Burns 52 (2026) 107888

Contents lists available at ScienceDirect

Burns

journal homepage: www.elsevier.com/locate/burns

Flap reconstruction following Fournier's gangrene: A systematic review of techniques and outcomes

Alwaleed Alammar [a,b], Kristine Laing [b], Janakan Somasundaram [b], David Lindsay Wallace [a,b], Alan David Rogers [a,b,*]

[a] Division of Plastic Surgery, Department of Surgery, University of Toronto, Toronto, Canada
[b] Ross Tilley Burn Centre, Sunnybrook Health Sciences Centre, Toronto, Canada

ARTICLE INFO

Keywords:
Fournier's gangrene
Necrotizing soft tissue infection
Flap reconstruction
Perineal reconstruction
Scrotal reconstruction
Regional flap
Fasciocutaneous flap
Gracilis flap
Anterolateral thigh flap
Reconstructive surgery

ABSTRACT

Fournier's gangrene is a life-threatening necrotizing soft tissue infection of the perineal and genital regions that often results in extensive tissue loss and complex reconstructive challenges. While initial management relies on aggressive debridement and source control, the subsequent reconstruction of perineoscrotal defects is critical to restore function, protect exposed structures, and preserve aesthetic and psychological well-being. Flap-based techniques, including fasciocutaneous and musculocutaneous options, are increasingly favored over skin grafts or secondary healing, particularly in the setting of exposed testes, urethra, or bone. We conducted a systematic review of 107 studies published between 1967 and 2024, encompassing 619 patients and 625 flaps, to comprehensively evaluate the types, indications, and outcomes of flap reconstruction following Fournier's gangrene. Medial thigh, pudendal thigh, anterolateral thigh (ALT), and gracilis muscle flaps emerged as the most commonly utilized, with regional flaps overwhelmingly preferred over free tissue transfer. The primary indications included coverage of exposed vital structures (52 %), functional restoration (39 %), and cosmesis (4 %). Despite the high-risk nature of the patient population, complication rates were low, with flap loss reported in only 1.6 % of cases. Functional and aesthetic outcomes were generally satisfactory, though standardized reporting tools were rarely used. Our findings highlight the apparent reliability, versatility, and safety of regional flaps in Fournier's gangrene reconstruction and underscore the need for greater standardization in outcome assessment and flap selection algorithms. This review serves as the most comprehensive synthesis to date and provides an evidence-based foundation for flap reconstruction decision-making in this devastating condition.

1. Introduction

Fournier's gangrene (FG) is a fulminant necrotizing soft tissue infection (NSTI) of the perineal, genital, and perianal regions. Originally described by Alfred Fournier in 1883 as a rapidly progressive idiopathic gangrene in young males, it is now recognized to affect patients of all ages, often with significant underlying comorbidities such as diabetes mellitus, obesity, malignancy, immunosuppression, and chronic kidney disease [1–6]. FG is typically polymicrobial in origin, involving synergistic infection with both aerobic and anaerobic organisms, most commonly Escherichia coli, Klebsiella species, Staphylococcus aureus, and Bacteroides fragilis [3,6]. The infection rapidly spreads along fascial planes, with the potential for systemic toxicity, multi-organ dysfunction, and death.

Early diagnosis and aggressive management are paramount. Mortality rates range from 7 % to 45 % in various series, with delays in debridement, comorbid burden, and elevated Fournier's Gangrene Severity Index (FGSI) scores all associated with worse outcomes [1–4]. Emergent surgical debridement remains the cornerstone of therapy, often requiring multiple operations to achieve source control. However, the resultant soft tissue defects are frequently complex and extensive, involving critical structures such as the testes, urethra, pubic symphysis, and anus.

Traditional wound management strategies, such as healing by secondary intention, negative pressure wound therapy (NPWT), or skin grafting, may suffice in minor cases. However, when vital structures are exposed or when defect coverage must restore complex functional anatomy, flap-based reconstruction is preferred. The ideal reconstructive strategy in FG should address not only durable wound closure but also thermoregulation (e.g., in scrotal wounds), urinary continence,

* Corresponding author at: D718, Ross Tilley Burn Centre, Sunnybrook Health Sciences Centre, 2075 Bayview Avenue, Toronto M4N 3M5, Canada.
E-mail address: alandavid.rogers@sunnybrook.ca (A.D. Rogers).

https://doi.org/10.1016/j.burns.2026.107888
Received 15 July 2025; Received in revised form 20 January 2026; Accepted 28 January 2026
Available online 29 January 2026

sexual function, and psychological wellbeing. Moreover, in cases with irradiated or infected tissue beds, well-vascularized flap tissue may reduce infection risk and promote durable healing and quality of life [7–10].

Flaps commonly used in this setting include the pudendal thigh flap, medial thigh fasciocutaneous flap, anterolateral thigh (ALT) flap, gracilis muscle flap, and, more rarely, free tissue transfers [7–10]. Despite a growing body of literature on their use, clinical decision-making remains highly individualized. There exists no consensus on flap selection, timing of reconstruction, or long-term outcome evaluation. The literature is marked by small single-centre case series, limited follow-up, and inconsistent reporting of complication rates and functional outcomes.

To address these knowledge gaps, we conducted a systematic review of the global literature on flap reconstruction for Fournier's gangrene. Our objectives were to (1) characterize the range and frequency of flap types used; (2) assess surgical indications, outcomes, and complications; and (3) identify gaps in evidence to inform future reconstructive strategies.

2. Methods

This systematic review was designed in alignment with the PRISMA 2020 guidelines to ensure methodological transparency, reproducibility, and rigor throughout the research process [10]. A structured review protocol was developed in advance, defining eligibility criteria, search strategy, data extraction methods, and quality assurance procedures to mitigate potential selection and reporting bias. The review protocol was not registered with the International Prospective Register of Systematic Reviews (PROSPERO).

A comprehensive search of the biomedical literature was undertaken using EMBASE, MEDLINE via PubMed, Cochrane Library, CINAHL, and Google Scholar to identify all relevant studies published up to 30 June 2024. The search strategy incorporated both Medical Subject Headings (MeSH) and relevant free-text keywords such as "Fournier's gangrene," "necrotizing soft tissue infection," "NSTI," "gas gangrene," "scrotal necrosis," "perineal reconstruction," "flap," "graft," "local flap," "regional flap," and "reconstructive surgery." Boolean operators and truncation symbols were employed to optimize sensitivity and specificity. No date restrictions were applied, allowing for the inclusion of both historical and contemporary literature to evaluate longitudinal trends in reconstructive approaches. For reproducibility, the complete search strategies (including full Boolean queries and exact search dates for each database) have been provided in Supplementary Table S1. In the Google Scholar search, we reviewed the first 200 results (sorted by relevance) for potentially eligible records, since this platform does not allow comprehensive export of results; no additional filters were applied to the Google Scholar search beyond language (English) and date (up to June 30, 2024). This approach yielded several unique references that were not identified in the other databases.

Supplementary studies were identified by manually reviewing the reference lists of included articles and related reviews through backward citation tracking. The review excluded non-peer-reviewed preprints, grey literature, and conference abstracts without accompanying full texts. Only articles published in English were included due to limitations in translation resources.

Eligibility criteria required that studies report on human patients diagnosed with Fournier's gangrene or related necrotizing soft tissue infections involving the perineum or genitalia, and that they include cases where flap-based reconstruction was used to manage the resulting soft tissue defects. To be eligible, articles needed to provide sufficient detail regarding the type of flap used, the reconstructive technique, and the reported clinical, functional, or aesthetic outcomes. Studies of all designs - including case reports, case series, retrospective reviews, and prospective analyses - were included, consistent with the exploratory aims of the review.

Exclusion criteria included studies focused exclusively on split-thickness skin grafts or healing by secondary intention, articles involving soft tissue loss due to trauma, congenital conditions, or oncologic resections unrelated to necrotizing infections, and reports limited to negative pressure wound therapy without definitive surgical reconstruction. Non-English articles, duplicates, abstracts lacking full texts, and studies for which full text access could not be obtained were also excluded despite interlibrary efforts.

All citations retrieved through the database search were imported into a secure systematic review platform, and titles and abstracts were screened in duplicate by two independent reviewers. Full-text articles deemed potentially eligible were assessed in detail according to the pre-established inclusion and exclusion criteria. Disagreements at any stage of the screening process were resolved by discussion or by a third reviewer when consensus could not be reached. Inter-reviewer agreement was high at both the title/abstract and full-text screening stages (Cohen's κ not formally calculated). We also cross-checked studies for potential overlapping patient cohorts from the same institutions; in cases of suspected overlap, the most comprehensive or latest report was used to avoid double-counting patients.

A standardized data extraction tool was developed and piloted to ensure consistency in data capture. For each included study, the extracted variables included authorship and publication year, study design and sample size, country of origin, institutional setting, patient demographics and comorbidities, site and extent of tissue loss, type and number of flaps used, timing of reconstruction relative to debridement, indications for flap selection, reported complications, and clinical, functional, or psychosocial outcomes. Classification of flaps was conducted based on tissue composition (fasciocutaneous, musculocutaneous, or muscle-only) and anatomical category (local, regional, or free) depending on donor site location and pedicle length.

To maintain reliability, data extraction was performed independently and in duplicate by two reviewers, with all discrepancies adjudicated through consensus or resolved with third-party arbitration. Due to the substantial heterogeneity across study designs, patient populations, and outcome reporting, a narrative synthesis approach was adopted rather than quantitative meta-analysis. Descriptive statistics were calculated to identify patterns and frequencies, and categorical data were organized into thematic tables to facilitate qualitative comparison. Missing or inconsistently reported outcome data were handled by including only available cases, and we explicitly noted the denominators for all reported percentages to ensure clarity.

All studies meeting the inclusion criteria were retained for analysis, regardless of methodological rigor or risk of bias, in keeping with the comprehensive and exploratory intent of the review. Furthermore, we performed a formal quality assessment of included studies using the Methodological Index for Non-Randomized Studies (MINORS) criteria. Two reviewers independently evaluated each study against the 8-item MINORS checklist for non-comparative studies (maximum score 16), resolving any differences through discussion. Overall, the methodological quality of the literature was low: the median MINORS score was approximately 7 (range 4–12) out of 16. Common limitations included retrospective study designs, absence of control groups, small sample sizes, and inconsistent outcome reporting. No study achieved the maximum score, confirming a high risk of bias across studies. The results of this appraisal were used to inform the interpretation of findings, but no study was excluded on the basis of quality.

3. Results

Our search yielded 4565 records. After removal of 805 duplicates, 3760 unique titles/abstracts were screened, leading to 513 full-text articles reviewed. Ultimately, 107 studies met the inclusion criteria for qualitative synthesis (see PRISMA flow diagram in Fig. 1). These 107 studies were published between 1967 and 2024, representing 26 countries. Most were single-centre case series or retrospective analyses (no randomized or multicentre trials were found). The median sample size

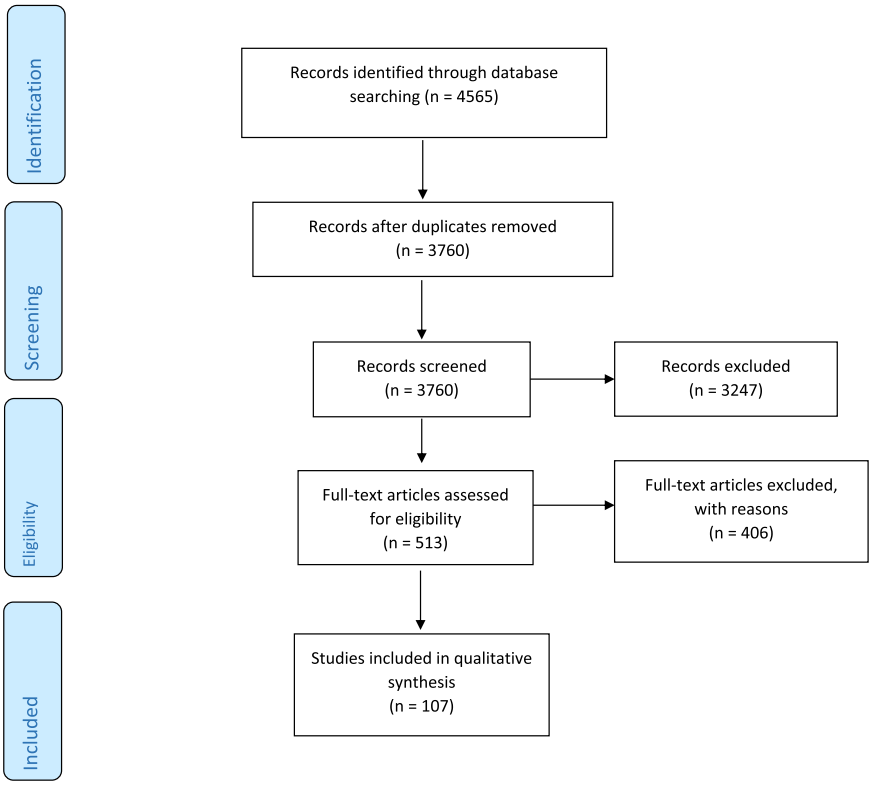

Fig. 1. PRISMA 2020 flow diagram summarizing the study selection process. A total of 4565 records were identified through database searches. After removal of duplicates and exclusions during title/abstract and full-text screening, 107 studies met inclusion criteria and were included in the qualitative synthesis.

was 5 patients per study (interquartile range 2–12), with only six studies including more than 20 patients. Table 1 provides a summary of included studies and their key characteristics [7–9,11–116].

In total, these studies reported on 619 patients who underwent flap reconstruction for Fournier's gangrene or similar perineal necrotizing infections. The patients were predominantly male (>90 %) with ages generally in mid-50s (range reported across studies ~42–67 years). Comorbid illnesses were common: over half of patients had diabetes mellitus, and many had other risk factors such as hypertension, obesity, chronic renal insufficiency, malignancy, or HIV infection. Mortality rates varied widely (7–45 %), reflecting differences in disease severity and patient comorbidity among series.

A total of 625 flaps were utilized across the 619 patients (some patients required more than one flap). We were able to classify 495 flaps (79 %) by type from the information provided. The vast majority were pedicled flaps of either local or regional variety. Only two instances of free flap transfers were reported in the entire cohort, indicating that free tissue transfer is rarely employed in this setting, likely due to patient and logistical factors as discussed later. Table 2 summarizes the types of flaps used for reconstruction.

Fasciocutaneous flaps were the most commonly reported. These included the medial thigh (anteromedial thigh) flap in 177 cases, the pudendal thigh flap in 69 cases, the anterolateral thigh (ALT) flap in 66 cases, and the scrotal advancement flap in 65 cases. Together, these four flap types represented the majority of reconstructions and were mainly used for scrotal and perineal defects. Advantages noted for these flaps included robust vascular supply, local availability (allowing quick transfer without microsurgery), and acceptable donor site appearance. Less frequently used fasciocutaneous options were Limberg or other rhomboid flaps (29 cases), groin flaps (14 cases), inferior gluteal artery perforator flaps (5 cases), posterior thigh flap (1 case), and a preputial flap (1 case). These were usually selected based on specific defect location/geometry or surgeon preference.

Musculocutaneous and muscle-only flaps also played a role, particularly for deeper or more extensive defects. A total of 66 muscle-based flaps were reported. The gracilis muscle flap was by far the most common muscle flap (54 cases); it was often used for perineal or ischiorectal defects where its bulk helped fill dead space and its arc of rotation allowed reach into the perineum. Other muscle flaps included rectus abdominis (6 cases, usually as pedicled myocutaneous flaps for suprapubic or perineal coverage), tensor fasciae latae (4 cases), and sartorius (2 cases, primarily for groin or thigh-based coverage). In general, muscle flaps were chosen when the goals included filling dead space or improving vascularity in an infected wound bed.

The primary indications for employing flap reconstruction were (in descending order of frequency): to cover exposed vital structures (e.g., exposed testes, spermatic cords, urethra, bone): this was cited in 52 % of reported flaps (271 of 525 flaps where indication was specified); to restore functional anatomy (particularly for urinary and sexual function): 39 % of flaps (203/525); and to improve cosmesis or psychosocial outlook: 4 % (22/525). In about 5 % of cases (24 flaps), no specific rationale was stated beyond general wound closure. Thus, the decision to use a flap was most often driven by the presence of critical structures that could not be left uncovered or by the need to reconstruct three-dimensional tissue loss in a way that grafts or secondary healing could not achieve.

Reporting on timing was inconsistent across studies. Most authors indicated that definitive flap coverage was performed after the acute infection was controlled and repeated debridements were complete. Many cases used a "delayed" approach (often a week or more after initial debridement). Only 11 cases (across the literature) were clearly reported as having an "early" or immediate reconstruction within 48 h of presentation. A few authors described using negative pressure wound therapy as a temporary measure to optimize the wound bed prior to flap surgery. Because many papers did not explicitly state timing, it is difficult to draw firm conclusions; however, the prevailing practice seems to favor waiting until the patient is stabilized and the wound is clean, rather than immediate reconstruction during the initial emergency

Table 1
Summary of included studies reporting flap-based reconstruction following Fournier's gangrene.

Author	Year	Title	Study Design	Flap Complications	Sample size	Number of FG	Number of flaps	Type of Flap	Mean age
Biju et al. [9]	2023	Fournier's gangrene reconstruction: A 10-year retrospective analysis of practice at Guys and St Thomas's NHS Foundation Trust	retrospective	N/A	34	34	3	3 Loco-Regional	58
Chen et al. [11]	2023	Vacuum sealing drainage to treat Fournier's gangrene	retrospective	N/A	36	36	6	6 Loco-Regional	53.5
Meuli et al. [12]	2023	Impact of etiology leading to abdominoperineal resection with anterolateral thigh flap reconstruction: A retrospective cohort study	retrospective	8 wound dehiscence 2 major necrosis 1 venous congestion 1 hematoma 1 dead space	40	7	44	ALT	63.5
Öcük et al. [13]	2022	Effectiveness of Fasciocutaneous Superomedial Thigh Flap in Reconstruction of Fournier Gangrene Defects	Retrospective	4 wound dehiscence	15	15	15	15 Superomedial fasciocutaneous thigh flap	67
Puranik et al. [14]	2022	An Innovative Technique of Testicular Preservation in Fournier's Gangrene: Surgical Details and Illustration	Case series	N/A	5	5	5	Scrotal Super medial thigh flap Pudendal flap Medial circumflex artery perforator flap Gracilis flap	N/A
Maurya et al. [15]	2022	Various Options for Scrotal Reconstruction: A Prospective Observational Study	Prospective Observational Study	3 Wound infection 3 Wound dehiscence 2 Distal flap necrosis	35	6	28	7 ALT 10 Scrotal 8 Medial thigh 3 Groin flap	48.5
Beecroft et al. [16]	2021	Fournier's Gangrene in Females:Presentation and Management at a Tertiary Center	retrospective chart review	N/A	143	143	31	30 Local 1 Gracilis flaps	55
Dadaci et al. [17]	2021	Assessment of Outcomes After Limberg Flap Reconstruction for Scrotal Defects in Patients With Fournier's Gangrene	Retrospective, single-center study	4 Wound Dehiscence 4 Seroma	29	29	29	Limberg flap	64
Insua-Pereira et al. [18]	2020	Fournier's gangrene: A review of reconstructive options	Review					Scrotal flap Local advancement flap Fasciocutaneous flap Myocutaneous flap Perforator flap Superomedial thigh fasciocutaneous flap Anterolateral thigh flap Pudendal thigh flap TRAM flap Perforator flap	
Odusanya et al. [19]	2020	Fournier's Gangrene: Management in a Poor Resource Setting	Retrospective	No complications	1 patient -1 flap (Not specified)			Not specified	47
Brielle et al. [20]	2020	Bilobed Gracilis Flap: A Novel Alternative for Pelvic and Perineal Reconstruction.	Retrospective	No complications in NSTI patient	1 patient -1 flap	1	1	Bilobed gracilis flap (1)	50
Graham et al. [21]	2020	Penile reconstruction after Fournier's gangrene	Case Report	No complications	1 patient -1 flap	1	1	Skin flap (1)	Not reported
Zhou et al. [22]	2019	Fournier's Gangrene With Septic Shock and Multiple Organ Dysfunction Syndrome	Case Report	No complications	1 patient -2 flaps	1	2	Groin flap (1) Local freestyle skin flap (1)	58
Unverdi et al. [23]	2019	A Reliable Technique in the Reconstruction of Large Penoscrotal Defect: Internal Pudendal Artery Perforator Flap.	Retrospective	1 hematoma 1 partial necrosis	13 patients -13 flaps	13	13	Internal pudendal artery perforator flap (13)	54.3

(*continued on next page*)

Table 1 (*continued*)

Author	Year	Title	Study Design	Flap Complications	Sample size	Number of FG	Number of flaps	Type of Flap	Mean age
Selvi,et al. [24]	2019	A different perspective for morbidity related to Fournier's gangrene: which scoring system is more reliable to predict requirement of skin graft and flaps in survivors of Fournier's gangrene?.	Retrospective	No complications	10 patients -10 flaps	10	10	Not specified	62.93
Onder et al. [25]	2019	Fournier's gangrene in a patient on dapagliflozin treatment for type 2 diabetes	Case Report	No complications	1 patient -1 flap	1	1	Fasciocutaneous flap (1)	64
Louro et al. [26]	2019	Fournier's gangrene: 10-year experience of a plastic surgery and burns department at a tertiary hospital	Retrospective	2 dehiscence 1 partial necrosis	9 patients -12 flaps	9	12	Internal pudendal pedicled flap (2) Contralateral rotational flap (1) Internal thigh bilateral fasciocutaneous transposition flaps (2) McGregor propeller flap (1) Pedicled anterolateral thigh flap (1) Local sliding flap (1) Medial femoral circumflex artery perforator (1) Fasciocutaneous transposition flap (1) Internal thigh rotational flap (1) Biloped internal thigh flap (1)	66.9
Kadota, et al. [27]	2019	Simultaneous deep inferior epigastric and bilateral anterolateral thigh perforator flap reconstruction of an extended perineoscrotal defect in Fournier's gangrene: A case report.	Case Report	1 Epidermal necrosis DIEP	1 patient -3 flaps	1	3	Anterolateral thigh flap (2) DIEP flap (1)	52
Ghahestani, et al. [28]	2019	A new technique of scrotoplasty following total scrotal destruction by raised rotated perineal flaps with de epithelialized borders.	Case Report	No complications	1 patient -flap number not specified		Not reported	Rotational perineal flap	2
Hoang, et al. [29]	2018	Phalloplasty Following Penectomy for Fournier's Gangrene at a Tertiary Care Center.	Case Report	1 distal flap necrosis	1 patient -1 flap	1	1	Radial forearm free flap (1)	60
Mello et al. [30]	2018	Scrotal reconstruction with superomedial fasciocutaneous thigh flap.	Retrospective	4 wound dehiscence	15 patients -30 flaps	15	30	Superomedial fasciocutaneous thigh flap (30)	48.9
Wang et al. [31]	2017	Bilateral femoral posterior neurocutaneous perforater flap successfully treating Fournier gangrene: A case report.	Case Report	No complications	1 patient -2 flaps	1	2	Femoral posterior neurocutaneous perforator flap (2)	61
Scaglioni et al. [32]	2017	Bilateral pedicle anterolateral thigh (ALT) flap combined with bilateral sartorius muscle flap for reconstruction of extensive perineoscrotal and medial thigh defect because of Fournier's gangrene.	Case Report	No complications	1 patient -4 flaps	1	4	Pedicle anterolateral thigh flap (2) Sartorius muscle flap (2)	61
Sawayama et al. [33]	2017	A fascia lata free flap in pelvic exenteration for Fournier gangrene due to advanced rectal cancer: a case report.	Case Report	No complications	1 patient -1 flap	1	1	Fascia lata flap (1)	66

(*continued on next page*)

Table 1 (*continued*)

Author	Year	Title	Study Design	Flap Complications	Sample size	Number of FG	Number of flaps	Type of Flap	Mean age
Ikramullah et al. [34]	2017	Fournier's gangrene: Management experience of 39 cases	Retrospective	No complications	4 patients -4 flaps	4	4	Medial thigh flap (4)	46.2
Hong et al. [35]	2017	Perineal reconstruction with multiple perforator flaps based on anatomical divisions.	Retrospective	1 wound dehiscence 3 flap congestion	4 patients -9 flaps	4	9	Internal pudendal artery perforator flap (8) Superficial external pudendal artery perforator flap (1)	49.25
Hagedorn et al. [36]	2017	A contemporary update on Fournier's gangrene	Review					Thigh flap Rotational fasciocutaneous thigh flaps Anterolateral thigh flap	
Fang et al. [38]	2017	A rare etiology of Fournier's gangrene: Pubic tubercle fracture complicated with hematoma and acute osteomyelitis	Case Report	No complications	1 patient -1 flap	1	1	Local flap (1)	68
Djedovic, et al. [38]	2017	The versatility of the medial thigh lift for defect coverage in the genito-perineal region.	Retrospective	2 wound infection 3 hematoma 1 partial flap necrosis 1 wound dehiscence	8 patients -16 flaps	8	16	Medial Thigh Lift (16)	54.6
Baek, et al. [39]	2017	Peri-vulvar reconstruction using internal pudendal artery perforator flap in female Fournier's gangrene.	Case Report	No complications	1 patient -1 flap	1	1	Internal pudendal artery-based perforator flap (1)	57
Abd-Al Moktader, et al. [40]	2016	Anteriorly based pudendal thigh flap for scrotal reconstruction based on the deep external pudendal artery (DEPA) flap	Retrospective	1 wound infection 1 wound dehiscence	15 patients -20 flaps	15	20	Anteriorly-based pudendal thigh fasciocutaneous flap (20)	45.3
Daigeler, et al. [41]	2016	Bilateral pedicled gracilis flap for scrotal reconstruction.	Correspondance	No complications	1 patient -2 flaps	1	2	Bilateral pedicled gracilis flap (2 flaps total)	Not reported
Han et al. [42]	2016	Scrotal reconstruction using a superficial circumflex iliac artery perforator flap following Fournier's gangrene.	Case Report	No complications	2 patients -2 flaps	2	2	Superficial circumflex iliac artery perforator flap (2)	48.5
Moore et al. [43]	2016	Primary metastatic squamous cell carcinoma of the male urethra presenting with scrotal abscess and subsequent development of Fournier's gangrene	Case Report	Flap failed	1 patient -1 flap	1	1	Anterolateral thigh skin flap (1)	40
Mopuri et al. [44]	2016	Scrotal reconstruction with modified pudendal thigh flaps.	Retrospective	1 flap congestion	5 patients -5 flaps	5	5	Pedicled pudendal thigh flap (5)	59
Namkoong et al. [45]	2016	Fournier's gangrene: a surgical emergency	Case Report	No complications	1 patient -1 flap	1	1	Gracilis myocutaneous flap (1)	61
Singh et al. [46]	2016	Fournier's gangrene. A clinical review	Review					Scrotal advancement flap Fasciocutaneous flap Superomedial thigh flap pudendal flap Anterolateral thigh flap Gracilis muscle flap	
Sung et al. [47]	2016	Reconstruction of large defects in the perineal area using multiple perforator flaps	Retrospective	1 partial flap necrosis	1 patient -3 flaps	1	3	Internal pudendal artery perforator flap (2) Superior gluteal artery perforator flap (1)	74
Scaglioni, et al. [48]	2015	Posteromedial thigh (PMT) propeller flap for perineoscrotal	Case Report	No complications	1 patient -1 flap	1	1	Pedicled posteromedial thigh propeller flap (1)	58

(*continued on next page*)

Table 1 (*continued*)

Author	Year	Title	Study Design	Flap Complications	Sample size	Number of FG	Number of flaps	Type of Flap	Mean age
		reconstruction: A case report.							
Onyekwelu et al. [49]	2015	Reconstruction of perineo-scrotal defects from Fournier's gangrene with the adipofascial anterolateral thigh flap	Case Report	No complications	3 patients -3 flaps	3	3	Anterolateral thigh flap (adipofascial) (3)	49.3
Kalra et al. [50]	2015	Keystone flap for staged urethroplasty: Reconstruction in a complex case of panurethral stricture disease	Case Report	No complications	1 patient -2 flaps	1	2	Bilateral perineal keystone design perforator island flaps (2)	65
di Summa et al. [51]	2015	The Combined Pedicled Anterolateral Thigh and Vastus Lateralis Flap as Filler for Complex Perineal Defects.	Retrospective	1 partial flap necrosis	5 patients -6 flaps	5	6	Anterolateral thigh - vastus lateralis conjoint flap (6)	60
Lin et al. [52]	2014	Reconstruction of perineoscrotal defects in Fournier's gangrene with pedicle anterolateral thigh perforator flap.	Retrospective	1 hematoma	10 patients -10 flaps	10	10	Anterolateral thigh perforator flap (10) -Pedicled	59.1
Ahn, et al. [53]	2014	Reconstructive strategy and classification of penoscrotal defects.	Retrospective	2 wound dehiscence	12 patients -12 flaps	12	12	Perforator-based island flap (10) Anterolateral thigh flap (2)	59.7
Bhadkamkar et al. [54]	2014	The ultra-thin, fascia-only anterolateral thigh flap	Retrospective	No complications in NSTI patients	1 patients -1 flap	1	1	Anterolateral thigh fascia-only free flap (1)	47
El-Shazly et al. [55]	2014	Fournier's gangrene: Outcome analysis of 62 consecutive cases	Prospective -Observational	No complications	9 patients -9 flaps	9	9	Skin flap (9)	Not specified -for flap only
Pagnotta et al. [56]	2014	Superficial circumflex iliac artery perforator flap in a case of Fournier's gangrene	Case Report	No complications	1 patient -1 flap	1	1	Propeller superficial circumflex iliac artery perforator flap (1)	72
Sliwinski, et al. [57]	2014	Fournier's gangrene - delayed pedicle flap based upon the anterior abdominal wall.	Case Report	No complications	1 patient -1 flap	1	1	Random pattern abdominal flap (1)	24
Ziypak et al. [68]	2013	Our experiences of Fournier's gangrene: 71 cases	Retrospective	No complications	8 patients -8 flaps	8	8	Not specified	62.1
Yarze et al. [59]	2013	Fournier's gangrene after sigmoidoscopy in a patient with distal rectal cancer	Case Report	No complications	1 patient -1 flap	1	1	Not specified	73
Spyropoulou, et al. [60]	2013	Reconstruction of perineoscrotal and vaginal defects with pedicled anterolateral thigh flap.	Case Report	No complications	9 patients -9 flaps	9	9	Anterolateral thigh flap (8) Anteromedial thigh flap (1)	Not specified for NSTI
Park et al. [61]	2013	Single-stage reconstruction of extensive defects after fournier's gangrene with an exposed iliac crest and testes	Case Report	No complications	1 patient -4 flaps	1	4	Pedicled anterolateral thigh flap (2) Gracilis myocutaneous flap (2)	55
Oufkir et al. [62]	2013	The superomedial thigh flap in scrotal reconstruction: Technical steps to improve cosmetic results	Case Report	No complications	4 patients -8 flaps	4	8	Superomedial thigh flap (7) Grafted gracilis muscle flap (1) -donor areas closed with posterior thigh flaps	39
Mughal et al. [63]	2013	Reconstruction of perineal defects.	Review					Local Flap Regional flap Singapore flap VRAM flap Thigh flap Gracilis myocutaneous flap Tensor fascia lata flap Gluteal flap Perforator flap Inferior gluteal artery perforator flap	

(*continued on next page*)

Table 1 (*continued*)

Author	Year	Title	Study Design	Flap Complications	Sample size	Number of FG	Number of flaps	Type of Flap	Mean age
Khan et al. [64]	2013	Scrotal reconstruction: A review and a proposed algorithm	Review					Anterolateral thigh flap Free flap Fasciocutaneous flap Groin flap Pudendal thigh flap Myofasciocutaneous flap Omental flap Short gracilis flap TRAM flap Latissimus dorsi flap	
Crane et al. [65]	2013	Urethral reconstruction using a prefabricated pedicled gracilis flap.	Case Report	No complications	1 patient -1 flap	1	1	Pedicled gracilis flap (1)	43
Aliyu et al. [66]	2013	Fournier's gangrene as seen in university of maiduguri teaching hospital	Retrospective	No complications	20 patients -20 flaps	20	20	Rotation flap (20)	37.82
De Souza et al. [67]	2012	Puerperal sepsis with Furnier's syndrome	Retrospective	No complications	1 -flap number not specified	N/A -1 patient	Not reported	Muscle-aponeurotic flap	23
Hsu, et al. [68]	2012	Expanding the applications of the pedicled anterolateral thigh and vastus lateralis myocutaneous flaps.	Retrospective	No complications in NSTI patient	3 patients -3 flaps	3	3	Anterolateral thigh flap (3)	68
Lee et al. [69]	2012	Penoscrotal reconstruction with gracilis muscle flap and internal pudendal artery perforator flap transposition.	Retrospective	No complications	6 patients -12 flaps	6	12	Gracilis muscle flap (6) Pudendal artery perforator flap (6)	52.6
Karsidag, et al. [70]	2011	Perineoscrotal reconstruction using a medial circumflex femoral artery perforator flap.	Retrospective	1 flap congestion	4 patients -5 flaps	4	5	Medial circumflex femoral artery perforator flap (5)	47
Dogan et al. [71]	2011	Bilateral super thin groin island flap for penile, scrotal, and pubic reconstruction after Fournier's gangrene	Case Report	No complications	1 patient -2 flaps	1	2	Bilateral super thin groin island flap (2 flaps total)	54
Djedovic, et al. [72]	2011	Re: Scrotal reconstruction by testicular apposition and wrap-around skin grafting.	Correspondance	No complications	1 patient -2 flaps	1	2	Medial Thigh Lift (2)	17
Coskunfirat, et al. [73]	2011	Superiority of medial circumflex femoral artery perforator flap in scrotal reconstruction.	Case Report	2 wound dehiscence	7 patients -8 flaps	7	8	Medial circumflex femoral artery perforator flap (8)	51.9
Chen et al. [74]	2011	Reconstruction of scrotal and perineal defects in Fournier's gangrene.	Retrospective	1 partial necrosis 2 wound edge necrosis 1 hematoma	23 patients -23 flaps	23	23	Pudendal thigh flap (5) Gracilis myocutaneous flap (2) Gracilis muscle flap (1) Pedicle anterolateral thigh flap (3) Scrotal advancement flap (12)	53.6
Callaghan et al. [75]	2011	Septic shock due to Fournier's gangrene of the scrotum.	Case Report	No complications	1 patient -1 flap	1	1	Pedicled gracilis flap (1)	57
Aydin et al. [76]	2010	Reconstruction of wide scrotal defect using groin fasciocutaneous island flap combined with a strip of deep fascia.	Correspondance	No complications	1 patient -1 flap	1	1	Groin fasciocutaneous flap (1)	62
Chen et al. [77]	2010	Fournier gangrene: a review of 41 patients and strategies for reconstruction.	Retrospective	2 Partial flap loss	17 patients -17 flaps	17	17	Scrotal advancement flap (9) Pudendal thigh fasciocutaneous flap (4) Gracilis myocutaneous flap (2) Gracilis muscle flap (2)	57.2
Maguina, et al. [78]	2010	Medial thigh fasciocutaneous flaps for	Correspondance					Medial thigh fasciocutaneous flap	

(*continued on next page*)

Table 1 (*continued*)

Author	Year	Title	Study Design	Flap Complications	Sample size	Number of FG	Number of flaps	Type of Flap	Mean age
		reconstruction of the scrotum following Fournier gangrene.							
Ng et al. [79]	2010	Scrotal reconstruction with a free greater omental flap: A case report.	Case Report	No complications	1 patient -1 flap	1	1	Greater omental flap (1)	43
Tomar, et al. [80]	2010	Fournier's gangrene - Not a stigma for surgery with newer surgical reconstruction of scrotum	Case Report	No complications	1 patient -2 flaps	1	2	Superomedial thigh flap (2)	34
Spyriounis [81]	2009	Scrotum reconstruction with the anterolateral (ALT) thigh flap	Case Report	1 wound dehiscence	2 patients -2 flaps	2	2	Anterolateral thigh flap (2)	65.5
Rajan, et al. [82]	2009	Testicular torsion following a skin graft for Fournier's gangrene.	Case Report		1 patient -0 flaps -1 graft			None	73
Isken et al. [83]	2009	A novel application for repair of skin defects of the penis: Anterior scrotal artery flap	Correspondance	No complications	1 patient -1 flap	1	1	Anterior scrotal artery axial flap (1)	27
Bhatnagar, et al. [84]	2008	Fournier's gangrene: a review of 110 cases for aetiology, predisposing conditions, microorganisms, and modalities for coverage of necrosed scrotum with bare testes.	Retrospective	16.9 % of flap patients had complications	12 patients -12 flaps	12	12	Fasciocutaneous rotation thigh flap (12)	36.4
Al-Fadhli et al. [85]	2008	The versatility of the medial thigh flap for coverage of large perineoscrotal defects in Fournier's gangrene.	Retrospective	3 Partial necrosis	7 patients -9 flaps (5 unilateral, 2 bilateral)	7	9	Medial thigh fasciocutaneous flaps (9)	42
Lee et al. [86]	2007	Penoscrotal reconstruction using groin and bilateral superomedial thigh flaps: a case of penile vaselinoma causing Fournier's gangrene.	Case Report	No complications	1 patient -3 flaps	1	3	Superomedial thigh flap (3)	42
Karacal, et al. [87]	2007	Scrotum reconstruction with neurovascular pedicled pudendal thigh flaps.	Case Report	No complications	8 patients -8 flaps	8	8	Posteriorly based neurovascular pedicled pudendal thigh flap (8)	Not reported -two cases were 41 and 37
Hsu, et al. [88]	2007	Unilateral gracilis myofasciocutaneous advancement flap for single stage reconstruction of scrotal and perineal defects.	Case Report	1 Hematoma 1 abscess	8 patients -8 flaps	8	8	Gracilis myofasciocutaneous advancement flap (8)	60.5
Ferreira et al. [89]	2007	Fournier's gangrene: a review of 43 reconstructive cases.	Retrospective	5 partial dehiscence	43 patients -71 flaps	43	71	Superomedial thigh flaps (46) Scrotal musculocutaneous flaps (17) Gracilis musculocutaneous flaps (2) Local advancement flaps (6)	56.6
Carvalho et al. [90]	2007	Relation between the area affected by Fournier's gangrene and the type of reconstructive surgery used. A study with 80 patients.	Retrospective	2 wound infection	21 patients -21 flaps	21	21	Rotation flap (21)	51.18
Atik, et al. [91]	2006	Reconstruction of wide scrotal defect using superthin groin flap.	Case Report	No complications	3 patients -3 flaps	3	3	Lateral groin flap (3)	49
Hallock, [92]	2006	Scrotal reconstruction following fournier gangrene using the medial circumflex femoral artery perforator flap.	Case Report	No complications	1 patient -1 flap	1	1	Medial circumflex femoral artery perforator flap (1)	68

(*continued on next page*)

Table 1 (*continued*)

Author	Year	Title	Study Design	Flap Complications	Sample size	Number of FG	Number of flaps	Type of Flap	Mean age
Morris et al. [93]	2006	Fibrin sealant as tissue glue: preliminary experience in complex genital reconstructive surgery.	Retrospective	1 wound dehiscence	4 patients -4 flaps (types of flaps' number not specified)			Thigh flap Scrotal flap -numbers not specified	Not reported
Gravvanis, et al. [94]	2005	Penile resurfacing with vascularized fascia lata.	Case Report	No complications	3 patients -3 flaps	3	3	Anterolateral thigh flap (2) Tensor fascia lata flap (1)	43.7
Ellabban [95]	2004	Single stage muscle flap reconstruction of major scrotal defects.	Correspondance					Rectus abdominis muscle flap Gracilis myocutaneous flap	
Kayikcioglu, [96]	2003	A new technique in scrotal reconstruction: short gracilis flap.	Case Report	No complications	2 patients -2 flaps	2	2	Short gracilis flap (2)	48.5
Ellabban, et al. [97]	2003	Single-stage muscle flap reconstruction of major scrotal defects: report of two cases.	Case Report	No complications	2 patients -2 flaps	2	2	Rectus abdominis muscle flap (1) Gracilis myocutaneous flap (1)	58
DeCastro et al. [98]	2002	Fibrin sealant for the reconstruction of fournier's gangrene sequelae.	Case Report	No complications	2 -1 thigh skin flap -Scrotal rotational flaps not specified	1	1	Scrotal rotational flap Thigh skin flap (1)	65.5
Maharaj, et al. [99]	2002	The scrotal reconstruction using the "Singapore Sling".	Case Report	No complications	1 patient -1 flap	1	1	Pudendal thigh flap (1)	65
Monteiro et al. [100]	2002	"Inner thigh lift flap" for Fournier gangrene of the scrotum	Correspondance	No complications	1 patient -1 flap	1	1	Inner thigh lift flap (1)	Not reported
Yu et al. [101]	2002	Anterolateral thigh fasciocutaneous island flaps in perineoscrotal reconstruction.	Case Report	1 wound dehiscence	4 patients -4 flaps	4	4	Anterolateral thigh fasciocutaneous island flaps	40.5
Murakami et al. [102]	2001	Scrotal reconstruction with a thinned flap based on both inferior epigastric arteries. Case report.	Case Report	No complications	1 patient -1 flap	1	1	Inferior epigastric artery flap (1) -Tensor fasica lata flap used for hernia repair defect a year later	62
Kilic, et al. [103]	2001	Fournier's gangrene: etiology, treatment, and complications.	Retrospective	No complications	5 patients -5 flaps	5	5	Local advancement flap (5)	52.04
al-Shaham [104]	2001	Prepucial skin flap for reconstruction of the scrotum in Fournier's gangrene.	Case Report	No complications	1 patient -1 flap	1	1	Prepucial skin flap (1)	Not reported
Beckenstein, et al. [105]	1996	Muscle flap reconstruction aids in urethral regeneration.	Case Report	No complications	1 patient -1 flap	1	1	Proximally pedicled gracilis muscle flap (1)	56
Hallock [106]	1996	Synchronous penile urethra onlay patch and scrotal reconstruction after Fournier's gangrene using medial thigh flaps	Case Report	No complications	1 patient -1 flaps	1	1	Medial thigh fasciocutaneous flap (1)	60
Kamei, et al. [107]	1994	Composite gastric seromuscular and omental pedicle flap for urethral and scrotal reconstruction after Fournier's gangrene.	Case Report	No complications	1 patient -2 flap	1	2	Composite gastric seromuscular and omental pedicle flap	58
Hallock, [108]	1990	Scrotal reconstruction following Fournier's gangrene using the medial thigh fasciocutaneous flap.	Case Report	1 wound dehiscence	1 patient -1 flap	1	1	Medial thigh fasciocutaneous flap (1)	67
Banks et al. [109]	1986	Gracilis musculocutaneous flap scrotal reconstruction after Fournier gangrene.	Case Report	No complications	1 patient -2 flaps	1	2	Musculocutaneous gracilis flap (2)	32
DiGeronimo [110]	1982	Scrotal reconstruction utilizing a unilateral adductor minimus myocutaneous flap	Case Report	No complications	1 patient -3 flaps	1	3	Adductor minimus myocutaneous flap (1) Gracilis myocutaneous flap (2)	59

(*continued on next page*)

Table 1 (*continued*)

Author	Year	Title	Study Design	Flap Complications	Sample size	Number of FG	Number of flaps	Type of Flap	Mean age
Goldan, et al. [111]	1982	Penile skin flap for reconstruction of the scrotum in Fournier's gangrene.	Case Report	No complications	1 patient -1 flap	1	1	Rotation-advancement penile skin flap (1)	Not specified
Hirshowitz, et al. [112]	1980	One-stage reconstruction of the scrotum following Fournier's syndrome using a probable arterial flap.	Case Report	No complications	1 patient -2 flaps	1	2	Superiomedial-based thigh flap (2)	61
Sonoda et al. [113]	1980	Spontaneous gangrene of the scrotum and penis (Fournier's gangrene)	Case Report	No complications	1 patient -1 flap	1	1	Inner thigh transposition flap (1)	43
Tiwari, et al. [114]	1980	Reconstruction of the scrotum by thigh flaps.	Case Report	No complications	1 patient -2 flaps	1	2	Medial thigh flap (2)	52
Biswas et al. [115]	1979	Necrotizing infection of scrotum	Retrospective	No complications	2 patients -2 flaps	2	2	Skin flap (2)	63.5 (flap patients)
Moustafa [116]	1967	Gangrene of the scrotum: An analysis of ten cases	Case Report	No complications	1 patient -3 flaps	1	3	Thigh flap (2) Rectangular abdominal flap (1)	51

Table 2
Summary of flap types used for reconstruction following Fournier's gangrene.

Flap Type	Tissue Type	Typical Indications	Number of Cases (n)	Key Advantages	**Notes**
Medial Thigh Flap	Fasciocutaneous	Bilateral scrotal defects, exposed testes	177	Reliable vascularity, good color/texture match	Most frequently used flap
Pudendal Thigh Flap	Fasciocutaneous / Myocutaneous variant	Scrotal + perineal composite defects	69	Sensate, low donor morbidity	Requires precise vascular preservation
Anterolateral Thigh (ALT) Flap	Fasciocutaneous / Adipofascial	Large perineoscrotal defects	66	Large surface area, long pedicle	Workhorse for extensive loss
Scrotal Advancement Flap	Local skin advancement	Partial scrotal loss with remaining scrotal skin	65	Simple, fast, excellent texture match	Not suitable for total loss
Gracilis Muscle Flap	Muscle or myocutaneous	Deep perineal or ischiorectal space defects	54	Fills dead space, well vascularized	Useful in contaminated wounds
Rectus Abdominis / VRAM	Myocutaneous	Suprapubic/perineal complex defects	6	Bulk + reliable vascularity	Higher donor morbidity
Groin / SCIA / IGAP / Posterior Thigh / Other Perforator Flaps	Fasciocutaneous	Reconstruction tailored to defect geometry	~40 total (various)	Versatile options	Less frequently used
Free Flaps	Microvascular	Reconstructive salvage when no regional tissue available	2	High versatility	Rare due to patient instability + logistics

surgery.

Reconstructive outcomes were generally positive, though follow-up durations were limited in many reports. Wound healing was achieved in the vast majority of cases with relatively few major complications. Total or near-total flap loss was reported in 17 cases (approx. 1.6 % of flaps). Partial flap necrosis or minor flap loss was uncommon as well. Infection of the flap or surgical site occurred in 25 cases (~4 %). Wound dehiscence was reported in 39 cases (~2.7 %). Seroma formation occurred in 8 cases and hematoma in 4 cases (each representing <2 % of flaps). Donor site morbidity (such as donor wound infection, hematoma, or gait disturbance from thigh flaps) was reported in roughly 7 % of patients (around 43 patients), although this was likely underreported in many studies. Importantly, no perioperative mortality was attributed to the reconstructive surgery itself in any report (deaths, when they occurred, were due to the underlying disease severity).

Functional outcomes (such as restoration of urinary continence or sexual function) and aesthetic outcomes were described in qualitative terms by some authors. Over 90 % of patients were said to have "satisfactory" or "acceptable" results from the surgeon's or patient's perspective in the subset of studies commenting on this. Commonly mentioned benefits of flaps included the ability to urinate normally (avoiding perineal urinary diversion), protection and normalization of testicular position and temperature (when scrotal reconstruction was done), and overall improved body image and confidence. However, objective measurements of these outcomes were almost never used. Only two studies applied a validated instrument (the International Index of Erectile Function in those two cases) to assess functional recovery. No study employed formal quality of life questionnaires or patient-reported outcome measures.

A general pattern could be discerned wherein certain flaps were favored for specific defect locations. For instance, medial thigh (anteromedial) flaps and pudendal thigh flaps were most often used for scrotal reconstruction, effectively replacing the scrotal skin. Gracilis muscle flaps were frequently chosen for deeper perineal defects, especially those extending into ischiorectal fossa or involving significant dead space. Large defects spanning the perineum to lower abdominal wall or thigh were sometimes addressed with ALT flaps or other thigh flaps (including, in one case, a combined bilateral ALT and abdominal flap). Penile shaft skin loss was relatively uncommon, but a few cases were managed with local shaft skin flaps or skin grafts; one case reported a preputial flap for penile reconstruction. When the abdominal wall or groins were involved, some authors used groin flaps or pedicled rectus abdominis myocutaneous flaps. Free flaps were essentially a last resort and were rarely needed given the availability of closer tissue.

4. Discussion

Fournier's gangrene remains a formidable clinical challenge, not only because of its rapid progression and life-threatening sepsis, but also due to the complex reconstructive demands following source control. This systematic review, the largest synthesis to date focusing specifically on flap reconstruction in Fournier's gangrene, demonstrates that

regional flap-based reconstruction is safe, effective, and widely applicable, offering functional and aesthetic benefits that surpass traditional methods such as skin grafting or healing by secondary intention.

The predominance of regional fasciocutaneous flaps, especially the medial thigh, pudendal thigh, anterolateral thigh (ALT), and scrotal advancement flaps, highlights several important considerations. First, these flaps are versatile and anatomically reliable, offering an arc of rotation and tissue bulk well suited to perineal and genital reconstruction. The medial thigh flap, used in 177 cases, stands out for its proximity, pliability, and low donor site morbidity, and is especially valuable in bilateral scrotal defects or when the testicles are completely denuded. It can be performed without microsurgical expertise, making it accessible in a range of healthcare settings [12,29,47,61,77,84,85,105,107].

Similarly, the pudendal thigh flap has gained favor for its ability to reconstruct scrotal and perineal tissues with good color and texture match, while preserving sensation and minimizing morbidity [22,38,39,43,68,86]. Though it requires precise planning to preserve the external pudendal vascular axis, its advantages in terms of recovery and outcome have been well described. The anterolateral thigh (ALT) flap, known for its long vascular pedicle and customizable skin paddle, was also widely used. Its capacity to cover large, composite defects makes it a superior option in massive tissue loss, particularly where prior grafting has failed or when other regional flaps are unavailable [11,26,31,50,51,53,59,67,79,100].

In contrast, muscle flaps, notably the gracilis, were employed less frequently but served an important role in specific situations [8,19,40,64,68,87,95,108]. The gracilis muscle is expendable, easily harvested, and can be tunneled into deep perineal or ischiorectal spaces, making it valuable when there is significant dead space or contamination. Its vascularity supports healing in previously infected or irradiated fields, and muscle bulk can help protect vital structures such as the urethra or femoral vessels. However, in the absence of these complexities, fasciocutaneous flaps are often preferred for their superior cosmesis and reduced donor site morbidity.

Complication rates across this large and diverse cohort were notably low, especially when considering the baseline clinical severity of the patients. The 1.6 % flap loss rate and 4 % infection rate compare favorably with outcomes in flap-based reconstructions for oncologic or trauma-related perineal defects. This suggests that flap reconstruction, even in previously infected fields, is not only feasible but robust, provided appropriate timing and technique are employed.

Importantly, the majority of flap reconstructions reported in this review were performed in carefully selected patients with complex defects, often after failure of standard wound management strategies such as secondary healing, negative pressure wound therapy, or skin grafting. As such, flap reconstruction in Fournier's gangrene should be viewed as a targeted solution for advanced reconstructive scenarios rather than a universal first-line approach.

A particularly salient finding from this review is the minimal role of free flaps, only two cases across 619 patients. This likely reflects a confluence of factors: patient instability, comorbidities, institutional limitations, and the adequacy of regional options. While free flaps such as the radial forearm or ALT can theoretically provide excellent outcomes, their use in Fournier's gangrene is often precluded by the need for stable recipient vessels, prolonged operative time, and microsurgical expertise. The widespread success of local and regional options underscores their ongoing relevance in contemporary reconstructive algorithms.

Functionally, the preservation of scrotal anatomy and thermoregulation is essential, particularly for those seeking fertility preservation. Local flaps such as the medial thigh and pudendal thigh restore normal anatomy and prevent the need for testicular implantation in the thigh, a historically common but now largely outdated technique that carries risks of infertility, discomfort, and psychological distress [13,14].

Despite the procedural success, the literature remains limited in its assessment of functional, psychological, and quality-of-life outcomes. No studies incorporated patient-reported outcome measures (PROMs). Additionally, outcome assessments were largely subjective; most authors described results as 'satisfactory' based on clinical or patient impression, without the use of standardized assessment tools. Given the profound impact of genital and perineal disfigurement on self-esteem, body image, sexuality, and continence, future research must prioritize long-term follow-up and incorporate PROMs into reconstructive outcomes.

This review also identifies a lack of standardized flap selection algorithms. Most studies reflected institutional or individual surgeon preferences rather than objective criteria. While the defect location and size naturally guide reconstruction, there is opportunity for future consensus statements or clinical guidelines to delineate flap preferences based on anatomical zones, availability of donor tissue, and patient factors such as comorbidity or previous surgeries. Moreover, timing of reconstruction was poorly reported, with most studies lacking explicit documentation of the interval between last debridement and flap coverage. Notably, only 11 cases (<5 %) in our review underwent reconstruction within 48 h of the initial debridement, whereas the vast majority were performed after 7 days; however, many publications did not clearly report the timing at all. This information is critical for establishing best practices around early versus delayed reconstruction, particularly in infected fields.

A final limitation of the existing literature is the paucity of high-level evidence. The vast majority of studies were retrospective, non-comparative, and single-centre. While this is understandable given the rarity and heterogeneity of Fournier's gangrene, it limits the ability to make evidence-based comparisons between flap types or reconstructive strategies. Prospective registries, multicentre collaborations, and standardized outcome reporting would substantially improve the evidence base and facilitate comparative effectiveness research. Cross-specialty collaboration, between urology, plastic surgery, general surgery, and wound care, would further strengthen clinical integration and resource optimization.

5. Conclusion

In summary, this comprehensive review demonstrates that flap-based reconstruction for Fournier's gangrene is a feasible and reliable reconstructive option in selected patients, with generally favorable short-term functional and aesthetic outcomes reported across the existing literature. The dominant use of regional fasciocutaneous flaps reflects their versatility, low complication profile, and reliability in complex genital and perineal reconstructions. While flap selection is influenced by defect characteristics and surgeon expertise, this review suggests that medial thigh, pudendal thigh, ALT, and gracilis flaps constitute the workhorse options for the majority of cases. The field would benefit from greater standardization in reporting, incorporation of validated outcome tools, and development of clinical algorithms. With the increasing prevalence of comorbid conditions such as diabetes and immunosuppression, Fournier's gangrene will remain a reconstructive challenge - one best met with thoughtful, evidence-informed flap reconstruction strategies. Future multicentre studies with standardized outcome reporting, longer follow-up, and comparative analysis between reconstructive strategies are needed to better define optimal flap selection, durability of results, and broader applicability across diverse patient populations.

Ethical statement

This study is a systematic review of previously published literature and did not involve human participants, identifiable personal data, or new data collection. Accordingly, research ethics board approval was not required. All procedures were conducted in accordance with applicable laws, institutional guidelines, and internationally accepted standards for systematic reviews.

The authors have no conflicts of interest to declare. All authors contributed to the conception, design, data extraction, and analysis of this review, participated in drafting and revising the manuscript, and approved its final submission. The manuscript is original and is not under consideration by any other journal.

Funding statement

No funding was received to undertake this research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.burns.2026.107888.

References

[1] Stevens DL, Bryant AE. Necrotizing soft-tissue infections. N Engl J Med 2017;377 (23):2253–65. https://doi.org/10.1056/NEJMra1600673. PMID: 29211672.
[2] Kalorin CM, Tobin EH. Community associated methicillin resistant Staphylococcus aureus causing Fournier's gangrene and genital infections. J Urol 2007;177(3):967–71. https://doi.org/10.1016/j.juro.2006.10.041. PMID: 17296389.
[3] Mallikarjuna MN, Vijayakumar A, Patil VS, Shivswamy BS. Fournier's gangrene: current practices. ISRN Surg 2012:942437. https://doi.org/10.5402/2012/942437. Epub 2012 Dec 3. PMID: 23251819; PMCID: PMC3518952.
[4] Wall DB, Klein SR, Black S, de Virgilio C. A simple model to help distinguish necrotizing fasciitis from nonnecrotizing soft tissue infection. J Am Coll Surg 2000;191(3):227–31. https://doi.org/10.1016/s1072-7515(00)00318-5.
[5] Endorf FW, Klein MB, Mack CD, Jurkovich GJ, Rivara FP. Necrotizing soft-tissue infections: differences in patients treated at burn centers and non-burn centers. J Burn Care Res 2008;29(6):933–8. https://doi.org/10.1097/BCR.0b013e31818ba112. PMID: 18997557; PMCID: PMC3042354.
[6] Thwaini A, Khan A, Malik A, Cherian J, Barua J, Shergill I, Mammen K. Fournier's gangrene and its emergency management. Post Med J 2006;82(970):516–9. https://doi.org/10.1136/pgmj.2005.042069. PMID: 16891442; PMCID: PMC2585703.
[7] Susini P, Marcaccini G, Efica J, Giuffrè MT, Mazzotta R, Caneschi C, Cuomo R, Nisi G, Grimaldi L. Fournier's gangrene surgical reconstruction: a systematic review. J Clin Med 2024;13(14):4085. https://doi.org/10.3390/jcm13144085. PMID: 39064124; PMCID: PMC11278345.
[8] Gokkulakrishnan S, Babu AS, Ramachandran K, Chakravarthy R, Chandrasekar S. Versatility of the gracilis myocutaneous flap in the reconstruction of perineal defects. Indian J Plast Surg 2013;46(1):94–8. https://doi.org/10.4103/0970-0358.113725.
[9] Biju NE, Sadiq M, Raj S, Patel A, Shah R, Weale RD, Thomas K, Rose V. Fournier's gangrene reconstruction: a 10-year retrospective analysis of practice at Guys and St Thomas's NHS Foundation Trust. J Plast Reconstr Aesthet Surg 2023;80:13–5. https://doi.org/10.1016/j.bjps.2023.02.030. Epub 2023 Mar 5.
[10] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372(n71). https://doi.org/10.1136/bmj.n71. PMID: 33782057; PMCID: PMC8005924.
[11] Chen JH, Li YB, Li DG, Zeng XM, Yao QY, Fu J, Wang GH, Huang XY. Vacuum sealing drainage to treat Fournier's gangrene. BMC Surg 2023;23(1):211. https://doi.org/10.1186/s12893-023-02109-0. PMID: 37496026; PMCID: PMC10373254.
[12] Meuli JN, Hubner M, Martineau J, Oranges CM, Guillier D, Raffoul W, di Summa PG. Impact of etiology leading to abdominoperineal resection with anterolateral thigh flap reconstruction: A retrospective cohort study. J Surg Oncol 2023;127(1):40–7. https://doi.org/10.1002/jso.27092. PMID: 36112361; PMCID: PMC10087003.
[13] Öcük Ö, Yağın FH, Dinç OG, Fırat C. Effectiveness of fasciocutaneous superomedial thigh flap in reconstruction of Fournier gangrene defects. Eplasty 2022;22:e26.
[14] Puranik A, Baskaran S, Kumar RR. An innovative technique of testicular preservation in Fournier's gangrene: surgical details and illustration. Cureus 2022;14(8):e27581. https://doi.org/10.7759/cureus.27581. PMID: 36059333; PMCID: PMC9433164.
[15] Maurya R, Mir MA, Mahajan S. Various options for scrotal reconstruction: a prospective observational study. Cureus 2022;14(2):e22671. https://doi.org/10.7759/cureus.22671. PMID: 35371653; PMCID: PMC8965535.
[16] Beecroft NJ, Jaeger CD, Rose JR, Becerra CMC, Shah NC, Palettas MS, Lehman A, Posid T, Jenkins LC, Baradaran N. Fournier's gangrene in females: presentation and management at a tertiary center. Urology 2021;151:113–7. https://doi.org/10.1016/j.urology.2020.05.056.
[17] Dadaci M, Yildirim MEC, Yarar S, Ince B. Assessment of outcomes after limberg flap reconstruction for scrotal defects in patients with Fournier's gangrene. Wounds 2021;33(3):65–9.
[18] Insua-Pereira I, Ferreira PC, Teixeira S, Barreiro D, Silva Á. Fournier's gangrene: a review of reconstructive options. Cent Eur J Urol 2020;73(1):74–9. https://doi.org/10.5173/ceju.2020.0060. PMID: 32395328; PMCID: PMC7203772.
[19] Odusanya BO, Saliu NA, Salami OA. Fournier's gangrene: management in a poor resource setting. SN Compr Cllin Med 2020;2:209–14. https://doi.org/10.1007/s42399-020-00226-y.
[20] Weinstein B, King KS, Triggs W, Harrington MA, Pribaz J. Bilobed gracilis flap: a novel alternative for pelvic and perineal reconstruction. Plast Reconstr Surg 2020; 145(1):231–4. https://doi.org/10.1097/PRS.0000000000006341.
[21] Graham JN, Khusid J, Smith M, Winer A, Shteynberg A, Kabarriti A. Penile reconstruction after Fournier's gangrene. Urol Video J 2020;5:100018. https://doi.org/10.1016/j.urolvj.2019.100018.
[22] Zhou Z, Guo F, Huan J. Fournier's gangrene with septic shock and multiple organ dysfunction syndrome. Int J Low Extrem Wounds 2019;18(1):94–6. https://doi.org/10.1177/1534734618818685. Epub 2019 Jan 8.
[23] Ünverdi ÖF, Kemaloğlu CA. A reliable technique in the reconstruction of large penoscrotal defect: internal pudendal artery perforator flap. Urology 2019;128: 102–6. https://doi.org/10.1016/j.urology.2019.02.028. Epub 2019 Mar 14. PMID: 30880073.
[24] Selvi I, Aykac A, Baran O, Burlukkara S, Ozok U, Sunay MM. A different perspective for morbidity related to Fournier's gangrene: which scoring system is more reliable to predict requirement of skin graft and flaps in survivors of Fournier's gangrene? Int Urol Nephrol 2019;(8):1303–11. https://doi.org/10.1007/s11255-019-02188-0. Epub 2019 Jun 8.
[25] Onder CE, Gursoy K, Kuskonmaz SM, Kocer U, Culha C. Fournier's gangrene in a patient on dapagliflozin treatment for type 2 diabetes. J Diabetes 2019;11(5): 348–50. https://doi.org/10.1111/1753-0407.12896. Epub 2019 Feb 5.
[26] Louro JM, Albano M, Baltazar J, Vaz M, Diogo C, Ramos S, Cabral L. Fournier's gangrene: 10-year experience of a plastic surgery and burns department at a tertiary hospital. Acta Med Port 2019;32(5):368–74. https://doi.org/10.20344/amp.11003. Epub 2019 May 31.
[27] Kadota H, Momii K, Hanada M, Kamizono K, Inatomi Y, Hisanaga K, Yoshida S, Ogaki K, Kiyoshima K. Simultaneous deep inferior epigastric and bilateral anterolateral thigh perforator flap reconstruction of an extended perineoscrotal defect in Fournier's gangrene: a case report. Microsurgery 2019;39(3):263–6. https://doi.org/10.1002/micr.30409. Epub 2019 Jan 21.
[28] Ghahestani SM, Hekmati P, Karimi S. A new technique of scrotoplasty following total scrotal destruction by raised rotated perineal flaps with de epithelialized borders. Urol J 2019;16(2):221–3. https://doi.org/10.22037/uj.v0i0.4170.
[29] Hoang D, Goel P, Chen VW, Carey J. Phalloplasty following penectomy for Fournier's gangrene at a tertiary care center. Cureus 2018;10(12):e3698. https://doi.org/10.7759/cureus.3698.
[30] Mello DF, Helene Júnior A. Scrotal reconstruction with superomedial fasciocutaneous thigh flap. Rev Col Bras Cir 2018;45(1):e1389. https://doi.org/10.1590/0100-6991e-20181389.
[31] Wang T, Zhao G, Rui YJ, Mi JY. Bilateral femoral posterior neurocutaneous perforater flap successfully treating Fournier gangrene: a case report. Med (Baltim) 2017;96(46):e8720. https://doi.org/10.1097/MD.0000000000008720. PMID: 29145312; PMCID: PMC5704857.
[32] Scaglioni MF, Fakin RM, Barth AA, Giovanoli P. Bilateral pedicle anterolateral thigh (ALT) flap combined with bilateral sartorius muscle flap for reconstruction of extensive perineoscrotal and medial thigh defect because of Fournier's gangrene. Microsurgery 2017;37(6):669–73. https://doi.org/10.1002/micr.30083.
[33] Sawayama H, Miyanari N, Sugihara H, Iwagami S, Mizumoto T, Kubota T, Haga Y, Baba H. A fascia lata free flap in pelvic exenteration for Fournier gangrene due to advanced rectal cancer: a case report. Surg Case Rep 2017;3(1): 74. https://doi.org/10.1186/s40792-017-0350-y. PMID: 28550641; PMCID: PMC5446431.
[34] Ikramullah Ullah I, Iqbal Q, Fournier's Saaiq M. gangrene: management experience of 39 cases. J Post Med Inst 2017;31(4):371–7.
[35] Hong JP, Kim CG, Suh HS, Kim H, Yoon CS, Kim KN. Perineal reconstruction with multiple perforator flaps based on anatomical divisions. Microsurgery 2017;37 (5):394–401. https://doi.org/10.1002/micr.30152. Epub 2017 Jan 4.
[36] Hagedorn JC, Wessells H. A contemporary update on Fournier's gangrene. Nat Rev Urol 2017;14(4):205–14. https://doi.org/10.1038/nrurol.2016.243. Epub 2016 Dec 13.
[37] Fang CL. A rare etiology of Fournier's gangrene: pubic tubercle fracture complicated with hematoma and acute osteomyelitis. Formos J Surg 2017;50(4): 145–9. https://doi.org/10.4103/fjs.fjs_46_17.
[38] Djedovic G, Del Frari B, Matiasek J, Schiltz D, Engelhardt TO, Pierer G, Rieger UM. The versatility of the medial thigh lift for defect coverage in the genito-perineal region. Int Wound J 2017;14(3):496–500. https://doi.org/10.1111/iwj.12634. Epub 2016 Aug 1. PMID: 27476473; PMCID: PMC7950170.
[39] Baek SO, Park SH, Rhie JW, Han HH. Peri-vulvar reconstruction using internal pudendal artery perforator flap in female Fournier's gangrene. Int Wound J 2017; 14(6):1378–81. https://doi.org/10.1111/iwj.12744. PMID: 28371369; PMCID: PMC7949781.

[40] Al Moktader MA. Anteriorly based pudendal thigh flap for scrotal reconstruction based on the deep external pudendal artery (DEPA) flap. Eur J Plast Surg 2016; 39:107–12. https://doi.org/10.1007/s00238-015-1160-8.

[41] Daigeler A, Behr B, Mikhail BD, Lehnhardt M, Wallner C. Bilateral pedicled gracilis flap for scrotal reconstruction. J Plast Reconstr Aesthet Surg 2016;69(9): e195-6. https://doi.org/10.1016/j.bjps.2016.05.024. Epub 2016 Jun 2.

[42] Han HH, Lee JH, Kim SM, Jun YJ, Kim YJ. Scrotal reconstruction using a superficial circumflex iliac artery perforator flap following Fournier's gangrene. Int Wound J 2016 Oct;13(5):996–9. https://doi.org/10.1111/iwj.12353. 25091799; PMCID: PMC7950137.

[43] Moore SJ, Rashidipour O, Moore RB. Primary metastatic squamous cell carcinoma of the male urethra presenting with scrotal abscess and subsequent development of Fournier's gangrene. Clin Med Insights Case Rep 2016;29(9): 83–6. https://doi.org/10.4137/CCRep.S40420. PMID: 27721660; PMCID: PMC5045045.

[44] Mopuri N, O'Connor EF, Iwuagwu FC. Scrotal reconstruction with modified pudendal thigh flaps. J Plast Reconstr Aesthet Surg 2016;69(2):278–83. https://doi.org/10.1016/j.bjps.2015.10.039. Epub 2015 Nov 18.

[45] Namkoong H, Ishii M, Koizumi M, Betsuyaku T. Fournier's gangrene: a surgical emergency. Infection 2016;44(1):143–4. https://doi.org/10.1007/s15010-015-0816-4.

[46] Singh A, Ahmed K, Aydin A, Khan MS, Dasgupta P. Fournier's gangrene. A clinical review. Arch Ital Urol Androl 2016;88(3):157–64. https://doi.org/10.4081/aiua.2016.3.157.

[47] Sung KW, Lee WJ, Yun IS, Lee DW. Reconstruction of large defects in the perineal area using multiple perforator flaps. Arch Plast Surg 2016;43(5):446–50. https://doi.org/10.5999/aps.2016.43.5.446. PMID: 27689052; PMCID: PMC5040847.

[48] Scaglioni MF, Chen YC, Yang JC. Posteromedial thigh (PMT) propeller flap for perineoscrotal reconstruction: a case report. Microsurgery 2015;35(7):569–72. https://doi.org/10.1002/micr.22479.

[49] Onyekwelu O, Reid A, McGrouther D. Reconstruction of perineo-scrotal defects from Fournier's gangrene with the adipofascial anterolateral thigh flap. J Clin Urol 2015;8(1):33–7. https://doi.org/10.1177/2051415814537821.

[50] Kalra S, Dorairajan LN, Mehra K, Manikandan R. Keystone flaps in urethroplasty: reconstruction in a complex case of panurethral stricture disease. Niger Med J 2019;60(2):95–7. https://doi.org/10.4103/nmj.NMJ_30_19. PMID: 31462850; PMCID: PMC6688390.

[51] di Summa PG, Tremp M, Meyer Zu Schwabedissen M, Schaefer DJ, Kalbermatten DF, Raffoul W. The combined pedicled anterolateral thigh and vastus lateralis flap as filler for complex perineal defects. Ann Plast Surg 2015;75 (1):66–73. https://doi.org/10.1097/SAP.0b013e3182a884c8.

[52] Lin CT, Chang SC, Chen SG, Tzeng YS. Reconstruction of perineoscrotal defects in Fournier's gangrene with pedicle anterolateral thigh perforator flap. ANZ J Surg 2016;86(12):1052–5. https://doi.org/10.1111/ans.12782.

[53] Ahn DK, Kim SW, Park SY, Kim YH. Reconstructive strategy and classification of penoscrotal defects. Urology 2014;84(5):1217–22. https://doi.org/10.1016/j.urology.2014.06.023.

[54] Bhadkamkar MA, Wolfswinkel EM, Hatef DA, Albright SB, Echo A, Hsu PW, Izaddoost SA. The ultra-thin, fascia-only anterolateral thigh flap. J Reconstr Microsurg 2014;30(9):599–606. https://doi.org/10.1055/s-0033-1361843. Epub 2014 Feb 19.

[55] El-Shazly M, Sultan M, Salem S, Alkandari I, Shebl M. Fournier's gangrene: outcome analysis of 62 consecutive cases. J Clin Urol 2014;7(4):261–5. https://doi.org/10.1177/2051415813518331.

[56] Pagnotta A, Colicchia GM, Tati E, et al. Superficial circumflex iliac artery perforator flap in a case of Fournier's gangrene. Eur J Plast Surg 2014;37:305–8. https://doi.org/10.1007/s00238-014-0938-4.

[57] Sliwinski A, Kavanagh LE, Bolton D, Lawrentschuk N, Crock JG. Fournier's gangrene - delayed pedicle flap based upon the anterior abdominal wall. Int Braz J Urol 2014;40(3):423–6. https://doi.org/10.1590/S1677-5538.IBJU.2014.03.18.

[58] Ziypak T., Adanur S., Ozkaya F., Yapanoglu T., Okyar G. Our experiences of Fournier's gangrene: 71 cases. Presented at the 28th Annual European Association of Urology Congress; March 15-19, 2013; Milan, Italy. DOI 10.1016/s1569-9056(13)61099-4.

[59] Yarze J, Sablich D. Fournier's gangrene after sigmoidoscopy in a patient with distal rectal cancer: 1217. Am J Gastroenterol 2013;108:S357 (Suppl).

[60] Spyropoulou GA, Jeng SF, Demiri E, Dionyssopoulos A, Feng KM. Reconstruction of perineoscrotal and vaginal defects with pedicled anterolateral thigh flap. Urology 2013;82(2):461–5. https://doi.org/10.1016/j.urology.2013.04.044.

[61] Park KR, Kim TG, Lee J, Ha JH, Kim YH. Single-stage reconstruction of extensive defects after Fournier's gangrene with an exposed iliac crest and testes. Arch Plast Surg 2013;40(1):74–6. https://doi.org/10.5999/aps.2013.40.1.74. PMID: 23362487; PMCID: PMC3556541.

[62] Oufkir AA, Tazi MF, El Alami MN. The superomedial thigh flap in scrotal reconstruction: technical steps to improve cosmetic results. Indian J Urol 2013;29 (4):360–2. https://doi.org/10.4103/0970-1591.120132. PMID: 24235804; PMCID: PMC3822358.

[63] Mughal M, Baker RJ, Muneer A, Mosahebi A. Reconstruction of perineal defects. Ann R Coll Surg Engl 2013;95(8):539–44. https://doi.org/10.1308/rcsann.2013.95.8.539. PMID: 24165333; PMCID: PMC4311526.

[64] Khan Q, Knight RJW, Goodwin-Walters A. Scrotal reconstruction: a review and a proposed algorithm. Eur J Plast Surg 2013;36:399–406. https://doi.org/10.1007/s00238-013-0833-4.

[65] Crane C, Cornejo A, Lyons R, Alter GJ. Urethral reconstruction using a prefabricated pedicled gracilis flap. Ann Plast Surg 2013;70(6):691–3. https://doi.org/10.1097/SAP.0b013e3182414843.

[66] Aliyu S, Ibrahim AG, Ali N, Waziri AM. Fournier's gangrene as seen in university of maiduguri teaching hospital. ISRN Urol 2013;12(2013):673121. https://doi.org/10.1155/2013/673121. PMID: 23997966; PMCID: PMC3753747.

[67] De Souza M.A.C., De Souza THSC, Mendonça DIM, Bessa IAF, Da Germano BCCP. Puerperal sepsis with Fournier's syndrome. DOI:10.1016/S0020-7292(12)61791-3.

[68] Hsu H, Chien SH, Wang CH, Cheng LF, Lin CM, Wu MS, Huang CC, Lee JT. Expanding the applications of the pedicled anterolateral thigh and vastus lateralis myocutaneous flaps. Ann Plast Surg 2012;69(6):643–9. https://doi.org/10.1097/SAP.0b013e3182749d31.

[69] Lee SH, Rah DK, Lee WJ. Penoscrotal reconstruction with gracilis muscle flap and internal pudendal artery perforator flap transposition. Urology 2012;79(6): 1390–4. https://doi.org/10.1016/j.urology.2012.01.073.

[70] Karsidag S, Akcal A, Sirvan SS, Guney S, Ugurlu K. Perineoscrotal reconstruction using a medial circumflex femoral artery perforator flap. Microsurgery 2011;31 (2):116–21. https://doi.org/10.1002/micr.20839. Epub 2011 Jan 25.

[71] Doğan F, Eskitaşçıoğlu T, Altıparmak M, Özyazgan İ. Bilateral super thin groin island flap for penile, scrotal, and pubic reconstruction after Fournier's gangrene. Eur J Plast Surg 2011;34:497–9. https://doi.org/10.1007/s00238-010-0479-4.

[72] Djedovic G, Rieger UM, Skradski V, Pierer G. Re: Scrotal reconstruction by testicular apposition and wrap-around skin grafting. J Plast Reconstr Aesthet Surg 2011;64(10):1392–3. https://doi.org/10.1016/j.bjps.2011.03.043.

[73] Coskunfirat OK, Uslu A, Cinpolat A, Bektas G. Superiority of medial circumflex femoral artery perforator flap in scrotal reconstruction. Ann Plast Surg 2011;67 (5):526–30. https://doi.org/10.1097/SAP.0b013e318208ff00.

[74] Chen SY, Fu JP, Chen TM, Chen SG. Reconstruction of scrotal and perineal defects in Fournier's gangrene. J Plast Reconstr Aesthet Surg 2011;64(4):528–34. https://doi.org/10.1016/j.bjps.2010.07.018.

[75] Callaghan MA, Baggott R, D'Arcy FT. Septic shock due to Fournier's gangrene of the scrotum. BMJ Case Rep 2011;(2011):bcr0820114634. https://doi.org/10.1136/bcr.08.2011.4634.

[76] Aydin T, Feyzi K, Tayfun T, Berna T. Reconstruction of wide scrotal defect using groin fasciocutaneous island flap combined with a strip of deep fascia. J Plast Reconstr Aesthet Surg 2010;63(8):1394–5. https://doi.org/10.1016/j.bjps.2010.01.006. Epub 2010 Jun 8.

[77] Chen SY, Fu JP, Wang CH, Lee TP, Chen SG. Fournier gangrene: a review of 41 patients and strategies for reconstruction. Ann Plast Surg 2010;64(6):765–9. https://doi.org/10.1097/SAP.0b013e3181ba5485.

[78] Maguina P, Paulius KL, Kale S, Kalimuthu R. Medial thigh fasciocutaneous flaps for reconstruction of the scrotum following Fournier gangrene. Plast Reconstr Surg 2010;125(1):28e–30e. https://doi.org/10.1097/PRS.0b013e3181c2a292.

[79] Ng D, Tang CB, Kadirkamanathan SS, Tare M. Scrotal reconstruction with a free greater omental flap: a case report. Microsurgery 2010;30(5):410–3. https://doi.org/10.1002/micr.20763.

[80] Tomar SS. Fournier's gangrene - Not a stigma for surgery with newer surgical reconstruction of scrotum. Indian J Surg 2010;72(1):339–40. https://doi.org/10.1007/s12262-010-0078-4. PMID: 23133291; PMCID: PMC3451867.

[81] Spyriounis PK. Scrotum reconstruction with the anterolateral (ALT) thigh flap. Eur J Plast Surg 2009;32(2):123–6. https://doi.org/10.1007/s00238-008-0321-4.

[82] Rajan P, Raza A, Pemberton RJ, Tolley DA. Testicular torsion following a skin graft for Fournier's gangrene. Int J Clin Pract 2009;63(1):176–7. https://doi.org/10.1111/j.1742-1241.2005.00717.x.

[83] Isken T, Onyedi M, Şen C, Izmirli H, Yucel E. A novel application for repair of skin defects of the penis: anterior scrotal artery flap. Plast Reconstr Surg 2009;124(1): 181e–2e. https://doi.org/10.1097/PRS.0b013e3181a83c29.

[84] Bhatnagar AM, Mohite PN, Suthar M. Fournier's gangrene: a review of 110 cases for aetiology, predisposing conditions, microorganisms, and modalities for coverage of necrosed scrotum with bare testes. N Z Med J 2008;121(1275):46–56.

[85] Al-Fadhli AN, Burezq H, Abdulfattah N, Ayad W. The versatility of the medial thigh flap for coverage of large perineoscrotal defects. Kuwait Med J 2008;40(4): 293–6.

[86] Lee SW, Bang CY, Kim JH. Penoscrotal reconstruction using groin and bilateral superomedial thigh flaps: a case of penile vaselinoma causing Fournier's gangrene. Yonsei Med J 2007;48(4):723–6. https://doi.org/10.3349/ymj.2007.48.4.723. PMID: 17722250; PMCID: PMC2628043.

[87] Karaçal N, Livaoglu M, Kutlu N, Arvas L. Scrotum reconstruction with neurovascular pedicled pudendal thigh flaps. Urology 2007;70(1):170–2. https://doi.org/10.1016/j.urology.2007.03.049.

[88] Hsu H, Lin CM, Sun TB, Cheng LF, Chien SH. Unilateral gracilis myofasciocutaneous advancement flap for single stage reconstruction of scrotal and perineal defects. J Plast Reconstr Aesthet Surg 2007;60(9):1055–9. https://doi.org/10.1016/j.bjps.2006.09.005. Epub 2007 Feb 22.

[89] Ferreira PC, Reis JC, Amarante JM, Silva ÁC, Pinho CJ, Oliveira IC, da Silva PN. Fournier's gangrene: a review of 43 reconstructive cases. Plast Reconstr Surg 2007;119(1):175–84. https://doi.org/10.1097/01.prs.0000244925.80290.57.

[90] Carvalho JP, Hazan A, Cavalcanti AG, Favorito LA. Relation between the area affected by Fournier's gangrene and the type of reconstructive surgery used. A study with 80 patients. Int Braz J Urol 2007;33(4):510–4. https://doi.org/10.1590/s1677-55382007000400008.

[91] Atik B, Tan O, Ceylan K, Etlik O, Demir C. Reconstruction of wide scrotal defect using superthin groin flap. Urology 2006;68(2):419–22. https://doi.org/10.1016/j.urology.2006.04.003.

[92] Hallock GG. Scrotal reconstruction following fournier gangrene using the medial circumflex femoral artery perforator flap. Ann Plast Surg 2006;57(3):333–5. https://doi.org/10.1097/01.sap.0000218505.13232.1b.
[93] Morris MS, Morey AF, Stackhouse DA, Santucci RA. Fibrin sealant as tissue glue: preliminary experience in complex genital reconstructive surgery. Urology 2006; 67(4):688–91. https://doi.org/10.1016/j.urology.2005.10.063.
[94] Gravvanis AI, Tsoutsos DA, Iconomou TG, Papadopoulos SG. Penile resurfacing with vascularized fascia lata. Microsurgery 2005;25(6):462–8. https://doi.org/10.1002/micr.20149.
[95] Ellabban MG. Single stage muscle flap reconstruction of major scrotal defects. Burns 2004;30(5):505. https://doi.org/10.1016/j.burns.2004.01.004.
[96] Kayikçioğlu A. A new technique in scrotal reconstruction: short gracilis flap. Urology 2003;61(6):1254–6. https://doi.org/10.1016/s0090-4295(03)00158-4.
[97] Ellabban MG, Townsend PL. Single-stage muscle flap reconstruction of major scrotal defects: report of two cases. Br J Plast Surg 2003;56(5):489–93. https://doi.org/10.1016/s0007-1226(03)00178-4.
[98] DeCastro BJ, Morey AF. Fibrin sealant for the reconstruction of fournier's gangrene sequelae. J Urol 2002;167(4):1774–6.
[99] Maharaj D, Naraynsingh V, Perry A, Ramdass M. The scrotal reconstruction using the "Singapore Sling". Plast Reconstr Surg 2002;110(1):203–5. https://doi.org/10.1097/00006534-200207000-00034.
[100] Monteiro E, Carvalho P, Costa P, Ferraro A. "Inner thigh lift flap" for Fournier gangrene of the scrotum. Plast Reconstr Surg 2002;110(5):1372–3. https://doi.org/10.1097/00006534-200210000-00041.
[101] Yu P, Sanger JR, Matloub HS, Gosain A, Larson D. Anterolateral thigh fasciocutaneous island flaps in perineoscrotal reconstruction. Plast Reconstr Surg 2002;109(2):610–6. https://doi.org/10.1097/00006534-200202000-00030.
[102] Murakami H, Hyakusoku H, Matsuzawa I, Kondo Y, Akimoto M. Scrotal reconstruction with a thinned flap based on both inferior epigastric arteries. Scand J Plast Reconstr Surg Hand Surg 2001;35(1):99–101. https://doi.org/10.1080/02844310151032718.
[103] Kiliç A, Aksoy Y, Kiliç L. Fournier's gangrene: etiology, treatment, and complications. Ann Plast Surg 2001;47(5):523–7. https://doi.org/10.1097/00000637-200111000-00009.
[104] al-Shaham AA. Prepucial skin flap for reconstruction of the scrotum in Fournier's gangrene. Ann Chir Plast Esthet 2001;46(6):637–9. https://doi.org/10.1016/s0294-1260(01)00071-1.
[105] Beckenstein M, Smith AA, Dinchman K, Wyatt-Ashmead J, Meland NB. Muscle flap reconstruction aids in urethral regeneration. Ann Plast Surg 1996;36(6): 641–3. https://doi.org/10.1097/00000637-199606000-00014.
[106] Hallock GG. Synchronous penile urethra onlay patch and scrotal reconstruction after Fournier's gangrene using medial thigh flaps. Eur J Plast Surg 1996;19: 105–6. https://doi.org/10.1007/BF00207927.
[107] Kamei Y, Aoyama H, Yokoo K, Fujii K, Kondo C, Sato T, Onishi S. Composite gastric seromuscular and omental pedicle flap for urethral and scrotal reconstruction after Fournier's gangrene. Ann Plast Surg 1994;33(5):565–8. https://doi.org/10.1097/00000637-199411000-00018.
[108] Hallock GG. Scrotal reconstruction following Fournier's gangrene using the medial thigh fasciocutaneous flap. Ann Plast Surg 1990;24(1):86–90. https://doi.org/10.1097/00000637-199001000-00016.
[109] Banks DW, O'Brien 3rd DP, Amerson JR, Hester Jr TR. Gracilis musculocutaneous flap scrotal reconstruction after Fournier gangrene. Urology 1986;28(4):275–6. https://doi.org/10.1016/0090-4295(86)90003-8.
[110] DiGeronimo EM. Scrotal reconstruction utilizing a unilateral adductor minimus myocutaneous flap. Plast Reconstr Surg 1982;70(6):749–51.
[111] Goldan SS, Binur NS. Penile skin flap for reconstruction of the scrotum in Fournier's gangrene. Ann Plast Surg 1982;8(5):412–5. https://doi.org/10.1097/00000637-198205000-00009.
[112] Hirshowitz B, Moscona R, Kaufman T, Pnini A. One-stage reconstruction of the scrotum following Fournier's syndrome using a probable arterial flap. Plast Reconstr Surg 1980;66(4):608–12. https://doi.org/10.1097/00006534-198010000-00021.
[113] Sonoda A, Maekawa Y, Arao T, Kuwahara H. Spontaneous gangrene of the scrotum and penis (Fournier's gangrene). J Dermatol 1980;7(5):371–5. https://doi.org/10.1111/j.1346-8138.1980.tb01985.x.
[114] Tiwari IN, Seth HP, Mehdiratta KS. Reconstruction of the scrotum by thigh flaps. Plast Reconstr Surg 1980;66(4):605–7. https://doi.org/10.1097/00006534-198010000-00019.
[115] Biswas M, Godec C, Ireland G, Cass A. Necrotizing infection of scrotum. Urology 1979;14(6):576–80. https://doi.org/10.1016/0090-4295(79)90527-2.
[116] Moustafa MF. Gangrene of the scrotum: an analysis of ten cases. Br J Plast Surg 1967;20(1):90–6. https://doi.org/10.1016/s0007-1226(67)80011-0.