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Review

Role of diverting colostomy and reconstruction in managing Fournier's gangrene—a narrative review

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Objective

To examine the role of bowel diversion and reconstructive surgeries in managing Fournier's gangrene (FG) to facilitate multidisciplinary collaboration between urologists, colorectal and plastic surgery teams.

Methods

A review of the literature was conducted using the databases Medline, Embase, PubMed in June 2023. The review included studies that evaluated the outcomes of FG following reconstructive surgeries or diverting colostomies.

Results

The existing evidence suggests that bowel diversion and colostomy formation could reduce the need for further debridement, shorten the time to wound healing, and facilitate skin graft or flap uptake in patients with FG. Additionally, the psychological impact of a stoma was shown not to be a major concern for patients. However, stoma carries a risk of perioperative complications and therefore may prolong the length of hospital stay. In reviewing the evidence for reconstruction in FG, large and deep defects seem to benefit from skin grafts or flaps. Noticeably, burial of testicles in thigh pockets has grown out of favour due to concerns regarding the thermoregulation of the testicles and the psychological impact on patients.

Conclusion

The use of bowel diversion and reconstructive surgeries in managing FG is case dependent. Therefore, it is important to have close discussions with colorectal and plastic surgery teams when managing FG.

Keywords

Fournier's gangrene (FG), reconstruction, flaps, graft, stoma, bowel diversion, wound closure

Introduction

Fournier's gangrene (FG) is a life-threatening necrotising fasciitis of the external genitalia and perineum that most commonly affects men [1]. Patients with immune impairment and diabetes are at increased risk of FG [2]. The infection typically originates from an anorectal, urogenital, dermatological or an unidentified source [1]. Spread occurs through the fascial layer, the infection may involve the scrotum, the penile skin, the perineum, and the abdominal wall, but it rarely affects the underlying structures including the penis and testicles. Current consensus highlights the importance of aggressive early urological debridement at the stage of initial management [1].

However, due to its infrequent presentation and widely variable severity and disease distribution, uncertainty exists in optimal wound management following debridement to restore function and cosmesis. Either a diverting stoma or faecal management system (FMS) may be considered to contain faecal content and reduce wound contamination. But the precise benefit and indication of each is unclear.

Various methods have been documented for repairing wound defects, including healing by secondary intention, direct wound closure, and reconstruction using skin grafts or flaps. Additionally, placing the testicles in a medial thigh pouch has been discussed in the literature for cases involving scrotal defects. However, limited evidence exists for comparing these wound closure techniques and determining which approach is most appropriate for specific cases. Furthermore, it is essential to evaluate the long-term cosmetic and functional outcomes associated with these methods.

This narrative review aimed to examine the role of bowel diversion and reconstructive surgeries in managing FG to facilitate multidisciplinary collaboration between urologists, colorectal and plastic surgery teams. The outcomes compared include: mortality, length of hospital stay, number of debridements, time to wound healing between stoma and non-stoma groups, as well as the complication rate and long-term cosmetic and functional outcomes following reconstructive procedures.

Methods

A review of literature was conducted using the databases Medline, Embase, PubMed in June 2023. The review included studies that evaluated the outcomes of FG following reconstructive surgeries or diverting colostomies. The search was performed using several keywords, including 'Fournier's gangrene', 'perineal necrotising fasciitis', 'genital necrotising fasciitis', 'scrotal necrotising fasciitis', 'perineal gangrene', 'testicular gangrene', 'penile gangrene', 'skin graft', 'skin flap', 'reconstruction', 'colostomy', 'faecal', 'catheter', 'mortality', 'length of stay', 'complications', 'quality of life'. The study designs considered for inclusion were clinical trials, prospective studies, and retrospective cohorts or comparative studies, and case series when the case number was >10. Studies were excluded if the location of the defect was not described or the disease outcome was not measured. The study language was restricted to English. Table 1 [3–37,39–41,43,44] provides a summary of the studies included in this review.

Results and Discussion

Anatomical Structures Affected in FG

Fournier's gangrene is a form of necrotising fasciitis with the characteristic infective spread rapidly affecting the skin and subcutaneous tissues of the scrotum, penis, perineum, and abdominal wall. However, the underlying structures, including the testicles, penis, urethra, and anorectal sphincter, are typically spared due to a separate blood supply and the anatomical barriers of fascia planes. This includes the Dartos and Buck's fascia overlying the penis and scrotum, Colles' fascia covering the perineum and Scarpa's fascia of the abdominal wall [1]. Therefore, following aggressive debridement, the question lies in how to optimise wound healing to restore cosmesis and physiological skin function. To effectively manage FG, it is essential to have a collaborative approach between urologists, colorectal surgeons, and plastic surgeons [45].

The Role of Bowel Diversion as an Adjunct for Wound Management in FG

The role of bowel diversion in FG is to effectively prevent wound contamination from faecal content, thereby promoting wound healing and facilitating skin graft or flap uptake when reconstruction is planned [46]. This can be achieved through either a colostomy or ileostomy. The decision regarding stoma reversal is evaluated at a later stage when wound healing is complete.

Complications Associated with Bowel Diversion

However, creating a diverting stoma is associated with perioperative complications and long-term effects on patients. In a retrospective review, which included 59 patients in the stoma group with FG, a 41% complication rate was found to be associated with stoma formation, mainly Clavien–Dindo Grade ≥IIIb; 25% required intensive care [47]. The common complications included anastomotic leakage with peritonitis, parietal abscess, and parastomal hernia. Furthermore, the reversal of a stoma may not succeed if the patient is no longer suitable for surgery [48].

Rate of Bowel Diversion in FG

The rate of bowel diversion in FG varies between 7% and 67% based on a systematic review and meta-analysis that included 27 studies [49]. The wide range of rates of bowel diversion is due to the lack of formal evidence assessing which patient population would benefit most from bowel diversion and the optimal timing of stoma formation in FG.

Perianal Involvement as a Main Indicator for Bowel Diversion

The current evidence suggests that bowel diversion shortens the time to wound healing and hospital length of stay (LOS) when there is perianal involvement of the infection. One prospective study, conducted in 2023 by Mahmood et al. [27], was a matched-pair study involving 30 patients who underwent an immediate stoma following the initial debridement and 30 patients who refused to have a stoma. The patients were matched for comorbidities, Fournier's Gangrene Severity Index (FGSI), and disease extent. All patients underwent perianal debridement. The study found that the time to wound healing was significantly shorter in the stoma group with a mean (SD) of 16.5 (3.9) days compared to 42.9 (6.9) days in the non-stoma group ($P < 0.001$). The study did not provide statistics on the complication rate related to stoma formation. However, the study revealed that bowel diversion led to a significantly shorter LOS. The mean (SD) LOS was 9.5 (3.3) days in the stoma group compared to 29.9 (6.2) days in the non-stoma group ($P < 0.001$). Despite the high mean (SD) FGSI scores of 25.4 (2.9) and 23.7 (4.1) in the colostomy and non-colostomy groups, respectively, no FG-related deaths were reported in this study [27]. In a prospective cohort study involving 48 patients, Planellas Giné et al. [31] also found that individuals with perianal involvement may benefit from diverting colostomy. In this study,

Table 1 Study characteristics.

Reference	Study type	Country	Year	Total, *N*	Plastic surgery, *n*	Complications, *n*	Colostomy, *n*	Mortality, *n*
Agwu et al. [3]	Retro.	Nigeria	2020	47	21	NA	0	8
Aliyu et al. [4]	Retro.	Nigeria	2013	38	24	NA	NA	6
Alwaal et al. [5]	Retro.	USA	2015	10	10	0	NA	0
Biju et al. [6]	Retro.	UK	2023	34	28	5	NA	NA
Carvalho et al. [7]	Retro.	Brazil	2007	80	53	7	NA	13
Chen et al. [8]	Retro.	Taiwan	2010	41	22	2	NA	8
Dadaci et al. [9]	Retro.	Turkey	2021	29	29	4	NA	NA
El-Khatib [10]	Retro.	Qatar	2002	13	13	0	4	0
Erol et al. [11]	Retro.	Turkey	2010	18	NA	NA	4	4
Ersoz et al. [12]	Retro.	Turkey	2012	52	NA	NA	13	12
Eskitaşcıoğlu et al. [13]	Retro.	Turkey	2014	80	52	1	12	3
Ferreira et al. [14]	Retro.	Portugal	2007	43	43	NA	NA	2
García Marín et al. [15]	Retro.	Spain	2011	34	NA	NA	7	9
Ghnnam [16]	Retro.	Egypt	2008	74	NA	NA	NA	16
Hahn et al. [17]	Retro.	Korea	2018	41	13	NA	11	9
Heijkoop et al. [18]	Case series	Australia	2018	14	13	NA	2	1
Hosseini et al. [19]	Case series	Iran	2006	12	5	0	1	2
Jiménez-Pacheco et al. [20]	Retro.	Spain	2011	37	7	NA	NA	5
Karki et al. [21]	Prosp. observational	Germany	2021	14	14	5	NA	NA
Khanal et al. [22]	Case series	Nepal	2020	14	14	1	NA	0
Lauerman et al. [23]	Retro.	USA	2018	168	16	NA	21	6
Li et al. [24]	Retro.		2023	51	NA	NA	28	6
Lin et al. [25]	Retro.	Taiwan	2016	26	10	2	NA	0
Louro et al. [26]	Retro.	Portugal	2019	15	15	6	2	0
Mahmood et al. [27]	Prosp. case comparison	Egypt	2023	30	NA	NA	15	0
Nnabugwu et al. [28]	Retro.	Nigeria	2021	23	4	NA	0	0
Öcük et al. [29]	Retro.	Turkey	2022	15	15	4	5	0
Özlü et al. [30]	Retro.	Turkey	2021	28	10	1	5	1
Planellas Giné et al. [31]	Prosp. cohort	Spain	2017	46	NA	NA	22	10
Sahai and Singh [32]	Retro.	India	2021	25	25	8	NA	NA
Sandberg et al. [33]	Retro.	USA	2022	84	28	19	NA	NA
Sivrioğlu et al. [34]	Clinical trial	Turkey	2013	15	15	0	NA	0
Sockkalingam et al. [35]	Prosp. observational	India	2018	34	17	NA	NA	4
Taken et al. [36]	Retro.	Turkey	2016	65	11	NA	5	6
Tan et al. [37]	Retro.	Singapore	2011	27	27	4	NA	NA
Tripodi et al. [38]	Case series	Italy	2022	23	23	2	NA	1
Ullah et al. [39]	Case series	Pakistan	2017	39	23	NA	NA	7
Ünverdi and Kemaloğlu [40]	Retro.	Turkey	2019	13	13	2	NA	NA
Wagner et al. [41]	Retro.	Germany	2011	41	27	NA	NA	0
Wang et al. [42]	Retro.	China	2012	24	20	NA	NA	5
Xeropotamos et al. [43]	Retro.	Greece	2002	11	0	NA	3	2
Zhang et al. [44]	Case series	China	2020	12	8	NA	3	1

NA, not available; Prosp., prospective; Retro., retrospective analysis.

both the stoma and non-stoma groups had comparable LOS and mortality. The presence of an anorectal abscess significantly influenced the decision to undergo bowel diversion. Table 2 [27,31] compares and contrasts the findings from the two studies.

Timing of Bowel Diversion

The timing of bowel diversion was evaluated by the same study conducted by Planellas Giné et al. [31]. The study compared the indications and outcomes of immediate colostomy (eight patients) versus delayed colostomy (14 patients). The indications for an immediate colostomy included high severity of the gangrene, anal canal tumour with severe perineal infiltration and previous faecal incontinence, whereas the indication for a delayed colostomy was mainly due to a lack of local infection control. The immediate colostomy group had a significantly lower number of surgical debridements. There was no significant difference in the LOS and mortality rates between the two groups. The study demonstrated that in situations where infection is challenging to control, early consideration of a diverting stoma should be taken into account.

Table 2 Pertinent findings from studies comparing stoma versus non-stoma groups in FG.

	Mahmood et al., 2023 [27]	Planellas Giné et al., 2017 [31]
Study characteristics		
Type of study	Prospective matched-pair	Prospective cohort
Groups	DC vs non-DC	DC(i) vs DC(d) vs non-DC
FGSI score, mean (SD)	DC, 25.4 (2.9); non-DC, 23.7 (4.1)	NA
Disease extent	Perianal ± other areas in both groups	NA
Aetiology	NA	Significantly more anorectal abscesses in DC group
Need for reconstruction	All cases	NS between DC and non-DC or DC(i) and DC(d)
Pertinent findings		
Number of wound debridements	Significantly fewer in DC	• NS between DC and non-DC • Significantly fewer in DC(i) than DC(d)
Time to wound healing	Significantly shorter in DC	• NS between DC and non-DC • NS between DC(i) and DC(d)
LOS	Significantly shorter in DC	• NS between DC and non-DC • NS between DC(i) and DC(d)
Mortality	NA	NS

DC(d), delayed DC; DC(i), immediate DC performed during first debridement; DC, diverting colostomy; NA, not available; NS, no statistical difference.

Impact of Bowel Diversion on Patient's Quality of Life

The quality of life of patients with a stoma following FG was assessed in one study using the Gastrointestinal Quality of Life Index (GIQLI). A score of <96 indicates an alteration in quality of life. The median GIQLI for the stoma group was lower than the non-stoma group, but the difference was not significant (103 vs 110, $P = 0.36$). However, the sample size of the study was small, with only 21 patients having completed the survey and the number of patients in the stoma vs non-stoma groups was not specified [50].

The FMS

Alternatively, the diversion of faecal content can be achieved by a FMS, which collects faecal content through a catheter. No surgical procedure is required for a FMS. A seal is achieved by inflating the catheter cuff against the pelvis floor. To ensure the patency of the catheter, laxatives are often required to soften the stool.

Adverse Events Associated with FMS

However, a FMS is associated with a higher risk of wound contamination as dislodgement of the catheter and leakage of faecal content can occur [51]. It also requires high patient adherence [52]. In addition, a FMS is contraindicated in cases of rectal perforation or anorectal tumour [51].

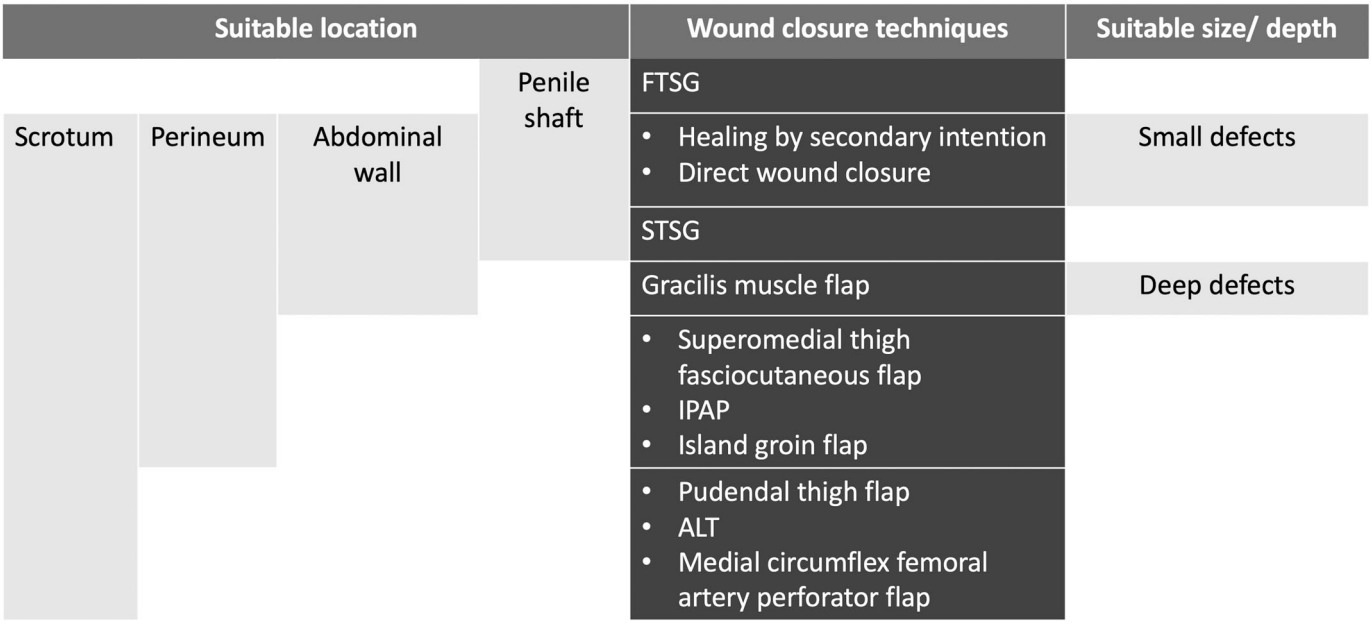
Diverting Stoma Versus FMS

One retrospective study compared the use of a FMS (21 patients) and diverting stoma (six patients) [48]. Both groups had a similar FGSI, with mean (SD) scores of 7.5 (0.7) in the FMS group and 8 (1.8) in the stoma group. The size and location of the defects were not specified. Wound healing time and LOS were comparable between the two groups. The stoma group had a higher rate of reconstruction, but this difference was not statistically significant. The stoma group experienced more complications, including two complications associated with stoma reversal. Additionally, two patients in the stoma group did not undergo stoma reversal. No complications were reported in association with the FMS placement. In another retrospective analysis of 48 patients [53], the stoma group was also associated with more complications than the FMS group, including colostomy necrosis, colostomy prolapsus, parastomal hernia and incisional hernia. Consequently, the total LOS was significantly higher, and the total cost was greater in the stoma group. The current evidence suggests that a FMS may be able to contain infections effectively while minimising complications. However, given the lack of description regarding the disease extent in the studies, it remains inconclusive when a FMS should be preferred over a diverting colostomy.

Role of Reconstructive Surgeries in Managing FG

To optimise wound healing and achieve cosmetically acceptable outcomes, closure techniques for FG vary depending on the extent of necrosed tissues. For smaller wounds, the skin may heal by secondary intention [6,16,19,30,33,42], e.g., when 25% of the scrotal tissue is affected [54]. Direct wound closure [6,19,33,35,39,42] or local flaps [3,6,8,13,35,38,44] are the preferred techniques for small to medium defects, such as when the defect is <50% of the scrotal tissue [3]. To close larger defects, reconstructive procedures including skin grafts and flaps may be required (Fig. 1).

Fig. 1 Fournier's gangrene wound closure techniques (middle); anatomical locations suited for the technique (left), size and depth of the defects indicated for the technique (right). ALT, anterolateral thigh flap; IPAP, internal pudendal artery perforator flap.



Evidence remains limited as to when reconstructive surgery is most beneficial, and which reconstructive technique is most superior. In the existing literature the rate of reconstructive surgeries is highly variable, with a median (range) of 44% (0–93%).

Risks Associated with Reconstructive Procedures in FG

Postoperative complication rates do not differ significantly between different reconstructive techniques, as they are largely dependent on the experience of the operating surgeon. This is illustrated by the higher rate of postoperative complications observed at the start of a learning curve [55]. In reviewing the literature, the median (range) rate of complications was 10% (0–68%), including skin graft or flap loss or necrosis, wound separation, haematoma, wound site infection [5–10,13,19,21,22,25,26,29,30,32–34,37,38]. These could all be managed through re-operation, drainage, or dressings.

Timing of Reconstruction

Where reconstruction is needed, it is paramount to wait until there is sufficient granulation tissue and the wound is clear of infection, without which, the risk of having postoperative complications increases [21]. This process takes approximately 2–4 weeks [9,35,56]. Operative fitness and baseline health status, including diabetic control and anaemia, should be optimised preoperatively for improved outcomes [32]. Interestingly, in one study plastic reconstruction was performed at a later stage when the wound was evaluated at 3 and 6 months [23]. The study reported successful uptakes of the skin grafts and flaps; however, there was no mention of the long-term cosmetic and functional outcomes.

Key Considerations in Repairing the Defects in FG

In repairing scrotal defects, it is critical to allow optimal thermoregulation of the testicles in men who wish to preserve fertility and restore the natural appearance of the scrotum to minimise psychological impacts. Placing testicles in thigh pockets is no longer a popular approach due to concerns over thermoregulation of the testicles, pain, and its psychological impact on patients [19,35,38]. Split-thickness skin grafts (STSGs) and flaps are commonly used methods to repair large defects of the scrotum, perineum, and abdominal wall [6,19,33,38], whereas myocutaneous flaps are typically used to fill in the dead space for deep wound defects [13,21].

Optimal reconstruction of the penile shaft is critical to restore sexual function. A STSG [3,5,14,16,19,33,35,39] was typically used to facilitate stretching of the skin. A full-thickness skin graft (FTSG) was used in some studies to provide better durability and sensation [6,38].

Functional and Cosmetic Impact of Reconstructive Surgeries

Favourable cosmetic results were observed after scrotal reconstruction using flaps [21,32] and penile shaft

reconstruction with STSGs [5], as well as FTSGs [38]. Flaps were shown to provide adequate thermoregulation for the testicles, as evidenced by normal sperm counts following scrotal reconstruction [22]. However, it is worth noting that ejaculation was affected due to impaired light touch sensation following penile shaft reconstruction with a STSG [5].

Future Directions

Currently, only one prospective matched-pair comparative study has been conducted in 2023 investigating the role of a diverting stoma in comparison to a non-stoma group; no prospective study has examined the use of a stoma vs a FMS in FG. Given the rarity of the disease, a randomised control trial would be challenging. However, more prospective studies are needed to assess the cost-effectiveness of a diverting stoma in FG.

Most studies have reported the immediate postoperative complications following reconstructive surgeries. However, there is a lack of assessment of the long-term functional and cosmetic outcomes. Furthermore, different assessment tools have been used by the studies to evaluate outcomes. Without a universal scale to provide an objective measure of the outcomes, challenges remain in comparing various reconstructive techniques.

Conclusion

In conclusion, FG is a complex condition that requires an optimised wound management plan. The treatment algorithm is dependent on the disease location, size, and depth. A multidisciplinary input is paramount for key decision making, such as choosing the wound closure techniques and whether to create a diverting colostomy as an adjunct method for wound healing.

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Abbreviations: FG, Fournier's gangrene; FGSI, Fournier's Gangrene Severity Index; FMS, faecal management system; FTSG, full-thickness skin graft; GIQLI, Gastrointestinal Quality of Life Index; LOS, length of hospital stay; STSG, split-thickness skin graft.