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Review

Management of mammalian bites to the external genitalia: a scoping review

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Objective

To review existing publications to determine the approaches for the medical and operative management of mammalian bites to the external genitalia.

Materials and Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis for Scoping Review guidelines were followed. Four databases were searched. Articles were independently screened and analysed by two reviewers. Publications were included if detailed summaries of genitalia bites and management were documented. Discrepancies were resolved by a third reviewer. Data were extracted from the final article cohort.

Results

A total of 42 articles were included in this scoping review with 67 cases of mammalian bites to the genitalia reported in the cohort. The most common injury site was the penis (44.9%). Dog and human bites were the most common type of mammalian bites (61.2% and 26.9%, respectively). In all, 13.4% of cases were managed with medical therapy while 86.6% of cases required surgical intervention. The most common intervention was wound irrigation, debridement, and primary closure (32.8%). Although uncommon, other operative approaches included skin flaps (7.5%) and grafts (4.5%), re-implantation (4.5%), urethroplasty/repair (7.5%), penectomy (3.0%), scrotoplasty (3.0%), and perineal urethrostomy (1.5%). The reported complication rate was 19.4%. The mean follow-up time was 39.9 months.

Conclusion

Trauma related to mammalian bites is associated with high utilisation of healthcare resources and cost. Although management of such bites to the genitalia is controversial, surgical intervention is often warranted ranging from simple debridement of devitalised tissue to complex reconstructive surgery. This review underscores the need for further investigation of mammalian bites to the genitalia to improve surgical options and monitor for long-term complication rates.

Keywords

mammalian bites, bite wounds, external genitalia, reconstructive surgery, #UroTrauma, #Urology

Introduction

Overall, mammalian bites are a common medical problem encountered in the USA, nearly costing the healthcare system $160 million each year [1]. Annually, 4.5 million dog bites occur in the USA of which 20% seek medical treatment and account for 1% of all emergency department visits [2]. Although most mammalian bite wounds can be managed conservatively, some patients have experienced significant morbidities such as ecchymosis, bacterial inoculation, soft tissue injury, and devitalised tissue [3].

Frequently occurring on the upper extremities, mammalian bite wounds rarely occur on the external genitalia [4]. Of the patients presenting with penetrating external genital trauma, 7% of cases are attributed to bite injuries [5]. Typical management includes irrigation, debridement, antibiotic prophylaxis, and tetanus and rabies immunisation in

appropriate cases in addition to primary wound closure or surgical reconstruction [6]. However, in severe cases patients presenting to the emergency department with animal bites to the genitals require major surgical intervention and coordination of care with several specialties including trauma surgeons, urologists, gynaecologists, and/or infectious disease specialists [5,6].

Due to the limited data on the management of mammalian bites to the genitalia, clinicians are not familiar with the management and surgical approaches for these injuries. The objective of this scoping review was to analyse the existing literature on mammalian bite wounds to the external genitalia to provide recommendations for medical and operative management of genitalia bite trauma.

Materials and Methods

A scoping review systematically evaluates published articles to identify research gaps to provide recommendations for future areas of study [7]. Because of the paucity of data on mammalian bites to the genitals and as reported cases are published as case reports or series, a scoping review was pursued over a systematic review with meta-analysis. This review utilises the Preferred Reporting Items for Systematic Review and Meta-Analyses Extension for Scoping Review guidelines [8].

Search Strategy

An information specialist generated a search strategy to identify articles that were published since the inception of the database to 28 March 2021. The following medical subject headings (MeSH) were used in this study: 'Animal and Insect Bites', 'Bites, Human', 'Animals, Domestic', 'Animals, Exotic', 'Animals, Wild', 'Animals, Zoo', 'Snake Bites', 'Urogenital System' as well as equivalent keywords, phrases and truncated terms (animal bites, dog, cat, pig, donkey, horse, sheep, goat bites, snake, or bites, genitalia, reproductive system, penis, testis, glans, scrotum, genitourinary and urogenital systems). The following databases were utilised: Medline Ovid to Embase (Elsevier), Cochrane Library (Wiley), and Web of Science (Clarivate). No study restrictions for peer review were enforced in the search. Restrictions on date of publication and type of publication were not limited to capture all articles on this topic.

Study Selection

Published articles were uploaded and managed through a systematic review software (Covidence, Veritas Health Innovation, Melbourne, Victoria, Australia, 2020). Two reviewers (H.P. and A.K.) independently selected articles to include based on title and abstracts. Discrepancies were then resolved by a third reviewer (S.P.). The remaining articles were screened based on full-length text by the same initial reviewers and subsequent discrepancies were resolved by the third reviewer. Inclusion/exclusion criteria were implemented before initiating the screening process.

Articles were excluded based on a hierarchical system. Exclusion priority was given to studies without suitable publication type, non-English text, or article duplication. Studies that reported non-mammalian bites (insect/reptile bites, gunshot wounds, stab wounds, crush injuries) to the genitalia were excluded. If details about demographics, insult of genital injury, and/or management of mammalian bite wounds were not specified, the article was excluded. Articles that merely acknowledged animal bites to the genitals were excluded.

Data Collection

Assessment parameters were created by one reviewer (S.P.) after discussion with the research team. Each reviewer independently gathered information on these parameters from the full-length articles and transferred variables into Microsoft Excel (Microsoft Corporation, Washington, DC, USA). Data extracted from the articles included demographic information, study design, type of mammalian bite, location of bite wound, country of insult, management of wound (surgical intervention, antibiotics, immunisation prophylaxis) and follow-up time (in months). Two reviewers utilised the National Heart, Lung, and Blood Institute (NHLBI) Study Quality Assessment tools to assess for risk of bias [9]. Discrepancies were resolved through discussion amongst all reviewers. All articles had a study quality score of 5–6 and thus all studies were included in the final cohort.

Results

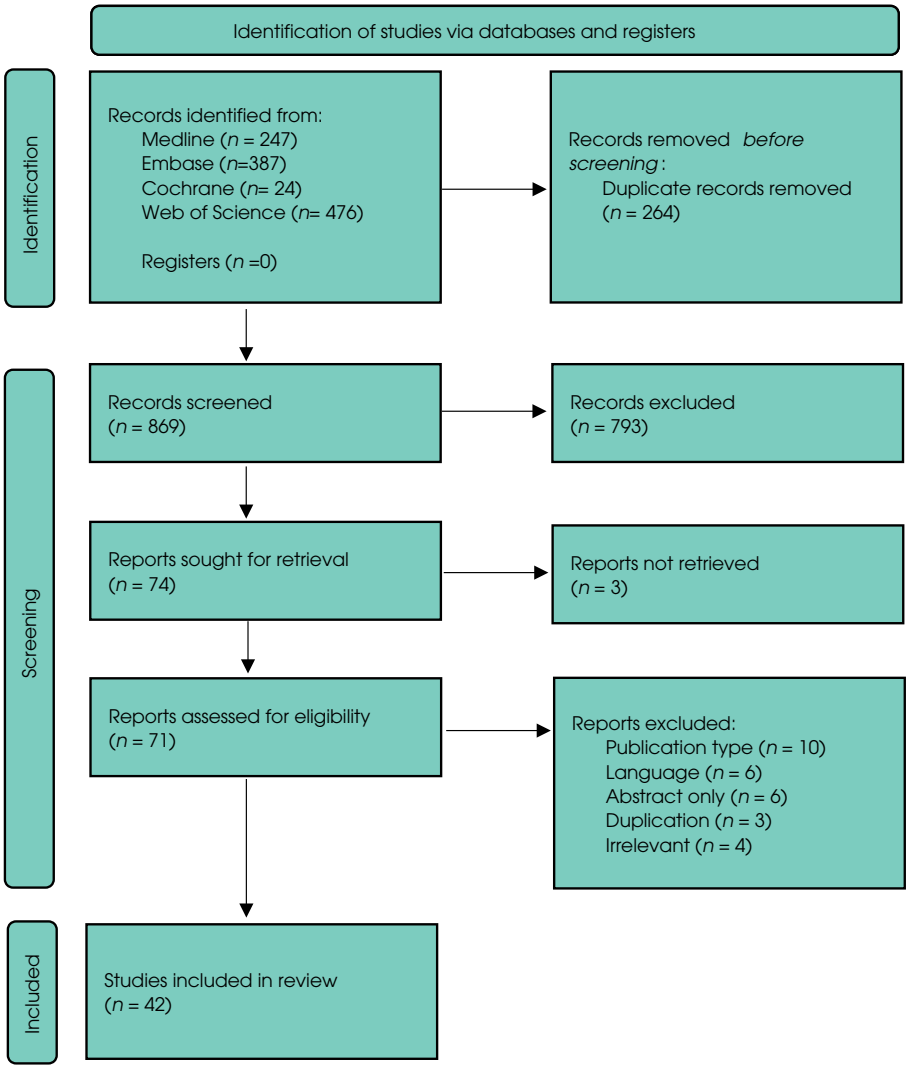
Description of Studies Included

Of the 1134 citations identified in all databases, 869 unique citations were extracted and included in the scoping review. Figure 1 depicts the extraction protocol for this review to obtain the final review articles. Of these articles, 793 articles were excluded after reviewing titles and abstracts. A further 29 articles were removed after reviewing the full text. The final cohort consisted of 42 articles.

Cohort Characteristics of Genital Injury

Table 1 outlines the cohort characteristics extracted from the 42 articles. A total of 67 cases were reported in the final article cohort. The age distribution of mammalian bites to the genitals were 11.9%, 31.3%, and 41.8% in the those aged <1, 1–18, and >18 years, respectively (14.9% of cases were included without ages). Most incidents occurred in North America (41.8%) followed by Europe (17.9%), Asia (17.9%), South America (14.9%), and Africa (7.5%). Of the cases,

Fig. 1 Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) diagram of systematic review.



86.6% required surgical intervention. The mechanisms of genitalia bites were the following: 10 (14.9%) unprovoked mammalian bites, nine (13.4%) provoked mammalian bites, 10 (14.9%) oral sex injuries, three (4.5%) intoxicated accidents, and 35 (52.2%) unexplained bite injuries. Of the operations, 32.8% required irrigation, debridement, and closure. Other complex interventions included incision and drainage (4.5%), circumcision (1.5%), skin flap (7.5%), skin graft (4.5%), re-implantation (4.5%), urethroplasty or urethral repair (7.5%), scrotoplasty (3.0%), penectomy (3.0%), and perineal urethrostomy (1.5%). Complications were not reported in 80.6% of cases. The most common complications noted were abscess formation (3.0%), erectile dysfunction (3.0%), and urethral stricture (3.0%). The mean (SD) follow-up time was 39.9 (76.8) months.

Most mammalian bites occurred on the penis (44.9%) while scrotal, glans, and testicular bites occurred less frequently (31.5%, 13.5%, and 10.1% respectively; Fig. 2A). Of the reports, dog bites were the most frequent mammalian bites to the human genitalia, accounting for 61.2% of cases. Human bites to the genitals were reported in 26.9% of cases. Less common reported cases were with donkey, horse, pig, and rat bites (6.0%, 3.0%, 1.5%, and 1.5%, respectively; Fig. 2B). Table 2 [6,12,13,14,15,16,17,19,20,21,22,24,32,33,34,38,39,40,41,42,43,44,45,46,47,48] lists cases that required surgical intervention outlining the details of mammalian bite and operative plans.

Organisms of the Infected Bite Wounds

Organisms that were grown from culture were identified in eight of the 67 cases. Three cases reported the organisms *Staphylococcus aureus* and *Eikenella corrodens* with one bite wound growing both organisms. *Neisseria weaveri*, Group A *Streptococcus*, and *Treponema pallidum* were less commonly

Table 1 Characteristics of articles extracted for the systematic review.

	N (%)
Articles	42
Sex	
Male	67 (100)
Age, years	
<1	8 (11.9)
1–18	21 (31.3)
>18	28 (41.8)
Not specified	10 (14.9)
Continent	
North America	28 (41.8)
Europe	12 (17.9)
Asia	12 (17.9)
South America	10 (14.9)
Africa	5 (7.5)
Intervention	
Non-operative	9 (13.4)
Irrigation, debridement, closure	22 (32.8)
Incision and drainage	3 (4.5)
Circumcision	1 (1.5)
Skin flap	5 (7.5)
Skin graft	3 (4.5)
Re-implantation	3 (4.5)
Urethroplasty/repair	5 (7.5)
Scrotoplasty	2 (3.0)
Penectomy	2 (3.0)
Perineal urethrostomy	1 (1.5)
Other*	11 (16.4)
Complication	
None reported	54 (80.6)
Abscess	2 (3.0)
Necrotising fasciitis	1 (1.5)
Cellulitis	1 (1.5)
Wound dehiscence/necrosis	2 (3.0)
Renal failure	1 (1.5)
Urethral stricture	2 (3.0)
Erectile dysfunction	2 (3.0)
Psychiatric illness	1 (1.5)
Follow-up, months, mean (SD)	39.9 (76.8)

**Corporoplasty, exploratory laparotomy, not specified.*

reported. All other cases did not grow organisms on culture or did not specify within the article.

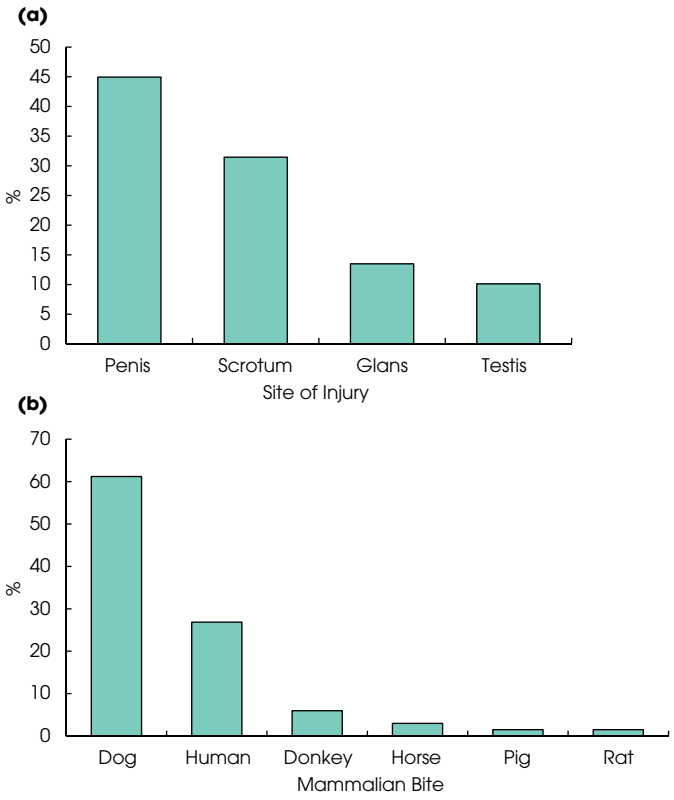
Antibiotic and Immunisation Prophylaxis

Of the 67 cases, 50 cases were provided with specific antibiotic regimens (74.6%). Amoxicillin-clavulanic acid was the most common antibiotics prescribed in the articles (23.1%). Ceftriaxone (19.2%), ampicillin-sulbactam (13.5%), and chloramphenicol (17.3%) were also frequently utilised. In all, 42 cases reported immunity prophylaxis, such as rabies and tetanus; one case reported observation of the dog after the incident to rule out rabies; and 24 cases did not mention any type of prophylaxis plan.

Discussion

Management of mammalian bites to the genitalia varies greatly depending on the mechanism, penetration depth, and tissue involvement. Accounting for 7% of all external genital

Fig. 2 Location of genital injury and type of mammalian bite.



traumas, these bites usually result in genital skin avulsion or penetrating injuries [5]. Surgical intervention, if warranted, often requires various reconstructive approaches ranging from scrotoplasty to urethroplasty to local tissue rearrangement without clear guidelines for management and follow-up [5]. In this scoping review, we analysed the current literature on management of mammalian bites to the genitalia.

Based on our review, we reported that 45% of mammalian bites occur on the penis while scrotal, glans, and testicular involvement occurs less frequently. Similar to prior published data, nearly 87% of reported genitalia wounds required surgical intervention [5]. Most patients required at least irrigation, debridement, and primary closure of defect (32.8%). Although complex reconstructive and local tissue grafts or flaps have been documented for genitalia after mammalian bites, there are no data to support one superior method, and often operative plans depend on extent of debridement, tissue loss, and viable anatomical function (e.g. urethra, testicles).

Here, we outline recommendations for management of mammalian bites to the genitalia based on our scoping review:

1. Initial management of bite trauma to the genitalia should include deep irrigation of wound to remove foreign bodies and pathogens [10].

Table 2 Characteristics of mammalian bites to the genitalia requiring surgical intervention.

Article	Cases, *n*	Country	Animal	Injury	Repair	Antibiotics	Discussed delay in care
Djordjevic et al. [34]	2	USA	Dog	Penetrating injury to penis and urethra	Glanuoplasty, urethroplasty, skin reconstruction	NS	✓
Palmer et al. [38]	1	USA	Dog	Scrotal puncture wound	Exploratory laparotomy, small bowel resection, inguinal hernia repair, primary closure	Ceftriaxone, Lincomycin	NR
Rosen [33]	1	USA	Human	Glans ulcer	Debridement of glans	Ceftriaxone, Augmentin	✓
Wolf et al. [39]	3	USA	Human	Glans ulcer	Incision and drainage	Penicillin	NR
Cummings and Boullier [40]	8	USA	Dog	Scrotal skin loss	Primary closure	NS	NR
Donovan et al. [13]	2	USA	Dog	Penile amputation	Debridement, split-thickness skin graft	NS	NR
Wolf et al. [39]	3	USA	Dog	Scrotal and bilateral testis amputation	Debridement, spermatic cord ligation, primary closure	Cefazolin	NR
Mathelier [41]	1	USA	Human	Labial haematoma	Incision and drainage	Penicillin, Ceftriaxone	NR
Kerins et al. [35]	1	UK	Human	Scrotal laceration	Debridement and secondary closure	Augmentin	✓
Spooner et al. [42]	1	UK	Dog	Penile and scrotal laceration	Debridement, testis repair, primary closure	Ceftriaxone, Metronidazole	NR
Chayla et al. [43]	1	Tanzania	Human	Penile ulcer	Distal penectomy	NS	✓
Aineskog and Huss [22]	1	Sweden	Dog	Penile degloving	Debridement, local skin flap, split thickness skin graft	Piperacillin-Tazobactam	NR
Ng et al. [44]	1	Singapore	Human	Scrotal laceration	Debridement and scrotoplasty	Ceftriaxone, Metronidazole	✓
Naidoo et al. [19]	1	South Africa	Dog	Glans amputation	Re-anastomosis of glans	Augmentin	NR
Miodrag et al. [21]	1	Serbia	Dog	Penile degloving	Re-anastomosis of penis and local skin flap	NS	NR
Younes et al. [42]	1	Egypt	Unknown	Scrotal laceration	Local skin flap, scrotoplasty	NS	NR
Lakmichi et al. [14]	1	Morocco	Mule	Penile amputation	Debridement, haematoma evacuation, urethral repair	Ampicillin-Sulbactam	NR
Ku et al. [20]	1	Korea	Dog	Penile and scrotal amputation	Urethral and meatal reconstruction	NS	NR
Nara et al. [15]	1	Japan	Dog	Scrotal avulsion, glans amputation, bilateral testis amputation	Primary closure of scrotal and penile skin	Augmentin	NR
Oshima et al. [45]	1	Japan	Dog	Scrotal laceration	Primary closure	NS	NR
Bertozzi et al. [24]	1	Italy	Dog	Scrotal laceration, haematocele	Haematoma evacuation, microsurgical vaso–epididymal anastomosis	Ampicillin-sulbactam	NR
De Luca [18]	1	Iran	Donkey	Penile and scrotal amputation	Primary closure with stump formation	NS	NR
Bothra et al. [17]	2	India	Dog	Penile and scrotal amputation	Debridement, urethral reconstruction	Third generation cephalosporin	✓
Mathur et al. [46]	1	India	Dog	Penile degloving	Primary closure	NS	NR

Table 2 (continued)

Article	Cases, *n*	Country	Animal	Injury	Repair	Antibiotics	Discussed delay in care
Haldar et al. [12]	1	India	Rat	Penile amputation	Microscopic penile re-implantation	NS	NR
Budhiraja and Ghei [47]	1	India	Dog	Hemiscrotum and unilateral testis amputation	Debridement and primary closure	NS	NR
Georgiou et al. [48]	1	India	Pig	Penile degloving	Debridement and primary closure	NS	NR
Ouattara et al. [16]	1	Burkina Faso	Donkey	Penile amputation	Debridement, urethral and cavernosal reconstruction	Ceftriaxone, Imidazole	NR
Gomes et al. [6]	1	Brazil	Donkey	Penile laceration	Primary closure	Chloramphenicol	NR
	1	Brazil	Horse	Scrotal and testis amputation	Spermatic cord ligation and primary closure	Chloramphenicol, Ampicillin	NR
	2	Brazil	Dog	Penile degloving	Scrotal skin flap and primary closure	Chloramphenicol	NR
	3	Brazil	Dog	Penile laceration	Debridement and primary closure	Chloramphenicol	NR
	1	Brazil	Dog	Partial penile amputation	Partial penectomy, urethral trimming, and primary closure	Chloramphenicol, Ampicillin	NR
	1	Brazil	Dog	Complete avulsion of penis, scrotum, and bilateral testis	Bilateral spermatic cord ligation and perineal urethrostomy	Chloramphenicol, Ampicillin	NR

NS, not specified; NR, not reported.

2. Penetrating mammalian bites to the external genitalia warrant prompt medical evaluation and surgical exploration [11].
3. Re-implantation is a feasible option for partial or complete penile amputation after mammalian trauma. The main goal of penile re-implantation is to reduce functional injury including sensory loss, voiding dysfunction and cosmetic deformity. In cases where amputated tissue is unable to be salvaged, the defect should be primarily closed [6,12,13,14,15,16,17,18,19,20]. Microvascular re-implantation is the treatment of choice for penile amputation if resources are available; it has been shown to produce better cosmetic results, physiological micturition, and preservation of sensation and erectile function compared to macrovascular re-implantation. A macrovascular approach has higher rates of skin necrosis, fistula formation, loss of sensation, and erectile dysfunction [12].
4. Primary closure should be attempted for mammalian bites. In extensive degloving or avulsion injuries, local skin flaps (e.g. scrotal skin) or grafts (e.g. medial thigh tissue) are viable options [13,21,22].
5. Universal antibiotic prophylaxis is not recommended for all genital bite wounds. The Infectious Disease Society of America recommends 3–5 days of antimicrobial therapy for patients that are immunosuppressed, asplenic, have advanced liver disease, have moderate to severe injuries especially on the hand or face, or injuries that may have penetrated the periosteum or joint capsule [23]. Although not specified, some authors debate that genital bite wounds are considered moderate to severe injuries and thus require antimicrobial prophylaxis [24]. For human bites, antibiotic therapy should consist of first parenteral dose ampicillin-sulbactam, cefoxitin or ertapenem followed by amoxicillin-clavulanate for 3–5 days [25]. For dog and cat bites to the genitalia, first-line treatment is amoxicillin-clavulanate for 3–5 days; for penicillin-allergic patients, doxycycline or clindamycin plus fluoroquinolones can be considered [26].
6. Tetanus and rabies immunisation should be considered during acute mammalian bites to the genitalia. There is a strong recommendation to administer the tetanus vaccination if patients have not received vaccination in the last 10 years [23]. Patients with dog or cat bites should be considered for post-exposure rabies prophylaxis if the animal is rabid or suspected rabid. If the animal can be observed for 10 days, prophylaxis should not be started unless the animal develops clinical signs of rabies. Consultation of public health officials is recommended if the dog or cat has escaped. Livestock bites warrant public health official consultation [27].
7. Routine follow-up after surgical management of a genitalia bite wound is recommended to monitor for complications such as infection, wound dehiscence, erectile dysfunction, urethral stricture disease, and psychiatric illness.

Nearly 40% of reported mammalian bites to the genitalia occurred in the paediatric population. Careful parental monitoring of children around mammals and wearing appropriate clothing attire may reduce the risk of genital bite injuries. In these cases where neglect or non-accidental trauma is suspected, consultation of child protective services may be warranted.

Although wound cultures are not routinely obtained during genital bite wounds, they may direct antibiotic treatment. Nearly 30–60% of infected bite wounds are colonised by mixed aerobic-anaerobic microbes either derived from the oral flora of animals or the victim's skin flora [28]. The most common organisms isolated from mammalian bite wounds includes *Streptococcus pyogenes*, *Pasteurella multocida*, *Eikenella corrodens*, *Capnocytophaga* species, *Neisseria* species, *Actinobacillus* species, *Staphylococcus* species, and rarely, *Pseudomonas* species [29]. Similarly, these isolates are often found in the bacteriology of mammalian saliva, which help guide empiric antibiotic treatment at time of injury [30,31].

Most cases were documented in North America (41.8%) and Europe (17.9%). This may be explained by immediate access to healthcare and academic resources, and thus oversaturate the literature with North American and European reports. Furthermore, several articles discussed the importance of early medical evaluation and intervention in the setting of mammalian bites to the genitalia to prevent worsening infection and the need for extensive debridement. We suspect that the true representation of animal bite injuries in developing countries where street animals are more common and housing facilities are poor is high [17]. In regions where rabies is more prevalent, the morbidity and mortality is higher after animal bites, although the burden and trend is often underestimated due to lack of accurate data, poor surveillance systems, and misdiagnosis of rabies [35].

There are several limitations to consider. The predominance of case reports and case series makes generalisation of data challenging. Non-operative management of mammalian bites to the genitalia may be underreported in the literature. There is a bias to publish rare cases of mammalian bites to the genitalia in literature and thus our data may overestimate the operative need for these traumas. Follow-up and complication rates for this population is not well documented. Although the documented complication rate is low, the sequelae from these complex reconstructive surgeries is not well known after mammalian bites. Hyperbaric oxygen therapy is a novel treatment for trauma and chronic wounds with promising utility in short- and long-term outcomes (e.g. short hospitalisation, less invasive surgery, low healthcare cost) [36]. Although hyperbaric oxygen therapy may reduce cytokine production and induce endothelial growth regulation, the role of this novel therapy still remains unclear for mammalian bites and requires further investigation [37].

A systematic review was not completed due to the heterogeneity of data collected and publication type. Hence, we performed a scoping review to determine the gaps in our understanding of management of mammalian bites and suggest areas of future investigation. Furthermore, this is the largest review article highlighting the medical and operative management of bites to the genitalia. The information synthesised here will hopefully guide future research in the management of bites to the genitalia.

Conclusion

Although management of bites to the genitalia are controversial, surgical intervention is often warranted ranging from debridement of devitalised tissue to complex reconstructive surgery. We recommend prompt evaluation and intervention if indicated, as well as close follow-up to monitor for postoperative complications. This review provides insight on the current approaches for medical and operative management of mammalian bites to the genitalia and suggests areas for further investigation on postoperative care and long-term complications.

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Competing Interests

The authors have no competing interests.

Ethical Approval

This manuscript has not been published in whole or part elsewhere nor currently being considered for publication in another journal. All authors have been personally and actively involved in the publication of this paper and will hold themselves jointly and individually responsible for its content. Personal and identifying information regarding the case has been retracted for confidentiality purposes.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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