

# Comparative Study Using Internal Pudendal Artery Perforator Flap and Superior Medial Thigh Flap for Scrotal and Perineal Reconstruction

MOHAMED AHMED AMIN SALEH, M.D., M.R.C.S.; MOHAMED ABDELMOHSEN GHANEM, M.D. and AHMED ELSHAHAT, M.D.

*The Department of Plastic, Reconstruction, Maxillofacial Surgeries and Burn Management, Faculty of Medicine, Ain Shams University, Cairo, Egypt*

## ABSTRACT

**Background:** Reconstruction of scrotal defects is crucial for its functional, aesthetic and psychological impact. In this retrospective study, data retrieved from medical records from February 2015 to December 2018 in El-Demerdash, Ain Shams University Hospital.

**Aim of Work:** The purpose of this study was to evaluate and compare the internal pudendal artery perforator and medial thigh flaps for reconstruction of major scrotal and perineal defects. 10 patients underwent reconstruction of the scrotal and perineal region by medial thigh flap (Group A) and 13 patients by internal pudendal artery perforator flap type I (Group B). Patients were followed at 3, 6 and 12 months post-operatively. Data were collected, analyzed and compared for flap dimension, intraoperative time, secondary procedure, complications, hospital stay and aesthetic patients' satisfaction (Likert scale).

**Results:** (Group A) patients showed less intraoperative time, less flap size, and hospital stay, while patients' satisfaction Likert scale was more in Group B patients. Post-operative rate of complications was less in (Group A) as regards, infection and need for secondary procedure, while was more as regards, flap necrosis, wound dehiscence, and scar contraction.

**Key Words:** *Fournier's gangrene – Scrotal and perineal reconstruction – Fasciocutaneous flaps – Perforator flaps – Internal pudendal artery perforator flap – Superior medial thigh flap.*

## INTRODUCTION

Fournier's gangrene is a necrotizing fasciitis, caused by multiple infecting organisms resulting in gangrene of the skin and subcutaneous tissue of the scrotal, penis, groin, perineum and gluteal region [1].

It is more common in immune compromised patients with chronic debilitating diseases [2]. The etiological identification was reviewed by Eke et al., 2000 [3]. They reported the etiological factors

in more than 90% of the cases, with dermatological infections (24%) followed by anorectal (21%) and urological (19%) cases.

Reconstruction of the scrotum is crucial for its functional, esthetic and psychological impact [4]. Our goal is to do one stage reconstruction and maintain the physiological testicular function, pliable skin coverage, preserving adequate sensation, minimal donor site morbidity and reach natural esthetic results [5,6].

In major scrotal and perineal defects local fasciocutaneous flaps [7-9] provides adequate coverage, avoid skin graft problems and preserve adequate sensation [10]. Medial thigh "SMT" flap or scrotal reconstruction has been described, with anatomical variation based on the deep external pudendal, anterior branch of obturator, and medial circumflex femoral artery [7-9,11-15]. Anatomical studies of the perineal region [16,17] and gluteal fold flap shown nourishment by the internal pudendal artery [18,19]. Clinical uses and flaps based on the internal pudendal artery perforators "IPAP" for vaginal reconstruction have been published [20,21]. Searching the literature, we did not find any studies comparing the reliability and outcome of these two fasciocutaneous flaps.

The purpose of this study is to evaluate and compare the internal pudendal artery perforator and superior medial thigh flaps for reconstruction of major scrotal and perineal defects.

*Anatomy for flap design and elevation:*

Internal pudendal artery perforator "IPAP" flap inset and design were based on anatomical studies of the internal pudendal artery and its skin perforators [22,23]. Internal pudendal artery originates

from the internal iliac artery deep to the sacrotuberous ligament, reaching the ischial tuberosity toward the ischioanal fossa. Three to five skin perforators emerge in the fossa and nourish the perineal skin. The vascular territory including the perforators is formed by the ischia tuberosity, the apex of the coccyx, and the scrotum. The imaginary line from the ischial tuberosity to the scrotum denotes the posterior boundary of the urogenital diaphragm. The imaginary line between the ischial tuberosity and the apex of the coccyx denotes the margin of the gluteus maximus muscle. The line from the scrotum to the apex of the coccyx indicates the anococcygeal ligament Fig. (1).

The superior medial thigh flap based deep external pudendal artery "DEPA" located at the groin crease, between the scrotum medially and the medial thigh laterally reaching posteriorly to the perineum. It is approximately 20cm in length and 10cm in width. The DEPA originates from the femoral artery and crosses from deep to superficial reaching the subcutaneous layer. During the course of the artery it pass through the adductor longus muscle and giving off both abdominal and perineal branches at 4-6cm from the pubic symphysis [24].

## PATIENTS AND METHODS

This is a cohort retrospective comparative study, data retrieved from medical records from August 2015 to December 2018 in El-Demerdash, Ain Shams University Hospital, we included records of patients with exposed testes and perineal defects due to forneir gangrene with more than 80% of scrotal skin is lost and need coverage by fasciocutaneous flaps rather than primary closure of residual scrotal skin.

Reconstruction was done after the surgical intervention is carried by the colorectal team and the patients general and local condition improves. Female patients were excluded from the study. Other surgical modalities such as primary closure skin grafts, free flaps were excluded from this study. Informed consent was obtained for all patients to be include in any study and for medical photography documentation as well.

10 patients underwent reconstruction of the scrotal and perineal region by medial thigh flap (Group A) and 13 patients by internal pudendal artery perforator flap "Type I" (Group B). Patients were followed at 3, 6 and 12 months post-operatively (range 3-22 months). Data were collected, analyzed and compared for flap dimension,

intraoperative time, the need of 2ry procedure, complication, post-operative hospital stay, aesthetic patients satisfaction "Likert scale", it is an overall rating for the aesthetic outcome was given on a scale of 1-10 for the reconstructed scrotal and perineal defects. Patients were asked, "how would they rate the reconstruction on this scale [25] (Tables 1,2).

All patients were photographed, flap marked and the use of hand held Doppler (Group B patients) is done in the pre-operative examination room. Recording the percentage of skin defect and tissue loss after surgical debridement, spermatic cord and testacies dissection. Before flap harvesting marking and flap design was assessed Fig. (1).

### • *The preparation of the recipient site:*

In Group (A) all patients is positioned in supine position with abduction and partial flexion of the hip joint and 10-20 degree flexion of the knee joint. In Group (B) all patients is positioned in lithotomy position. Patient's anesthetised by general or regional anesthesia (spinal or epidural). Immediate pre-operative broad spectrum antibiotic was administered, fibrotic scars and excessive granulation tissue was excised followed by caudal dissection of the spermatic cord and the testacies reaching their anatomical position Fig. (2).

### • *Group SMT flap:*

Flap is dissected in the sub fascial plane from lateral to medial and caudal to cranial direction, deep to the epimysium of the adductors and deep fascia of the pudendal region. The blood supply to this flap is through septo-cutaneous perforators of the deep external pudendal artery DEPA, which is located at the groin crease at the level of scrotal neck approximately 4-6cm from the pubic symphysis [15]. Flap transposition followed by closure of the donor site. In bilateral cases sutures are made between the two flaps to the midline in the base of the penis and the perineum, the donor sites are primary closed in all patients without the use of suction drain.

### • *Group B IPAP flap Type I (Propeller):*

The flap is elevated with sharp dissection from lateral to medial toward the vascular pedicles in the subfascial plane reaching deep the epimysium of gluteus maximums muscle. The perforators in the ischioanal fossa originate from the internal pudendal artery in its thick fatty layer. The flap is rotated 90 degrees and skin incision is completed around the pedicles and blunt dissection is completed until the flap reaches the defect without any tension Fig. (3).

## RESULTS

Patient's age ranged from 9 to 67 years, with mean age of  $46.8 \pm 11.8$ . A total number of 45 flaps included in the study. Twenty SMT thigh flaps were used for coverage of scrotal and perineal defects in 10 patients. Twenty five IPAP flaps were used for coverage of scrotal and perineal defects in 13 patients. Twenty two patients reconstructed with bilateral flaps and one patients a unilateral flap.

In Group A, 10 patients underwent reconstruction of the scrotal and perineal region by medial thigh flap with mean age ( $43.4 \pm 8.1$  years), age range (34-62 years) and time for reconstruction ( $14.3 \pm 2.58$  days).

In Group B, 13 patients underwent reconstruction of the scrotal and perineal region by internal pudendal artery perforator flap "Type I" with mean age ( $49.3 \pm 13.8$  years), and time for reconstruction ( $13 \pm 1.65$  days). Average intraoperative time was ( $113 \pm 21.1$  minutes) in Group A, while it was ( $143.8 \pm 30.1$  minutes) in Group B, see Diagram (1).

In Group A, flap dimensions were ( $10.6 \pm 0.69$  cm) average length and ( $7.6 \pm 0.96$  cm) average width. Average hospital stay in this group of patient was ( $2.6 \pm 0.5$  days) with average aesthetic patients satisfaction Likert scale ( $6.8 \pm 1.03$ ).

In Group B, flap dimensions were ( $15.9 \pm 2.43$  cm) average length and ( $7 \pm 0.9$  cm) average width. Average hospital stay in this group of patient was ( $3.4 \pm 0.97$  days) with average aesthetic patient's satisfaction Likert scale ( $7.5 \pm 1.1$ ), see Diagram (2).

Post-operative complications for both groups were analyzed and tabulated in a period of 12 months, including flap loss, hematoma, wound dehiscence, infection, need for secondary procedure and scar contracture, see (Table 3) and Diagram (3). All patients followed in the outpatient clinic and medical photography was taken in the pre and post-operative period with a mean follow-up time in Group A ( $9.2 \pm 5.8$ ) and ( $10 \pm 5.4$ ) months in Group B. Fig. (4) till 12 shows some off our patients clinical outcome.

Table (1): Patient's summary.

No.	Gender	Age	Smoking	Diabetes	HTN	Debridement sessions	Flap used	Time of surgery (day)	Flap dimension length x width (cm)		OR time (min)
1	M	62	Y	Y	Y	2	IP	14	14	6	140
2	M	54	Y	Y	Y	2	IP	13	16	7	180
3	M	9	N	N	N	1	IP	10	11	5	170
4	M	50	N	Y	Y	3	IP	12	18	8	90
5	M	46	Y	N	N	2	IP	16	13	7	150
6	M	47	Y	Y	N	2	IP	12	14	6	170
7	M	52	N	Y	Y	3	IP	14	19	8	150
8	M	51	Y	Y	Y	2	IP	13	19	7	160
9	M	42	N	Y	N	1	IP	12	18	7	150
10	M	51	N	Y	Y	2	IP	15	17	7	180
11	M	56	Y	Y	N	1	IP	14	17	8	100
12	M	67	Y	Y	N	3	IP	14	16	8	110
13	M	54	N	Y	Y	2	IP	11	15	7	120
14	M	34	Y	Y	Y	4	MT	14	10	7	90
15	M	42	Y	Y	N	3	MT	15	11	6	100
16	M	48	Y	N	Y	2	MT	15	11	7	100
17	M	62	N	N	Y	2	MT	16	10	8	130
18	M	45	Y	Y	Y	4	MT	17	10	7	140
19	M	44	N	Y	N	1	MT	18	11	8	120
20	M	48	Y	N	Y	1	MT	10	12	9	150
21	M	38	Y	Y	N	3	MT	15	11	9	90
22	M	38	Y	N	N	2	MT	12	10	8	110
23	M	36	Y	N	Y	1	MT	11	10	7	100

Table (2): Surgical and aesthetic outcome.

No.	Hospital stay (day)	Hematoma	Dehiscence	Infection	2ry procedure	Scar contracture	Flap loss	Aesthetic score (0-10)
1	3	N	Y	Y	Y	N	Y	7
2	3	N	N	Y	Y	N	N	8
3	5	N	N	N	N	N	N	7
4	4	N	N	N	N	N	N	8
5	4	N	N	N	N	N	N	7
6	4	N	N	N	N	N	N	8
7	4	N	N	N	N	N	N	9
8	3	N	N	N	N	N	N	9
9	5	N	N	N	N	N	N	8
10	3	N	N	N	N	N	N	8
11	2	N	N	Y	N	Y	N	6
12	2	N	N	N	N	N	N	7
13	3	N	N	N	N	N	N	9
14	2	N	Y	Y	Y	Y	Y	8
15	3	N	N	N	N	N	N	7
16	3	N	N	N	N	N	N	7
17	3	N	N	N	N	N	N	6
18	2	N	Y	Y	N	Y	N	6
19	3	N	N	N	N	N	N	8
20	3	N	N	N	N	N	N	7
21	2	N	N	N	N	N	N	6
22	2	N	N	N	N	N	N	5
23	3	N	N	N	N	N	N	8

Table (3): Post-operative complications.

Group	Flap loss	Hematoma	Wound Dehiscence	Infection	2ry procedure	Contracture
A	10%	0%	20%	20%	10%	20%
B	7.7%	0%	7.7%	23%	15.4%	7.7%

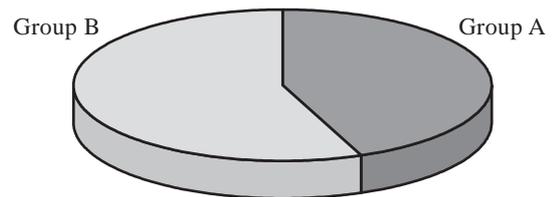


Diagram (1): Intraoperative time in Group A and B.

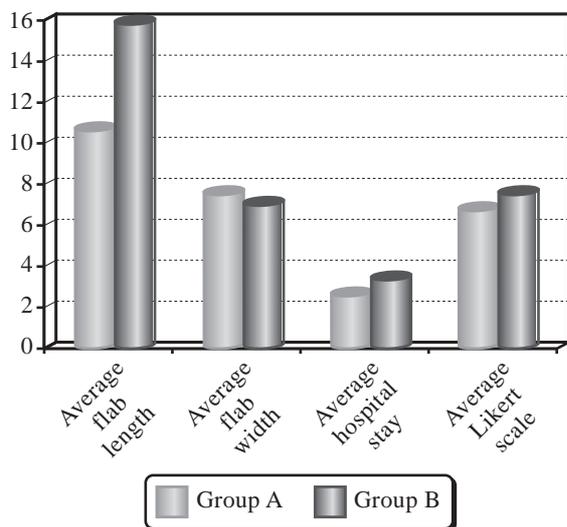


Diagram (2): Average flap dimension, hospital stay and patients satisfaction in Group A and B.

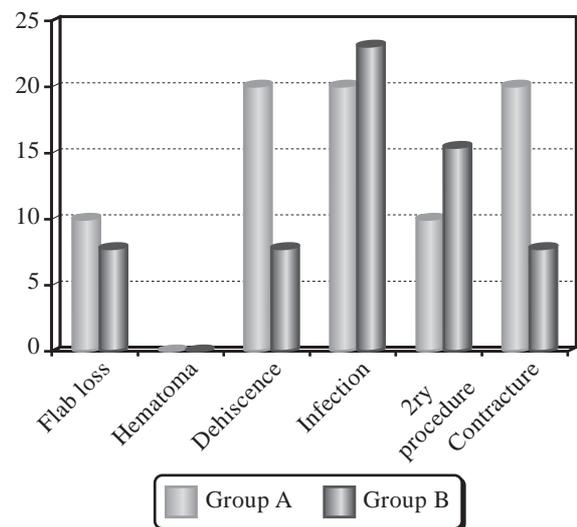


Diagram (3): Post-operative complications in Group A & B.

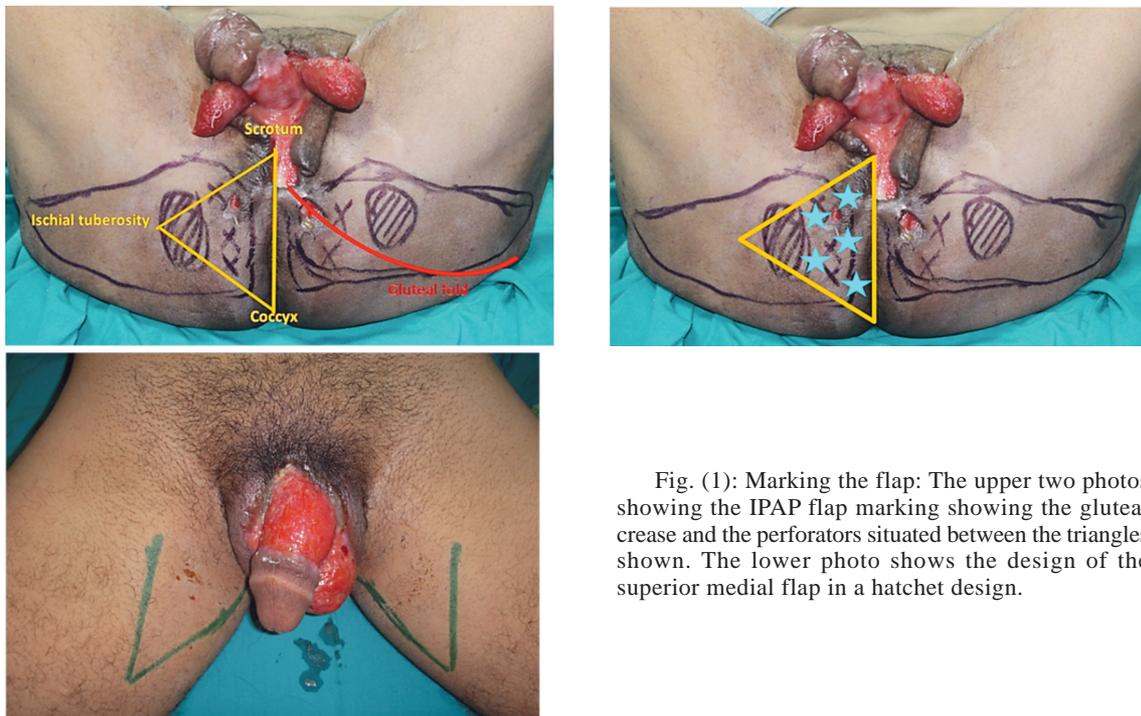


Fig. (1): Marking the flap: The upper two photos showing the IPAP flap marking showing the gluteal crease and the perforators situated between the triangles shown. The lower photo shows the design of the superior medial flap in a hatchet design.

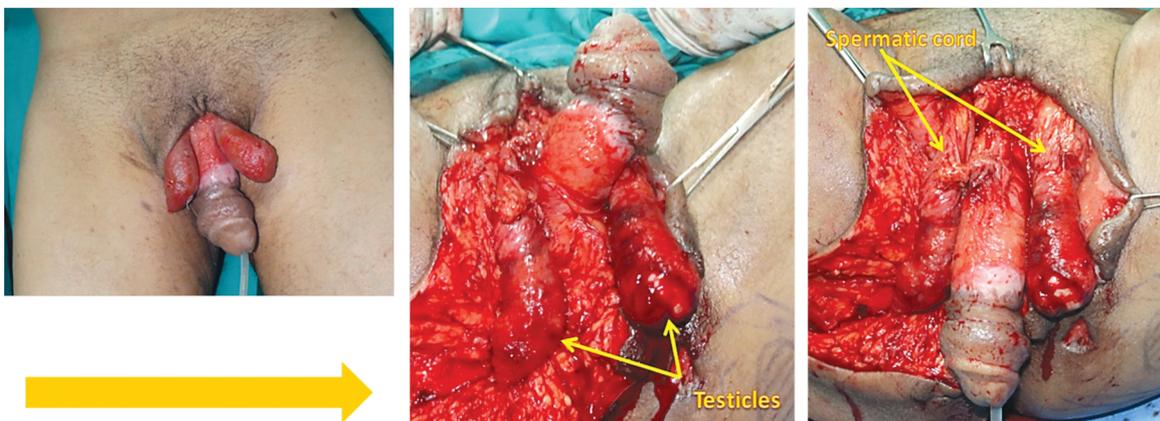


Fig. (2): Preparation of the recipient site: Photos from right to left showing the steps and significance of the cord and testicle dissection to reach its normal caudal orientation.

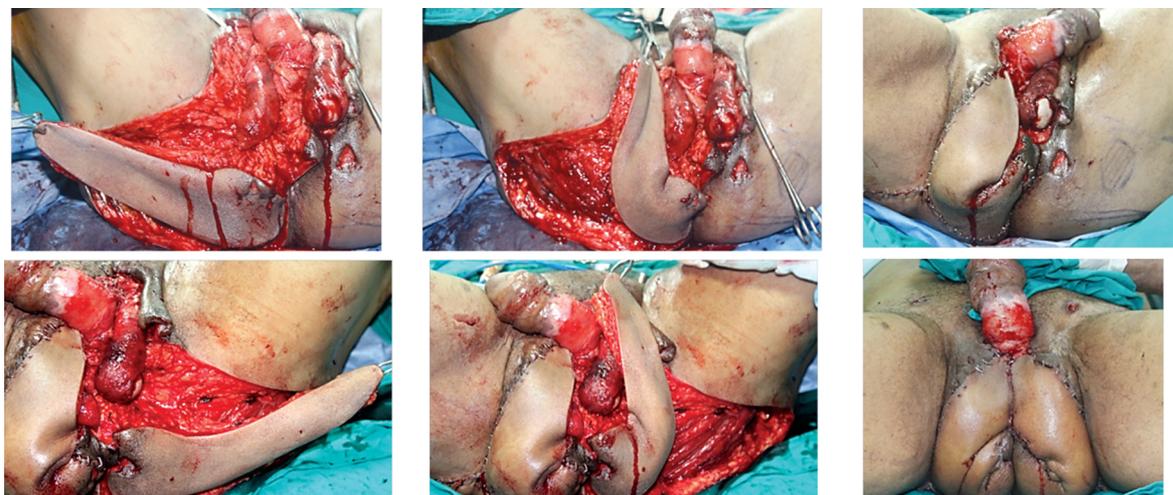


Fig. (3): IPAP flap harvesting: Photos in the upper row from the right to the left showing the dissection from lateral to medial reaching the base and 90 degree rotation of the flap. Lower row is the same but in the other side and suturing both together in the mid line to create the mid line raphe.

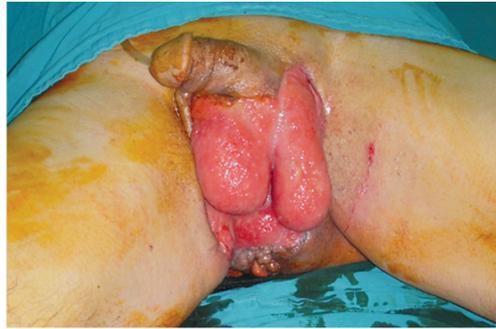


Fig. (4): Case 1, pre and post-operative photos of scrotal and perineal defect reconstructed by SMT flap.



Fig. (5): Case 2, pre and post-operative photos of scrotal and perineal defect reconstructed by SMT flap.



Fig. (6): Case 3, pre and post-operative photos of scrotal and perineal defect reconstructed by SMT flap.



Fig. (7): Case 4, pre and post-operative photos of scrotal and perineal defect reconstructed by SMT flap. The remaining scrotal skin was used to cover the penis and the whole scotum was reconstructed with SMT flap.



Fig. (8): Case 5, pre and post-operative photos of scrotal and perineal defect reconstructed by IPAP flap. The remaining scrotal skin was used to cover the root of the penis and the whole scotum was reconstructed with IPAP flap.



Fig. (9): Case 5, pre and post-operative photos of scrotal and perineal defect reconstructed by IPAP flap.



Fig. (10): Case 6, pre and post-operative photos of scrotal and perineal defect reconstructed by IPAP flap.

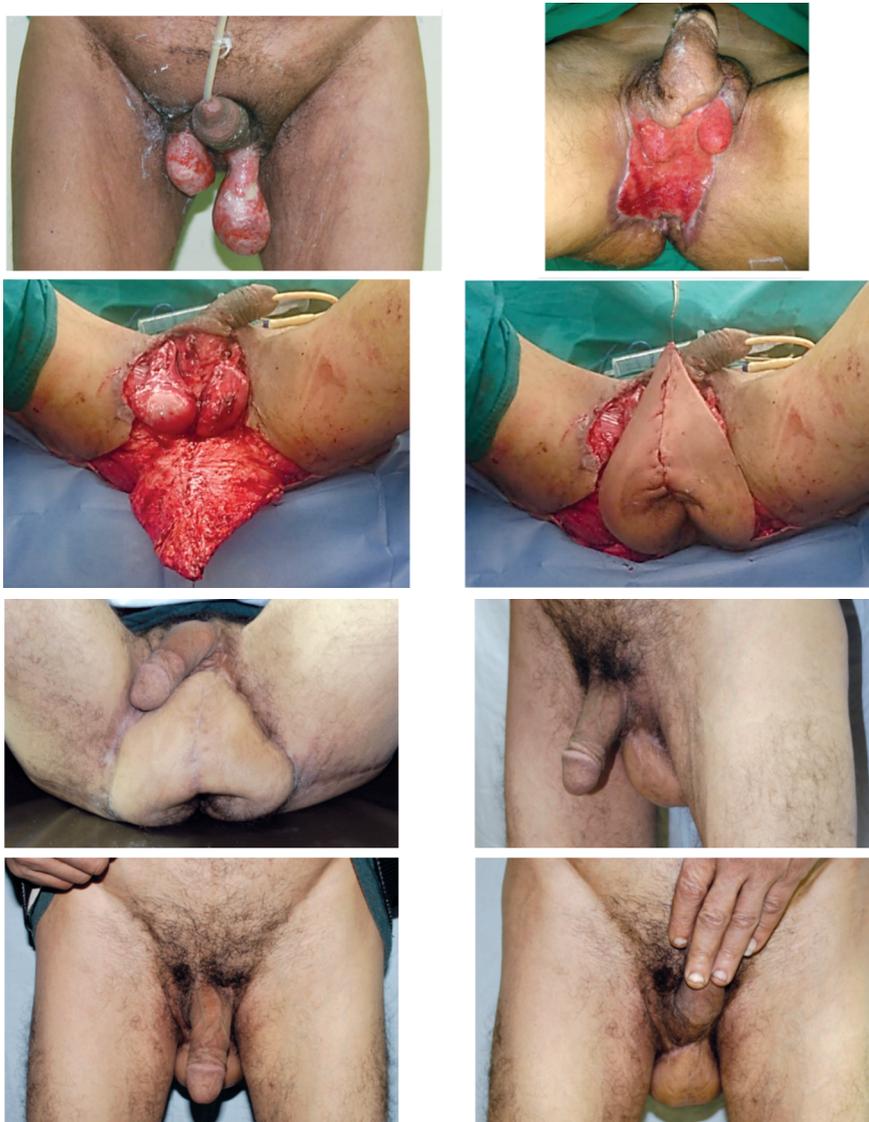


Fig. (11): Case 7, pre and post-operative photos of scrotal and perineal defect reconstructed by IPAP flap.

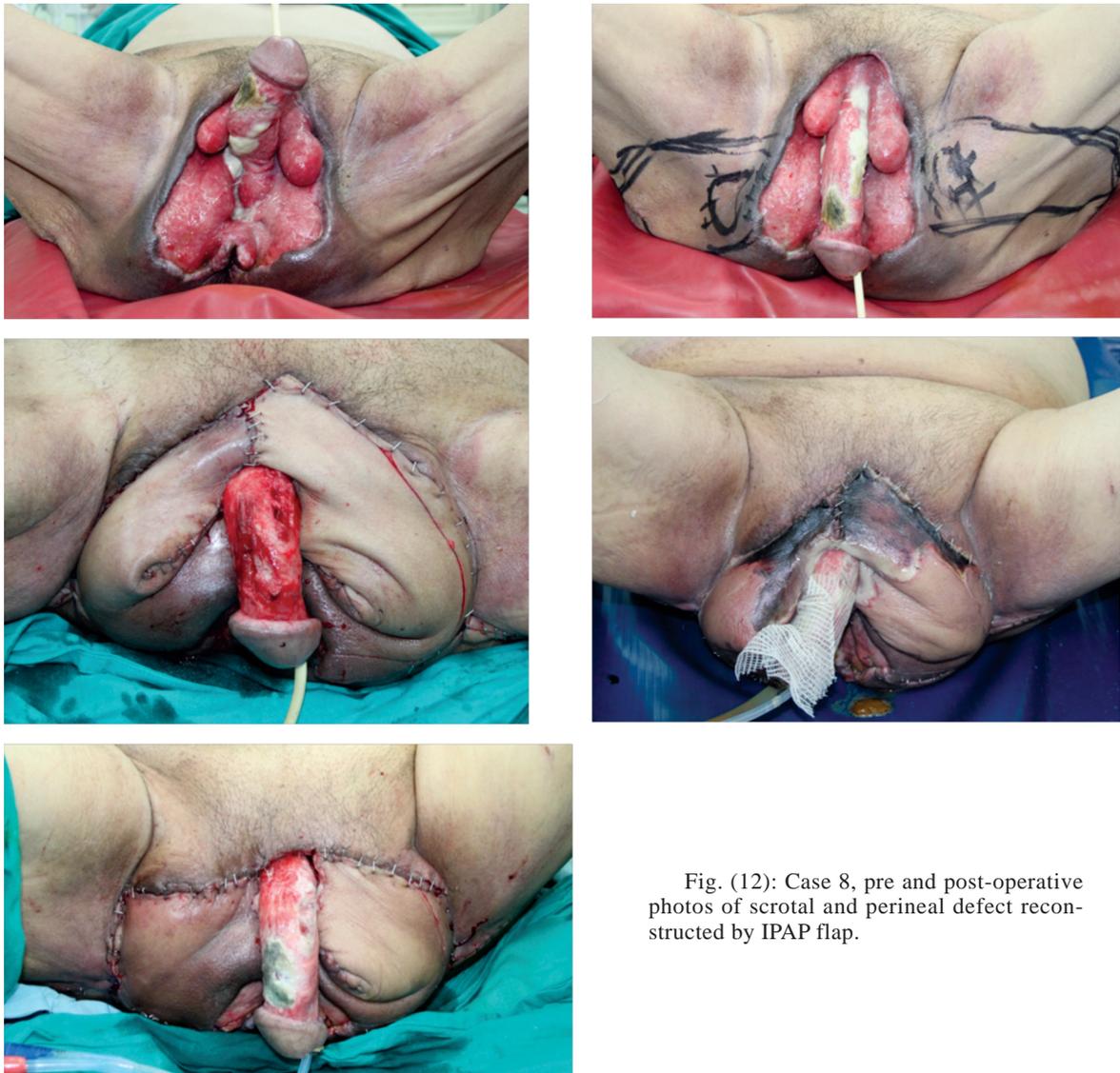


Fig. (12): Case 8, pre and post-operative photos of scrotal and perineal defect reconstructed by IPAP flap.

## DISCUSSION

Fournier's gangrene was described by Baurienne and Hebler. Male idiopathic severe genital gangrene was described by Fournier in 1883, and Wilson 1952 explained it as necrotizing fasciitis [25]. Wound preparation and debridement is of utmost and using the vacuum assisted closure therapy is an option till definitive reconstruction is done. However it is difficult to apply the dressing foam and the adhesive film to this moist, contaminated and irregular perineal, inguinal and scrotal region [27,28]. In our study debridement was carried by the colorectal team as shown in (Table 1) with an average (2.130434783), and patients were transferred to our department after general and local wound improvement.

Scrotal and perineal reconstruction is complex and it's clear from the different techniques men-

tioned in the literature. The decision of choosing a way of reconstruction depend on multiple factors: The patients general condition and preference, the wound site, size, condition and the surgical team experience [29,30]. Testicular pocketing in the medial thigh subcutaneous tissue was mentioned as an option for temporary protection, but it cause pain, psychological negative impact and testicular atrophy [31-35]. We did not adopt this procedure in any of our patients.

Scrotal defects with less than 50% could be reconstructed with the primary closure or with the residual myo-cutaneous residual scrotal tissue. For losses >50%, or presence of perineal defects, other ways of reconstruction to be considered as: Skin grafting, local, regional or distant flaps [29,30, 36-38]. All the patients in our study was having more than 80% of scrotal tissue loss plus perineal defects.

Meshed split thickness skin graft is a good option for reconstruction, however fixing the graft to avoid shearing movements is very difficult, presence of healthy tunica vaginalis is a must for the graft take and the limited testicular mobility after the graft 2ry contracture leading to chronic pain. We used sheet grafts to cover defects over the shaft of the penis and it is excluded from the study [34,35,39].

Myo-cutaneous flaps as: The adductor minimums myocutaneous flap [39], the gracilis myocutaneous flap [41], the rectus abdominis flap [42], and omental pedicle flaps [43], are very useful and reliable, however their main disadvantage are the donor site morbidity, bulky reconstruction, and technically demanding [44].

Perforator flaps is an excellent tool in scrotal reconstruction, including the thigh fasciocutaneous flaps as: Medial, superior and lateral, superomedial and anterolateral thigh flap [45-52]. These flap are technically not demanding with minimal donor site morbidity however, they are claimed to be thick and obliterate the perineoscrotal angle. Ferreira [25] and Maguina 53 mentioned the advantage of [30] using the SMT flap as a single stage reconstruction with no change in the patient's position on the surgical table. Mauro [54] showed low percentage of ischemia and excellent esthetic outcome. Elshahat mentioned the versatility of using the hatchet flap in soft tissue reconstruction so we utilized this concept in all our flaps [55]. As a disadvantage, he considered the limitation of the thigh diameter and the skin elasticity.

While utilizing the SMT flap we didn't change the patient operative position. The average operative time was (113±21.1 minutes) less than the IPAP flap (143.8±30.1 minutes) and the average hospital stay (2.6±0.5 days) were less than the IPAP flap (3.4±0.97 days). Complications occurred in high risk patients with diabetes hypertension and smokers. Only one patient had partial flap loss which required debridement and 2ry sutures. Infection and dehiscence occurred in two patients which is managed with daily dressings and unfortunately resulted in 2ry contracture.

Internal pudendal artery perforator flap is close to the perineal and scrotal regions so it doesn't require tunneling, close the donor site primarily in a hidden region [11]. Hong et al., [56] showed no flap loss in in patients with perineal defects. Hashimoto et al., used the flap for vaginal and perineal reconstruction with partial flap loss in 3 cases [22]. Lee et al., used the flap in 7 patients for scrotal

reconstruction, showing partial necrosis in one patient [57].

IPAP flap entails the use of the lithotomy position, which might explain the longer operative time if compared to the SMT flap. The flap surface area is larger in dimensions if compared to the SMT flap (10.6±0.69cm) average length and (7.6±0.96 cm) average width comparing to the SMT flap (15.9±2.43cm) average length and (7±0.9cm) average width. See (Table 1) and Diagram (2).

Debulking of the flap was done in one patient however it atrophy greatly after 3 to 6 months. The aesthetic outcome with average aesthetic patient's satisfaction is superior using the IPAP which is (6.8±1.03) compared to the SMT (7.5±1.1), flap Likert scale. One patient with diabetes, hypertension and smoker had partial flap loss which required debridement and 2ry sutures. Infection and dehiscence occurred in two patients which is managed with daily dressings and unfortunately resulted in 2ry contracture in one patient.

#### Conclusion:

We can conclude that both SMT flap and IPAP flap are reliable and versatile option for the reconstruction of huge scrotal and perineal region, showing adequate functional and esthetic results. They are easy to harvest, adequate with minimal morbidity.

The MTF is having the benefits of simple flap design, no change in the patient's operative position, less operative time and hospital stay but with limited surface area to cover large defects of the premium and less aesthetic outcome. While the IPAP flap harvesting is more technically demanding, patients prepared in lithotomy position, need more operative time and hospital stay, however they could cover extensive surface area of tissue loss and more aesthetically pleasing to the patients.

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