J Androl* 2017; 19: 362

44 **Barone MA**, **Li PS**, **Awori QD**, **Lee R**, **Goldstein M**. Clinical trials using the Shang Ring device for male circumcision in Africa: A review. *Transl Androl Urol* 2014; 3: 113–24

Correspondence: Ameer Steven-Jorg Hohlfeld, Cochrane South Africa, South African Medical Research Council, Cape Town, Tygerberg, 7505, South Africa.

e-mails: ameer.hohlfeld@mrc.ac.za; ameersjh@gmail.com

Abbreviations: AE, adverse event; GRADE, Grading of Recommendations, Assessment, Development, and Evaluation; MD, mean difference; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-analyses; RCT, randomised controlled trial; RR, risk ratio; VAS, visual analogue scale; VMMC, voluntary medical male circumcision; WHO, World Health Organization.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Characteristics of the included studies.
Appendix S1. Summary of the excluded studies.