Prognostic influence of the amputation level on outcomes following the reconstruction of circumcision-related penile amputation: A systematic review

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Abstract. Penile amputation is a rare, yet severe complication of circumcision, posing substantial physical, psychological and social burdens. Surgical outcomes are largely determined by the level of amputation and the timing of the intervention. The present systematic review evaluated the prognostic implications of the amputation level on functional recovery, aesthetic outcomes and post-operative complications. Utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, 28 studies comprising 102 cases were included. Amputation levels were classified as glans-only (n=60), glans with corpora (n=3) and below corpora (n=39). Glans-only amputations demonstrated optimal outcomes with the favorable restoration of urinary and erectile function and low complication rates. Amputations below the corpora, despite increased complexity, exhibited satisfactory results when managed promptly due to preserved vascular integrity. By contrast, injuries involving both the glans and corpora exhibited the highest complication rates, often requiring complex reconstructive procedures. On the whole, these findings indicate that the amputation level is a key prognostic factor in penile reconstruction. Future multicenter and prospective studies are warranted to standardize treatment protocols and explore advancements in reconstructive surgery.

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Abbreviations: JBI, Joanna Briggs Institute; PICO, patient interventions comparisons outcomes; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses

Key words: penile amputation, circumcision complications, reconstruction, functional recovery, aesthetic outcomes

Introduction

Circumcision is a widely practiced surgical procedure performed globally for religious, cultural and medical reasons. While it is generally considered safe, the procedure carries the risk of rare, yet severe complications, such as penile amputation. These complications often stem from improper techniques or unskilled practitioners. Such injuries not only result in substantial physical impairment, but also cause profound psychological and social consequences for the affected individuals. To address these challenges, microsurgical techniques have been developed as advanced reconstructive options, aiming to restore both the functional and aesthetic aspects of the penis. Achieving satisfactory recovery in terms of urinary and sexual function, alongside acceptable cosmetic outcomes, is crucial for improving the overall well-being and quality of life of patients (1,2).

Despite its rarity, penile amputation due to circumcision represents a marked medical and psychosocial burden. The likelihood of such injuries occurring depends largely on the operator's expertise and the technique employed (2). Beyond the immediate physical trauma, patients may experience long-term psychological effects, including anxiety, depression and social stigma. These issues highlight the urgency of timely and effective surgical intervention. However, the path to recovery is complex, encompassing not only surgical restoration, but also long-term rehabilitation efforts, particularly regarding urinary and sexual function, and the need for comprehensive psychological support (1,3).

Clinical outcomes following penile amputation and reconstruction vary significantly, particularly depending on the level of amputation. Understanding how the extent and location of the injury affect functional and aesthetic recovery is essential for optimizing both surgical approaches and rehabilitation plans. However, to the best of our knowledge, systematic analyses of the prognostic factors influencing these outcomes remain limited, resulting in critical knowledge gaps that hinder improvements in clinical decision-making and patient counseling (1,3).

The present systematic review thus aimed to investigate the prognostic impact of the amputation level on the outcomes of microsurgical reconstruction, focusing on functional recovery,

aesthetic results and complication rates. By identifying key outcome-related factors, the present systematic review aimed provide information which may enhance surgical strategies and improve the standards of patient care. Ultimately, it is hoped that the findings presented herein may contribute to improved clinical outcomes and quality of life of individuals undergoing reconstruction following circumcision-related penile amputation, while also equipping healthcare providers with the knowledge needed to provide more accurate guidance and set realistic expectations for recovery.

Data and methods

The present systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. A systematic search was performed across multiple databases, including PubMed, ScienceDirect and the Cochrane Controlled Trials Register, and Google Scholar to identify relevant studies. The search was conducted on December 7, 2024. The search terms used included the following: 'penile amputation', 'circumcision complications', 'penile amputation reconstruction', 'penile replantation', 'amputation level', 'functional recovery', 'aesthetic outcomes', 'surgical complications.' No restrictions were applied to the publication dates.

The present systematic review was written based on the PRISMA 2020 guidelines with the patient interventions comparisons outcomes (PICO) approach, as demonstrated in Table I. The PICO used in the present systematic review are described below:

Eligibility criteria. The eligibility criteria for the present systematic review were defined using the PICO framework. Studies included in the systematic review focused on patients who experienced penile amputation as a result of complications from circumcision, with a particular emphasis on categorizing these cases by the level of amputation, which are glans-only, glans and corpora, and below corpora. Comparisons between the outcomes of the level of penile amputations were also a key inclusion factor. Eligible studies reported on functional outcomes, such as erectile and urinary function, aesthetic results and complication rates. Furthermore, only studies published in the English language were considered for inclusion. Studies were excluded if they involved non-human subjects. This comprehensive set of criteria was designed to ensure that the included studies were both relevant to the research question and methodologically robust.

Outcomes. The primary outcome of the present systematic review was overall functional recovery, which was assessed as a time-to-event outcome from the time of reconstruction to the achievement of functional outcomes, such as restored urinary function and erectile capability. Secondary outcomes included aesthetic outcomes, measured as patient and/or clinician satisfaction with the cosmetic appearance of the reconstructed penis, and complication rates, defined as the occurrence of any adverse events related to the reconstruction procedure. Functional recovery outcomes included the restoration of urinary function, defined as normal urinary stream and continence, and sexual function, evaluated through reports of erectile function and nocturnal erections. Aesthetic outcomes were evaluated based on subjective and/or objective assessments, such as validated scales or qualitative descriptions provided by the included studies. Complication rates cover issues, such as vascular congestion, necrosis, urethral stricture, infection and other adverse events, assessed from the time of surgery to the latest follow-up reported in the studies.

Data extraction. Data extraction was performed independently by two reviewers (YHS and BHRM). The following data were extracted from each included study: author and year of publication, study design, country of study, demographic characteristics of the patients (age, level of penile amputation, circumcision technique and operator), reconstruction technique, primary outcomes assessed (e.g., functional recovery, aesthetic outcomes, and complication rates) and summary results for each outcome. Any discrepancies between reviewers were resolved through discussion, with a third reviewer consulted when necessary. A standardized data extraction form was used to ensure consistency and minimize errors throughout the data collection process.

Study quality assessment and data synthesis. Of note, two authors (YHS and BHRM) independently performed the quality assessment of the included studies using the Joanna Briggs Institute (JBI) critical appraisal checklist for case reports and series. Any discrepancies were resolved through discussion.

Results

Study selection. A total of 439 records were initially identified. After removing 214 duplicates, 225 titles and abstracts were screened. Subsequently, 175 articles were excluded for not meeting inclusion criteria. A total of 50 articles were reviewed in full-text, and 22 articles were further excluded due to insufficient data or irretrievability. A final total of 28 studies were included in the present systematic review (1,4-30), consisting of 22 case reports, 4 case series, and 2 retrospective studies (Fig. 1).

Patient characteristics. Across the 28 studies, 102 cases of penile amputation following circumcision were identified. The age of the patients ranged from 7 days to 22 years, with the majority of cases (≥70%) occurring in children <10 years of age. The cases were classified based on the level of amputation into three groups as follows: Glans-only (n=60), glans with corpora (n=3) and below the corpora (n=39). Circumcision procedures were performed by non-healthcare providers (n=66), non-doctor healthcare workers (n=25) and medical doctors (n=5). A variety of circumcision techniques were documented, including guillotine, forceps-guided, Mogen clamp and ritual methods (Table II).

Treatment and outcomes. Treatment approaches were categorized as reconstructive surgery (n=72), primary anastomosis (n=16), reattachment (n=10) and conservative management (n=4). Techniques varied depending on the level of injury and included oral mucosa grafts, skin grafts, groin flaps and

Table I. PICO of the study.

Patient/Problem (P)	Intervention (I)	Comparison (C)	Outcome (O)
Patients with penile amputation due to circumcision complications who undergo reconstruction	Level of the penile amputation	-	Functional recovery, aesthetic outcomes, and complication.

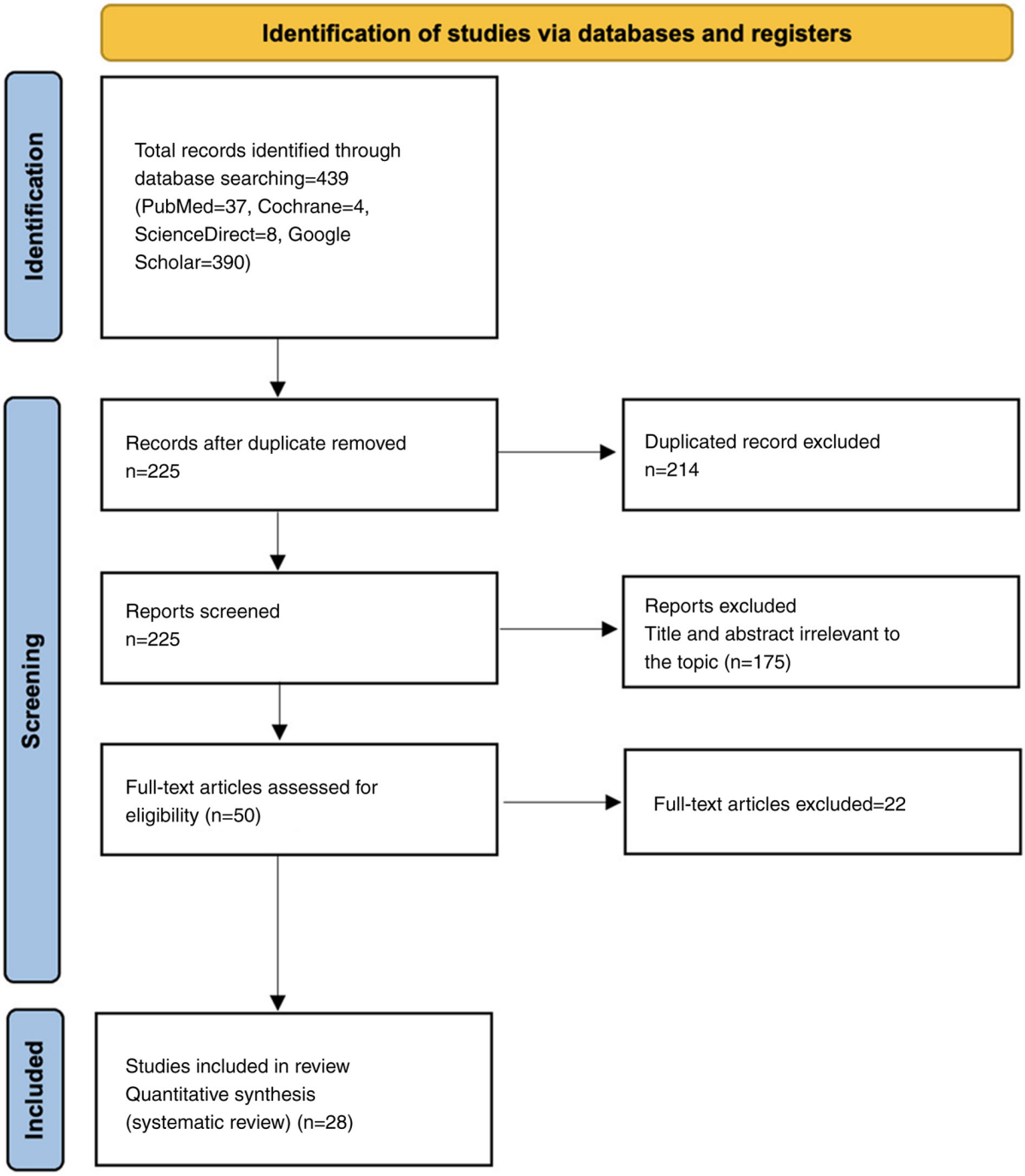

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) literature flow chart.

microsurgical replantation. Aesthetic and functional outcomes were reported as favorable in the majority of cases, with restoration of urinary function, penile length and erectile capability. Notably, successful cases exhibited viable grafts, normal urinary stream, preserved sensation and morning erections (Table III).

Table II. Information of the included studies and characteristics of the patients in the included studies.

First author	Year of publication	Study design	Country	No. of cases	Age (years) of the patients	Level of amputation	Operator of circumcision	Technique of circumcision	Treatment	Outcome	(Refs.)
Soltani	2020	Case report	Iran	1	4	Glans	General practitioner	Mogen clamp	Reimplantation with urethral and glans anastomosis, pentoxifylline	Normal voiding, satisfactory cosmesis, resolved ischemia	(1) (4)
Ahmed	2021	Case report	Yemen	1	0.42 (5 months)	Glans	Traditional circumciser	Mogen clamp	Debridement, wound care, suprapubic catheterization	Parents withdrew, future surgical reconstruction planned	
Akram	2021	Case report	India	1	5	Glans	Traditional practitioner	Ritual circumcision	Amputation of gangrenous portion, referral for delayed reconstruction	Gangrenous portion removed, referred for specialist reconstruction	(5)
Appiah	2014	Case report	Ghana	1	3	Glans	Traditional circumcisionist	Guillotine-type	Glanuloplasty with oral mucosa graft	Satisfactory cosmetic and functional outcomes	(6)
Banihani	2014	Case report	USA	1	Neonate (7 days)	Shaft	Layman	Mogen clamp	Replantation using microvascular anastomosis and leech therapy	Good graft viability, superficial necrosis treated conservatively	(7)
Cook	2005	Case report	Canada	1	Neonate	Glans	Non-urologist	Sheldon clamp	Buccal mucosa graft for coronal sulcus reconstruction	Good cosmesis and function	(8)
Dar	2023	Case report	Saudi Arabia	1	6	Glans	Grand-father	Guillotine-type	Full-thickness skin graft from groins	Well-taken grafts, family satisfied with results	(9)
Faydaci	2011	Case report	Turkey	1	7	Glans	Non-surgeon	Clamp	Primary anastomosis with hyperbaric oxygen therapy	Excellent cosmetic and functional results	(10)
Giovanny	2018	Case report	Indonesia	1	5	Glans	Medical doctor	Guillotine-type	Neo-glans reconstruction with buccal mucosa graft	Healthy graft simulating glans, good cosmetic outcome	(11)

Table II. Continued.

First author	Year of publication	Study design	Country	No. of cases	Age (years) of the patients	Level of amputation	Operator of circumcision	Technique of circumcision	Treatment	Outcome	(Refs.)
Gluck-man	1995	Case report	USA	1	Neonate	Glans	Non-urologist	Sheldon clamp	Reattachment with microvascular techniques	Glans hypoplasia	(12)
Hanash	1981	Case report	Saudi Arabia	1	22	Midshaft	Layman	Guillotine-type	Plastic penile reconstruction using split-thickness skin graft	Satisfactory cosmetic and functional results, restored erectile function	(13)
Hashem	1999	Case report	Saudi Arabia	1	4	Corpus penis amputation	Family member	Ritual circumcision	Microsurgical penile replantation	Viable penis with restored tactile sensation, erectile function unassessed due to age	(14)
Ince	2013	Case report	Turkey	1	8	Corpus penis amputation	Layman	Electro-cautery	Groin flap surgery with re-epitheliali-zation	Good voiding and erectile function, minimal tissue loss and scars	(15)
Khaired-dine	2014	Case report	Tunisia	2	3 and 5	Distal penile glans	Urologist and GP	Clamp	Reattachment with Foley catheter and interrupted sutures	Good penile cosmesis, glans sensation, morning erections maintained	(16)
Ozkan	1997	Case report	Turkey	1	10	Shaft	Religious circumciser	Guillotine-type	Reconstruction with advanced dorsal penile artery and glans reattachment	Glans necrosis	(17)
Petrella	2021	Case report	Canada	1	0.03 (12 days)	Glans	Experienced practitioner	Mogen clamp	Reimplantation of glans with 7-0 sutures, no vascular anastomosis	Good cosmesis and function, viable glans after repair	(18)
Sharma	2022	Case report	India	1	14	Partial glans	Religious worker	Ritual circumcision	End-to-end urethro-plasty and glansplasty	Healthy wound, nocturnal erections at 2-month follow-up	(19)
Sheikh	2023	Case report	Somalia	1	0.02 (7 days)	Complete shaft amputation	Untrained practitioner	Cautery	Debridement, catheter placement, conservative wound care	Healed wound,l norma urine stream at follow-up	(20)

Table II. Continued.

First author	Year of publication	Study design	Country	No. of cases	Age (years) of the patients	Level of amputation	Operator of circumcision	Technique of circumcision	Treatment	Outcome	(Refs.)
Tawaran-urak	2023	Case report	Thailand	1	8	Complete shaft amputation	Imam (religious leader)	Ritual circumcision	Microsurgical replantation with reattachment of vessels, nerves, and urethra	Good cosmetic and functional outcomes, normal voiding, morning erections	(21)
Van der Merwe	2017	Case report	South Africa	1	21	Distal glans	Traditional circumcisionist	Ritual Circumcision	Penile allotransplantation, immunosuppression, rehabilitation therapy	Normal erectile and voiding functions, substantial quality-of-life improvements	(22)
Yilmaz	1993	Case report	Turkey	1	10	Distal glans	Traditional circumcisionist	Clamp	Reattachment with microsurgical techniques and stenting	Excellent cosmetic result, restored glans sensation, and normal voiding	(23)
Yosra	2020	Case report	Tunisia	1	4	Glans	Retired nurse	Improvised	Glans reattachment using spongiocavernosal shunt, urethral and glans repair	Good vitality, normal urinary stream, satisfactory cosmesis	(24)
Pippi Salle	2013	Case series	Canada, USA	6	0.03 (12 days)	Glans	Non-specialized providers	Mogen clamp	Free composite graft (n=2), delayed glansplasty (n=2), buccal mucosa graft (n=1), did not undergo reconstruction (n=1)	Stenosis urethra (n=1) in glansplasty, mild glanular deformity and slight meatal deformity (n=1) in patient whom did not undergo reconstruction	(25)
Manentsa	2019	Case series	South Africa	3	10, 10 and 15	Glans below the coronal sulcus, glans.	Medical officers	Forceps-guided circumcision	Urgent reattachment (n=1), reconstruction (n=2)	Fistula (n=1) in reattachment, fistula and necrotic glans (n=1) in reconstruction, and normal function and cosmetic (n=1)	(26)

Table II. Continued.

First author	Year of publication	Study design	Country	No. of cases	Age (years) of the patients	Level of amputation	Operator of circumcision	Technique of circumcision	Treatment	Outcome	(Refs.)
Shaeer	2008	Case series	Egypt	32	0.2-6 years	Shaft	Not mentioned	Clamp (25 cases) or thermal injury (7 cases)	A-Y plasty to elongate penis, burial technique (n=32)	Normal penile length restored, good cosmetic and functional outcomes (n=32), better outcome in patients who presented early than late	(27)
Sherman	1996	Case series	USA	7	0.02 (8 days) to 5 months	Glans and distal urethra (n=7)	Physicians and ritual Mohel	Mogen clamp, shield	Reanastomosis and reconstruction of glans, urethra, stenting	Acceptable cosmetic outcomes, one fistula requiring further repair in urethral injury (n=1)	(28)
Lucas	2020	Retros-pective	Multiple (Africa)	24	Mean (range): 10 (<1-14)	Glans penis (9 complete, 13 partial, 1 degree not specified)	VMMC providers	Forceps-guided/ Dorsal slit/Mogen	Reconstruction (n=24)	8 Injuries healing well at last report; 2 partial amputation, 1 complete amputation, 1 amputation degree not specified, 4 laceration. 16 patients not healing well (clinical situation not mentioned)	(29)
Raisin	2020	Retros-pective	Israel	8	0.02 (7-9 days)	Glans	Laypeople	Ritual circumcision	Primary glans anastomosis (n=3) and urethroplasty for urethral injuries (n=5)	Good cosmetic and functional results, hypospadias in 2 cases with urethral injury	(30)

Table III. Outcomes of each group level of amputations.

Level of amputation	Total no. of cases	Treatment	Total no. of cases	Outcomes
Glans	60	Reconstructive surgery	37	The majority of cases achieved good cosmetic and functional outcomes, including normal voiding, erectile function, and substantial quality-of-life improvements. Several cases reported restored glans sensation, morning erections, and family satisfaction with graft results. However, complications included glans hypoplasia, urethral stenosis, mild glanular deformity, and slight meatal deformity in patients withoutreconstruction. Urethral injuries resulted in hypospadias (n=2), fistulas (n=2), and necrotic glans in some reconstructions. Additionally, 8 injuries healed well, while 16 did not, though their clinical situations were unspecified. A few cases required further surgical interventions, such as for gangrene or fistula repair, with one patient withdrawing from care and others achieving variable results.
		Reattachment techniques	5	Cases achieved excellent cosmetic and functional outcomes, including restored sensation, normal voiding, and family satisfaction. Some required future surgical intervention for complications like gangrene or hypoplasia, while others had satisfactory but suboptimal results (n=5).
		Primary anastomosis	15	Good cosmetic outcomes overall, with urethral injuries leading to complications such as hypospadias (n=2) and one fistula requiring further repair.
		Wound care and conservative	3	Cases requiring future surgical intervention due to poor functional and cosmetic outcomes, including one where parents withdrew from immediate care and another involving removal of gangrenous tissue with referral for specialist reconstruction
Glans and corpora	3	Reconstructive surgery	2	Fistula and necrotic glans (n=1) in reconstruction, and normal function and cosmetic (n=1)
		Reattachment techniques	1	Fistula was found in patient
		Primary anastomosis	-	-
		Wound care and conservative	-	-
Below corpora	39	Reconstructive surgery	33	Normal penile length restored, good cosmetic and functional outcomes (n=32), better outcome in patients who presented early than late. Glans necrosis in 1 patient
		Reattachment techniques	4	Overall satisfactory outcomes with restored or maintained functionality, good cosmetic appearance, minimal complications such as superficial necrosis or tissue loss, and cases of erectile function restoration or preserved voiding capability. No complication was found.
		Primary anastomosis	1	Good cosmetic and functional outcomes, normal voiding, good morning erections.
		Wound care and conservative	1	Healed wound, normal urine stream at follow-up.

Quality assessment. All included studies underwent quality evaluation using the JBI checklist for case reports and case series. The majority of studies met essential quality criteria, although heterogeneity in reporting and follow-up duration was observed (Table IV).

Discussion

The present systematic review analyzed 102 cases of penile amputation resulting from circumcision complications, with the majority affecting children under the age of 10 years. Amputations were categorized into three levels as follows: Glans-only, glans with corpora and below the corpora. Among these, glans-only amputations were the most common, followed by below corpora, while amputations involving both the glans and corpora were relatively rare (1,4,5,7-30).

The level of amputation was closely associated with post-operative outcomes, primarily influenced by the extent of vascular and neural damage. In glans-only amputations, outcomes were generally favorable due to the preservation of deep erectile and vascular structures. Being a superficial structure, the glans is often amenable to reattachment or reconstruction, enabling restoration of urinary flow, erectile function, and cosmetic appearance (4,28). These patients experienced fewer complications, such as urethral stenosis or fistulas, as the integrity of deeper structures remained intact, simplifying surgical intervention (13,26).

Supporting these findings, successful management of penile amputations, including glans injuries, has been reported using stump-plasty and microsurgical techniques, often resulting in minimal complications and favorable functional outcomes (31,32). This reinforces the notion that superficial injuries with preserved vasculature and nerves offer the best prognosis.

By contrast, amputations below the corpora, while more severe, can still yield excellent outcomes if managed promptly. Successful recovery in these cases depends heavily on the timely re-establishment of vascular flow. Prompt microsurgical intervention minimizes complications like necrosis and tissue loss (17,18,25). When vascular structures remain viable, patients can achieve near-normal penile length and function. These findings emphasize the critical importance of early surgical management to optimize recovery (18,27).

On the other hand, amputations involving both the glans and corpora present the most complex challenges. The involvement of deeper erectile tissues and their intricate vascular supply demands more extensive reconstruction, often involving flap-based or grafting techniques (19,20,27). These procedures are associated with higher rates of complications, such as vascular congestion, necrosis, fistulas, and urethral strictures, requiring potential follow-up surgeries. Despite some degree of recovery, outcomes in this group remain highly variable (32,33).

Across all amputation levels, the selection and timing of surgical techniques were decisive in determining success. Glans-only injuries responded well to simple reattachment techniques. such as microsurgical anastomosis of vessels and nerves, yielding excellent aesthetic and functional results (15). In below corpora injuries, early revascularization through advanced microsurgical techniques was vital, reducing complications and preserving function. For glans with corpora injuries, the need for complex reconstruction resulted in higher complication rates, underscoring the need for refined surgical strategies and innovations (17,18,25,26).

A consistent theme across the reviewed literature was the impact of untrained practitioners and non-standardized techniques in causing severe injuries. Devices such as guillotines, Mogen clamps, Sheldon clamps and electrocautery, when used improperly by traditional circumcisers or untrained individuals, significantly contributed to these complications (17-20,25,27,28,30). By contrast, procedures carried out by trained medical professionals using standardized methods, such as forceps-guided circumcision, resulted in substantially fewer adverse outcomes. These findings underscore the urgent need for public education, practitioner training, and implementation of standardized protocols to prevent such preventable injuries.

Setting realistic expectations for patients undergoing penile reconstruction is equally important. Patients should be informed about the possibilities and limitations of recovery, including urinary and sexual function, aesthetic outcomes and potential complications, such as sensory changes or erectile dysfunction (21-24,32). Satisfaction rates following reconstruction vary from 67 to 100%, depending on injury severity and technique used. Clear communication, as recommended by the Asia Pacific Society of Sexual Medicine guidelines, helps manage anxiety and builds patient trust by anticipating the need for secondary procedures and managing outcomes (31,33).

In addition to clinical considerations, ethical, cultural and legal aspects surrounding non-medical circumcision merit deeper attention. A number of the reported complications occurred during ritual or traditional circumcision performed by untrained individuals, often without proper consent or regulation. This raises serious ethical concerns, particularly when performed on minors who cannot provide informed consent. Culturally, circumcision holds significant religious and traditional value in various communities, which can complicate efforts to enforce medical standards. Legally, numerous countries lack clear regulatory frameworks to govern non-medical circumcision, leading to inconsistent oversight and limited accountability. These issues highlight the urgent need for public health education, community engagement, and the establishment of culturally sensitive but medically sound guidelines to prevent harm while respecting cultural practices.

The present systematic review contributes to the understanding of penile amputation outcomes by linking surgical success to amputation level and intervention strategy. By systematically classifying cases and analyzing prognostic factors, it provides a practical foundation for improving tailored surgical planning and patient counseling.

To build upon these findings, future research should consider the establishment of a prospective registry or multicenter study to systematically capture standardized data on penile amputation and reconstruction outcomes. A multicenter approach would help overcome sample size limitations and heterogeneity, allowing for more robust statistical analysis and generalizable conclusions.

Additionally, technological advancements in surgery, such as tissue engineering, regenerative medicine and telehealth-assisted surgical planning, hold promise for improving

Table IV. JBI critical appraisal of the studies.

First author	Question									
	Were patient demographic characteristics clearly described?	Was the patients' history clearly described and presented as a timeline?	Was the current clinical condition of the patient on presentation clearly described?	Were diagnostic tests or assessment methods and the results clearly described?	Was the intervention(s) or treatment procedure(s) clearly described?	Was the post-intervention clinical condition clearly described?	Were adverse events (harms) or unanticipated events identified and described?	Does the case report provide takeaway lessons?	Overall appraisal	(Refs.)
Soltani.	Y	Y	Y	Y	Y	Y	U	Y	Include	(1)
Ahmed	Y	Y	Y	Y	Y	Y	Y	Y	Include	(4)
Akram	Y	Y	Y	Y	Y	Y	Y	Y	Include	(5)
Appiah	Y	Y	Y	Y	Y	Y	Y	Y	Include	(6)
Banihani	Y	Y	Y	Y	Y	Y	Y	Y	Include	(7)
Cook	Y	Y	Y	Y	Y	N	Y	Y	Include	(8)
Dar	Y	Y	Y	Y	Y	Y	Y	Y	Include	(9)
Faydaci	Y	Y	Y	Y	Y	Y	Y	Y	Include	(10)
Giovanny	Y	Y	Y	Y	Y	Y	Y	Y	Include	(11)
Gluckman	Y	Y	Y	Y	Y	Y	U	Y	Include	(12)
Hanash	Y	Y	Y	Y	Y	Y	Y	Y	Include	(13)
Hashem	Y	Y	Y	Y	Y	Y	Y	Y	Include	(14)
Ince	Y	Y	Y	Y	Y	Y	Y	Y	Include	(15)
Khaireddine	Y	Y	Y	Y	Y	Y	Y	Y	Include	(16)
Ozkan	Y	Y	Y	Y	Y	Y	Y	Y	Include	(17)
Petrella	Y	Y	Y	Y	Y	Y	Y	Y	Include	(18)
Sharma	Y	Y	Y	Y	Y	Y	Y	Y	Include	(19)
Sheikh	Y	Y	Y	Y	Y	Y	Y	Y	Include	(20)
Tawaranurak	Y	Y	Y	Y	Y	Y	Y	Y	Include	(21)
Van der Merwe	Y	Y	Y	Y	Y	Y	Y	Y	Include	(22)
Yilmaz	Y	Y	Y	Y	N	Y	Y	Y	Include	(23)
Yosra	Y	Y	Y	Y	Y	Y	Y	Y	Include	(24)
Pippi Salle	Y	Y	Y	Y	Y	Y	Y	Y	Include	(25)
Manentsa	Y	Y	Y	Y	Y	Y	Y	Y	Include	(26)
Shaeer	Y	Y	Y	Y	Y	Y	Y	Y	Include	(27)
Sherman	Y	Y	Y	Y	Y	Y	Y	Y	Include	(28)
Lucas	Y	Y	Y	Y	Y	Y	Y	Y	Include	(29)
Raisin	Y	Y	Y	Y	Y	Y	Y	Y	Include	(30)

Y, yes; N, no; U, unclear.

outcomes in severe penile trauma. These emerging tools may eventually support personalized treatment strategies and more precise reconstruction techniques, especially in complex cases involving extensive tissue loss or delayed presentation.

Another key consideration in the present systematic review is the potential for publication bias, particularly due to the predominance of case reports and small case series. These types of studies are more likely to be published when outcomes are successful or striking, which may overestimate the overall success rates of penile reconstruction procedures.

To ensure consistency during study selection and data extraction, disagreements between authors were resolved through discussion and, when necessary, consultation with a third reviewer. However, inter-rater agreement was not formally quantified. Future reviews could benefit from the use of inter-rater reliability statistics, such as Cohen's kappa, to measure the level of agreement during the screening or quality assessment process.

Nonetheless, the present systematic review also highlights limitations. Variability in reporting outcomes, surgical methods and patient characteristics across studies limits the consistency of conclusions. Moreover, a lack of long-term follow-up data restricts the understanding of the durability of functional and cosmetic outcomes. These gaps point to the need for more robust, standardized and longitudinal research in the future.

In conclusion, the present systematic review demonstrates that the level of penile amputation significantly influences surgical outcomes following circumcision-related injuries. Glans-only amputations yield superior functional and aesthetic results due to the preservation of key structures, while more extensive injuries involving the corpora are associated with higher complication rates and complex reconstruction needs. Timely microsurgical intervention and surgeon expertise play a decisive role in optimizing recovery across all injury levels. Standardizing circumcision practices, strengthening community awareness, and ensuring the involvement of trained medical personnel are essential preventive strategies. Future research is required to focus on prospective, multicenter data collection and technological innovation to enhance the quality, safety and sustainability of penile reconstruction efforts.

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Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors' contributions

YHS, MHW and BHRM were involved in the conception and design of the study. YHS and BHRM were involved in data acquisition. MHW and BHRM were involved in data analysis. YHS and MHW were involved in the drafting of the manuscript, and in the critical revision of the manuscript. YHS and BHRM confirm the authenticity of all the raw data. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

References

1. Soltani S, Mottaghi M, Jafarpisheh A and Tavakkoli M: Penile glans amputation following circumcision: A case report of a rare complication. Case Rep Urol 2020: 5806987, 2020.
2. Rudin Y, Runenko V, Marukhinenko D, D AK, and Rudin A: Penile glans amputation during circumcision: Causes, treatments and preventive measures. Urologiia: 79-86, 2021 (In Russian).
3. Tanyi OA, Aurele MA, Junior MM, Fouda JC, Abessolo O, Jacques NJ, Christain A and Fouda PJ: Traumatic penile amputation post circumcision: A series of 3 cases. Open J Urol 13: 517-524, 2023.
4. Ahmed F, Al-wageeh S, Ghabisha S, Al-Shami E, Al-Naggar K, Obaid G, Eslahi A and Alfaragi M: Catastrophic complications of circumcision by traditional circumcisers. Open Access Emerg Med 13: 425-429, 2021.
5. Aiman Akram S, Ansari Z and Akram S: Delayed gangrene and amputation of penile glans after a religious circumcision in male child-A case report. Trop Doct 51: 663-664, 2021.
6. Appiah K, Amoah G, Azorliade R, Gyasi-Sarpong K, Aboah K, Arthur D, Nyamekye B, Otu-Boateng K, Maison P, Twumasi-Frimpong B, *et al*: Glanuloplasty with oral mucosa graft following total glans penis amputation. Case Rep Urol 2014: 671303, 2014.
7. Banihani OI, Fox JA, Gander BH, Grunwaldt LJ and Cannon GM: Complete penile amputation during ritual neonatal circumcision and successful replantation using postoperative leech therapy. Urology 84: 472-474, 2014.
8. Cook A, Khoury AE, Bagli DJ, Farhat WA and Pippi Salle JL: Use of buccal mucosa to simulate the coronal sulcus after traumatic penile amputation. Urology 66: 1109, 2005.
9. Dar L, Baarimah A, Alshehrani S, Alasiri A, Alassiri M and Al-Ghamdi S: Male genital mutilation in the name of ritual circumcision: A case report and literature review. Case Rep Urol 2023: 9935247, 2023.
10. Faydaci G, Uğur K, Osman C, Şermin Ş and Bilal E: Amputation of glans penis: A rare circumcision complication and successful management with primary anastomosis and hyperbaric oxygen therapy. Korean J Urol 52: 147-149, 2011.
11. Giovanny A, Wahyudi I and Rodjani A: Neo-glans reconstruction after glans amputation during circumcision using autologous buccal mucosal graft. Urol Case Rep 18: 11-13, 2018.
12. Gluckman G, Stoller M, Jacobs M and Kogan B: Newborn penile glans amputation during circumcision and successful reattachment. J Urol 153: 778-779, 1995.
13. Hanash KA: Plastic reconstruction of partially amputated penis at circumcision. Urology 18: 291-293, 1981.
14. Hashem FK, Ahmed S, Al-Malaq AA and AbuDaia JM: Successful replantation of penile amputation (post-circumcision) complicated by prolonged ischaemia. Br J Plast Surg 52: 308-310, 1999.
15. Ince B and Gundeslioglu AO: A salvage operation for total penis amputation due to circumcision. Arch Plast Surg 40: 247-250, 2013.

16. Khaireddine B, Adnen H, Khaled B and Adel S: Surgical reimplantation of penile glans amputation in children during circumcision. Urol Ann 6: 85-87, 2014.
17. Ozkan S and Gurpinar T: A serious circumcision complication: Penile shaft amputation and a new reattachment technique with a successful outcome. J Urol 158: 1946-1947, 1997.
18. Petrella F, Ammar S, El-Sherbiny M and Capolicchio JP: Total glans amputation after neonatal circumcision. Urol Case Rep 37: 101624, 2021.
19. Sharma AP, Yashaswi T, John JR and Singh SK: Iatrogenic partial glanular amputation. Indian J Urol 38: 312-314, 2022.
20. Sheikh OA, Mohamed SS and Sarac A: Penile amputation after neonatal circumcision: A case report. Ann Med Surg (Lond) 85: 4083-4086, 2023.
21. Tawaranurak N, Attawettayanon W, Boonchai S, Chalieopanyarwong V, Chungsiriwattana W and Kongpanichakul L: Successful pediatric penile replantation following amputation during ritual circumcision: A case report and literature review. Am J Case Rep 24: e942448, 2023.
22. van der Merwe A, Graewe F, Zühlke A, Barsdorf NW, Zarrabi AD, Viljoen JT, Ackermann H, Spies PV, Opondo D, Al-Qaoud T, *et al*: Penile allotransplantation for penis amputation following ritual circumcision: A case report with 24 months of follow-up. Lancet 390: 1038-1047, 2017.
23. Yilmaz AF, Sankaya S, Yildiz S and Büyükalpelli R: Rare complication of circumcision: Penile amputation and reattachment. Eur Urol 23: 423-424, 1993.
24. Yosra K, Wiem H and Mourad H: Saving an amputated glans: Role of winter shunt. J Pediatr Urol 16: 238-240, 2020.
25. Pippi Salle JL, Jesus LE, Lorenzo AJ, Romão RL, Figueroa VH, Bägli DJ, Reda E, Koyle MA and Farhat WA: Glans amputation during routine neonatal circumcision: Mechanism of injury and strategy for prevention. J Pediatr Urol 9: 763-768, 2013.
26. Manentsa M, Mukudu H, Koloane N, Ringane A, Matta E, Martinson NA and Lebina L: Complications of high volume circumcision: Glans amputation in adolescents; a case report. BMC Urol 19: 65, 2019.
27. Shaeer O: Restoration of the penis following amputation at circumcision: Shaeer's A-Y plasty. J Sex Med 5: 1013-1021, 2008.
28. Sherman J, Borer J, Horowitz M and Glassberg K: Circumcision: Successful glanular reconstruction and survival following traumatic amputation. J Urol 156: 842-844, 1996.
29. Lucas TJ, Toledo C, Davis SM, Watts DH, Cavanaugh JS, Kiggundu V, Thomas AG, Odoyo-June E, Bonnecwe C, Maringa TH, *et al*: Case series of glans injuries during voluntary medical male circumcision for HIV prevention-eastern and southern Africa, 2015-2018. BMC Urol 20: 45, 2020.
30. Raisin G, Kocherov S, Jaber J, Shenfeld O, Hardak B and Chertin B: Glans injury during ritual circumcision. J Pediatr Urol 16: 471.e1-471.e5, 2020.
31. Mensah JE, Bray LD, Akpakli E, Kyei MY and Oyortey M: Successful penile reimplantation and systematic review of world literature. African J Urol 23: 253-257, 2017.
32. Chung E, Moon DG, Hui J, Chang HC, Hakim L, Nagao K, Tan R, Mak SK, Tantiwongse K, Lin H, *et al*: Clinical recommendations on penile reconstructive and prosthetic surgery: A consensus statement from the Asia-pacific society of sexual medicine. Sex Med 11: qfad003, 2023.
33. Ottaiano N, Pincus J, Tannenbaum J, Dawood O and Raheem O: Penile reconstruction: An up-to-date review of the literature. Arab J Urol 19: 353-362, 2021.