A Reliable Technique in the Reconstruction of Large Penoscrotal Defect: Internal Pudendal Artery Perforator Flap

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OBJECTIVE To reconstruct the defect secondary to Fournier's gangrene, which is an infection localized in the perineum and the lower abdominal region, characterized by large tissue loss following debridement. A large tissue loss caused by Fournier's gangrene brings with repair problems. The primary goal is to achieve cosmetically and functionally successful results. The purpose of this article is to share the results of reconstruction of large penoscrotal defects with internal pudendal artery perforator (IPAP) flap.

MATERIAL AND METHODS The data of 13 patients, who were operated with the diagnosis of Fournier's gangrene between October 2014 and September 2018, and whose resulting large scrotal defect repair was carried out with IPAP flap, were evaluated retrospectively.

RESULTS The age of the patients ranged from 32 to 80 years (mean 54.3 years). The smallest flap area was 84 cm^2 and the largest flap area was 171 cm^2 (mean 120 cm^2). The mean follow-up time was 26 months. One patient developed hematoma and 1 patient developed limited necrosis. The remaining defect was repaired primarily in the second surgery.

CONCLUSION The goal of the repair of the scrotal region is to obtain successful results that will please the patients both cosmetically and functionally. The IPAP flap is close to the defect area and is an easy-to-perform technique. The most important advantages are that it does not require dissection in the muscle tissue, and that successful results can be achieved in the reconstruction of large scrotal defects. UROLOGY 128: 102–106, 2019. © 2019 Elsevier Inc.

Fournier's gangrene is a form of necrotizing fasciitis located in the perineum and the lower abdominal region. This condition caused by a severe infection has a rapid progression and can be life-threatening for the patient, if not intervened early. The disease commonly arises in middle-aged men and rarely affects the children's age group.[1,2] The group A *Streptococcus* bacteria have been generally accused in the etiology, but the cultures taken frequently show a combination of aerobic and anaerobic microorganisms.[3,4] Moreover, comorbidities such as underlying diabetes mellitus, alcohol consumption, steroid use, malignancy, chemotherapy, and HIV infection in some patients impair the functioning of the immune system and facilitate the formation of Fournier's gangrene. The most important step in the treatment is emergency surgical debridement and subsequent administration of broad-spectrum antibiotic.[5]

The debridement of Fournier's gangrene results in a large tissue defect in the penoscrotal region. Various techniques have been described for the repair of these resulting large tissue defects. Primary closure, skin grafts, local flaps, and distal flaps are the main techniques among these.[6,7] However, perforator flaps, a type of local flap, have become more prominent in recent years. The main reason for this is that these flaps require less dissection and lead to less donor area morbidity.[8-10] Thus, in this study, the outcomes of the use of free-style propeller flap based on internal pudendal artery perforator (IPAP) in the reconstruction of scrotal defect and perineum were shared, and it was aimed to demonstrate the effectiveness of the technique.

MATERIALS AND METHODS

A total of 13 patients with a large penoscrotal defect due to Fournier's gangrene were operated between October 2014 and September 2018. All patients were informed about the surgical technique preoperatively and written informed consent was

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obtained. The defects of the patients were repaired by 2 surgeons (ÖFÜ and CAK) using propeller flap based on IPAP, and the outcomes were retrospectively evaluated.

SURGICAL PROCEDURE

Following the emergency debridement and antibiotherapy, the patients, whose defect areas were ready to be repaired, were scheduled for operation. The patients were operated under general anesthesia. The ischiorectal fossa located between the anus, scrotum, and ischial tuberosity was marked with a skin marker in the lithotomy position.[11] The locations of the perforator vessels of the internal pudendal arteries, which originated from the ischiorectal fossa and provided blood supply to the skin of the perineum, were determined by using a hand-held Doppler device just before cleansing the operation area with an antiseptic solution while the patient was in the lithotomy position. The defect area was calculated by means of a caliper. An excess of 10% was added both to the length and width of the flap size during calculations, in order to eliminate the potential contraction stress on the flap (Fig. 1).

First, incisions were made on the superior borders of the flaps. While elevating the flaps, the deep fascia was also included in the flap and the epimysium was left on the base. The dissection was continued until the previously marked perforators originating from the intermuscular septum located between the adductor longus and gracilis muscles were reached. Then, incisions were made on the inferior border of the flap. The gracilis muscle was found here and the deep fascia was included in the flap, and the dissection was advanced up to the intermuscular septum (Fig. 2). Afterwards, the intermuscular septum was incised from the distal to the proximal reaching up the area where the perforators were marked, and sufficient rotation was obtained. At this point, the soft tissue around the perforators was preserved and the perforators were not completely skeletonized. The flaps were transposed to the penoscrotal region and attached to the remaining dermal tissue at the defect area with 3/0 poliglecaprone 25 sutures. A total of

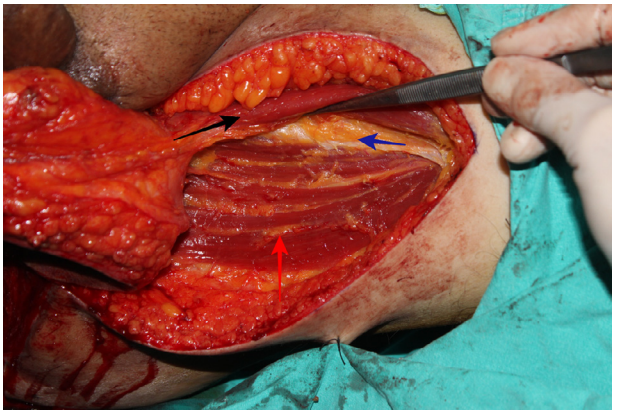

Figure 2. The image of the flap elevated from the distal to the proximal (the black arrow indicates the adductor longus muscle, the red arrow indicated the gracilis muscle and the blue arrow indicates the intermuscular septum.) (Color version available online.)

2 hemovac drains were placed at the operation site. One of them was placed beneath the testicles for draining the reshaped or reconstructed scrotum and the second drain was placed to the donor area. Subsequently, the overlying skin on the donor area was closed up primarily. Flaps were sutured with 4/0 poliglecaprone 25 sutures (Supplementary Fig. 1).

RESULTS

Infection was polymicrobial in all patients. Most common pathogens were *Bacteroides fragilis*, *Escherichia coli*, *Klebsiella*, and *Pseudomonas aeruginosa*. Antibotherapy was prescribed by the consultant physician, who was an infectious diseases specialist. The most common initial antibiotic choice was Piperacillin-Tazobactam. All patients on whom the technique was used were male and the mean age was 54.3 years (range, 32-80 years). Of the study patients, 3 were accepted as idiopathic cases as they had no medical comorbidities or no causative agents were identified for their infections (Table 1).

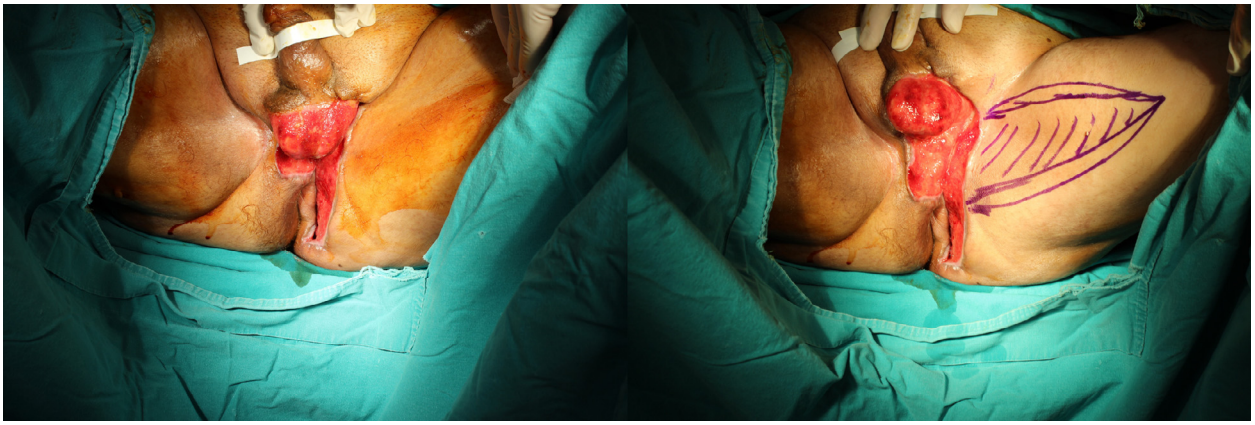

Figure 1. The measurement of scrotal defect area and flap planning. (Color version available online.)

Table 1. The age, flap size, comorbidity, complication, and follow-up times of the patients undergone repair with IPAP flap

Patient	Age (y)	Flap Size	Comorbid Disease	Complication	Follow-up Time (mo)
1	72	8 × 12 cm	Diabetes	Hematoma	50
2	80	8 × 16 cm	Diabetes + Hypertension		44
3	32	7 × 15 cm	Diabetes		4
4	40	9 × 19 cm	Diabetes		38
5	46	6 × 14 cm	None		28
6	63	7 × 16 cm	Diabetes + Hypertension		13
7	57	8 × 15 cm	Diabetes		20
8	44	8 × 17 cm	None		17
9	67	6 × 13 cm	Diabetes + Hypertension		32
10	52	7 × 14 cm	Hypertension		14
11	49	9 × 17 cm	Diabetes	Marginal Necrosis	12
12	65	8 × 18 cm	Diabetes		30
13	39	9 × 15 cm	None		42

The mean postoperative follow-up time of all patients was 26.4 months (range, 4-50 months). The smallest flap area was 84 cm^2 and the largest flap area was 171 cm^2 (mean 120 cm^2) (Table 1). The mean duration of the operation took 119 minutes from the start of anesthesia induction until the suturing was completed both in the flap and donor areas. During the postoperative period, 11 patients had a smooth recovery, while 1 patient developed hematoma, and 1 patient developed limited necrosis at the distal margin. These patients underwent hematoma drainage and debridement of the necrotic tissues, and then the respective areas were primarily closed accordingly. The drains of all patients were withdrawn between the days 5 and 7, and the patients were discharged on the postoperative first week in average and included in the follow-up program. The mean duration of time elapsed between the first debridement procedure to the reconstruction surgery was 36 days. The mean duration of hospital stay was 42 days. During the first 3 days of the postoperative period, the patients were not allowed to ambulate (Fig. 3, Supplementary Fig. 2). Testicular atrophy was not observed in any of the patients. Young patients did not report any concerns about their sexual life after the reconstruction procedure.

DISCUSSION

Fournier's gangrene is a specific term given to the form of necrotizing fasciitis arising in the pelvic area. It is known that aerobic and anaerobic bacteria have a common role in the etiology. In the pathogenesis of the disease, the underlying immune dysfunction and the bacteria invading the skin as a result of this dysfunction are thought to initiate the formation of microthrombus in the vascular structures. In the ongoing process, these microthrombi also trigger the development of thrombosis in the large vessels and accelerate the disease progression with severe ischemia.[4-6]

Because of the rapid progression of the disease among the fasciae, the most important step in the treatment is the emergency debridement of necrotic tissues. During these procedures, tissue loss at various extents may occur in the penoscrotal region. It has been reported that a difficulty arises in both spermatogenesis and the hormone production of the Leydig cells in cases where the testicles are exposed. Therefore, the repair of tissue loss following the debridement of Fournier's gangrene is necessary and inevitable in terms of function and cosmetics.[8,12,13]

A variety of alternative techniques, such as primary repair, implantation of the testicles in the thigh, secondary healing, split-thickness skin graft, pedicled and perforator flaps, have been described in the repair of tissue loss resulting from Fournier's gangrene.[12-16] Primary repair is undoubtfully the easiest technique and mostly preferred in

Figure 3. The postoperative 6th month image of the repair of large penoscrotal defect due to Fournier's gangrene using propeller IPAP flap in a 63-year-old male patient. (Color version available online.)

eligible patients. In cases where primary repair is not possible, it can be attempted to implant the testicles in the pouches created in the thighs; however, it has been reported that testicular atrophy may arise as a result of this.[16] In order to allow the defect to heal by secondary intention, it should be small and localized in the scrotum. Moreover, the length of hospital stay is longer compared to other options due to prolonged recovery period of these patients.[17-19] A healthy recipient site freed from infection is needed to use split-thickness skin graft in the repair of the defect. Furthermore, the graft should be fixed to adapt to the irregular surface of the wound and the patient's movements should be extremely restricted. The use of gracilis muscle flap + skin graft has been attempted to overcome all these challenges and thus, successful results have been obtained. However, the disadvantage of this technique is that it requires large dissections for the repair and an additional donor area is utilized for the graft area.[20]

The mentioned disadvantages are fewer in the repair with perforator flaps. The defects can be repaired in a single session with perforator flaps, better functional results can be achieved thanks to thin flaps, resulting in more limited donor site morbidity. However, the potential disadvantages of the technique are the requirement for dissection experience, and in some cases, dissection difficulties and the need for subcutaneous tunneling between the flap donor site and the recipient site.[21,22]

In the literature, publications on the use of perforator flaps in the reconstruction of the scrotum and perineum report that the technique is successful, and point out some technical challenges. For example, Karsidag et al used perforator flaps based on the medial circumflex femoral artery in the reconstruction of Fournier's gangrene-related defect and were able to perform donor site repair primarily in all of their patients and needed grafting only in 1 patient.[8] Although Coskunfirat et al did not need grafting in the donor site by designing their perforator flaps based on the medial circumflex femoral artery in the form of V-Y advancement flap, they reported that the dissection of perforator reaching up to the inside of the muscle was necessary.[23]

IPAP flap has the advantages such as being close to the scrotal region, generally nonrequirement for tunneling between the recipient site and the donor site, ability to repair the donor site primarily and ability to be designed in the form of a propeller, transposition, or VY advancement flap.[11,24] Since the distal part of the flap is distant from the perforators, it can be easily thinned without damaging the circulation of the flap. Hong et al reported that the flap was easily transposed to the defect area and they did not experience any loss in the flaps when IPAP flap was used unilaterally or bilaterally in patients with large defects in the perineum.[7] Hashimato et al used this technique as a reconstruction alternative in 71 patients with defects in the vulva, vagina, and hip region and encountered partial necrosis only in 3 patients.[11] Lee et al performed repair with IPAP flap in 7 patients with large scrotal defect, and experienced partial necrosis only in 1 patient.[24] In accordance with the literature, we only encountered 1 partial necrosis in our series, and we could close it up primarily in this patient without any problem.

In the repair of a large tissue loss, a sufficient volume can be obtained in the scrotal region, functional losses can be prevented and successful cosmetic results can be achieved with the use of IPAP flap. No reported case of complete flap loss in the literature and the low complication rates in patients undergone perineum reconstruction demonstrate that this flap can be used safely in the repair of large scrotal defects due to Fournier's gangrene. However, our study was not free of limitations. First, all study patients were males; therefore, we did not have the chance to demonstrate the outcomes of this flap procedure for perineum reconstruction in women. Second, we did not compare this flap procedure with other perforator flaps in terms of their practical usefulness.

CONCLUSION

Internal pudendal artery perforator flap is an easy-to-learn and easy-to-perform reliable technique in the reconstruction of patients with large scrotal defects with the low complication rates.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.urology.2019.02.028.

References

1. 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;37:669–673.
2. Thwaini A, Khan A, Malik A, et al. Fournier's gangrene and its emergency management. *Postgrad Med J*. 2006;82:516–519.
3. Kiliç A, Aksoy Y, Kiliç L. Fournier's gangrene: etiology, treatment, and complications. *Ann Plast Surg*. 2001;47:523–527.
4. Singh A, Ahmed K, Aydin A, Khan MS, Dasgupta P. Fournier's gangrene. A clinical review. *Arch Ital Urol Androl*. 2016;88:157–164.
5. Quatan N, Kirby RS. Improving outcomes in Fournier's gangrene. *BJU Int*. 2004;93:691–693.
6. Maguina P, Paulius KL, Kale S, Kalimuthu R. Medial thigh fasciocutaneous flaps for reconstruction of the scrotum following Fournier gangrene. *Plast Reconstr Surg*. 2010;125:28–30.
7. Hong JP, Kim CG, Suh HS, Kim H, Yoon CS, Kim KN. Perineal reconstruction with multiple perforator flaps based on anatomical divisions. *Microsurgery*. 2017;37:394–401.
8. Karsidag S, Akcal A, Sirvan SS, Guney S, Ugurlu K. Perineoscrotal reconstruction using a medial circumflex femoral artery perforator flap. *Microsurgery*. 2011;31:116–121.
9. Al-Shaham AA. Prepucial skin flap for reconstruction of the scrotum in Fournier's gangrene. *Ann Chir Plast Esthet*. 2001;46:637–639.
10. 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;86:1052–1055.
11. Hashimoto I, Abe Y, Nakanishi H. The internal pudendal artery perforator flap: free-style pedicle perforator flaps for vulva, vagina, and buttock reconstruction. *Plast Reconstr Surg*. 2014;133:924–933.

12. Hallock GG. Scrotal reconstruction following Fournier gangrene using the medial circumflex femoral artery perforator flap. *Ann Plast Surg*. 2006;57:333–335.
13. McAninch JW. Management of genital skin loss. *Urol Clin North Am*. 1989;16:387–397.
14. Tan BK, Rasheed MZ, Wu WT. Scrotal reconstruction by testicular apposition and wrap-around skin grafting. *J Plast Reconstr Aesthet Surg*. 2011;64:944–948.
15. 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;13:996–999.
16. Moustafa MF. Gangrene of the scrotum: an analysis of ten cases. *Br J Plast Surg*. 1967;20:90–96.
17. Karian LS, Chung SY, Lee ES. Reconstruction of defects after Fournier gangrene: a systematic review. *Eplasty*. 2015;15:e18.
18. 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;33:510–514.
19. Akilov O, Pompeo A, Sehrt D, Bowlin P, Molina WR, Kim FJ. Early scrotal approximation after hemiscrotectomy in patients with Fournier's gangrene prevents scrotal reconstruction with skin graft. *Can Urol Assoc J*. 2013;7:E481–E485.
20. Daigeler A, Behr B, Mikhail BD, Lehnhardt M, Wallner C. Bilateral pedicled gracilis flap for scrotal reconstruction. *J Plast Reconstr Aesthet Surg*. 2016;69:e195–e196.
21. Wei FC, Mardini S. Free-style free flaps. *Plast Reconstr Surg*. 2004;114:910–916.
22. Chen SY, Fu JP, Chen TM, Chen SG. Reconstruction of scrotal and perineal defects in Fournier's gangrene. *J Plast Reconstr Aesthet Surg*. 2011;64:528–534.
23. Coskunfirat OK, Uslu A, Cinpolat A, Bektas G. Superiority of medial circumflex femoral artery perforator flap in scrotal reconstruction. *Ann Plast Surg*. 2011;67:526–530.
24. Lee SH, Rah DK, Lee WJ. Penoscrotal reconstruction with gracilis muscle flap and internal pudendal artery perforator flap transposition. *Urology*. 2012;79:1390–1394.