Outcome of pudendal thigh flap in scrotal Reconstruction and its effect on testicular function

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Abstract
Reconstruction of major scrotal defects represent a great challenge for surgeons. Although a lot of therapeutic methods have been established for the reconstruction of these defects each technique has its own advantages and disadvantages. The pudendal thigh flap is an axial and sensate fasciocutaneous flap based on the terminal branches of the superficial perineal artery which is a continuation of the internal pudendal artery (below the urogenital diaphragm). The data on the testicular function after reconstruction of cover for the testes have been rarely reported. In this study, followed-up of patients with pudendal thigh flap was done regarding aesthetic, functional outcome, and testicular function.

Aim: The aim of this study was to show the versatility and usefulness of posteriorly based pudendal thigh flap for scrotal reconstruction and to evaluate its effect on testicular function.

Patient and Methods: nineteen flaps in 13 patients with major scrotal defects were subjected to reconstruction using posteriorly based pudendal thigh flap. The cause of scrotal skin loss was Fournier gangrene in nine cases, trauma in three cases, and animal bite in one case. Six patients underwent bilateral and 7 patient unilateral flap reconstructions.

Results: All 19 flaps survived completely with good color matching, the donor site was closed directly, and the scar was hidden in the inguinal crease. One patient had wound dehiscence in the donor site and required a secondary procedure for healing. Testicular function regarding spermatogenesis and hormonal functions showed non-significant changes 6months and one year after flap coverage.

Conclusion: posteriorly based pudendal thigh flap is a good option for reconstruction of major scrotal defects. This flap gives a wide coverage with excellent aesthetic appearance of the scrotum, without any significant effect on testicular function.

Keywords: Pudendal thigh flap, scrotal reconstruction, Fournier's gangrene, spermatogenesis.

Introduction
Scrotal skin loss can occurs following many factors including trauma, tumor excision, Fournier’s gangrene and burn. Fournier gangrene is one of the most common causes of scrotal skin loss it is a synergistic necrotizing fasciitis spreading deeply along the fascial planes of the perineum, inner thighs, penis, scrotum (or vagina), and lower abdomen. It is usually associated with significant loss of the covering soft tissue. In cases of Fournier gangrene of the scrotum the testes usually survive and remain exposed because it have an independent blood supply from the testicular artery. [1]

Management and reconstruction of Scrotal defects after different types of injuries may present a challenge, in cases with Partial scrotal skin loss it can be managed by debridement and primary closure however in cases with large or total defects of the scrotum there are different options include : residual scrotal skin mobilization for defects up to fifty percent, split thickness skin graft, [2] thigh flaps with pouch, [3] use of tissue expanders, [4] gracilis myocutaneous flap, [5] groin island fasciocutaneous flap, [6] superiomedial thigh flaps, [7] and pudendal thigh flaps, the choice of the method of reconstruction depends on many factors including the defect size, the quality of the surrounding skin, surgeon’s preference and the choice of the patient. The presence of multiple techniques in scrotal reconstruction demonstrates that there is no single ideal reconstructive technique.

Reconstruction of the scrotum is important for functional, aesthetic, and psychological causes.

To have an ideal reconstruction of the scrotum it should be a single staged technique, provides a non-bulky soft tissue coverage of the testis, maintains thermoregulation that don’t interfere with spermatogenesis, maintain a natural looking scrotal ptosis and color matching, resilient to withstand shearing forces from the thighs with the least donor site morbidity. [8]

Local pedicled fasciocutaneous flaps are usually the appropriate choice for scrotal reconstruction as it avoids skin graft problems, preserve adequate sensation, not technically demanding like free flaps or musclocutaneous flaps and can cover large defects. [9]

The pudendal thigh flap is an axial and sensate fasciocutaneous flap that is based on the terminal branches of the superficial perineal artery which is a continuation of the internal pudendal artery (below the urogenital diaphragm), which is a major branch of the internal iliac artery. [11] this
flap was first described by Wee and Josef and since then it has been reported several times in vaginal reconstruction by many authors. [10]

The main scrotal function is the local regulation of testicular temperature to keep it within a range of 2-8 lower than the abdominal temperature which is necessary for normal spermatogenesis, so the testicular temperature in the reconstructed location should be maintained as close as possible to that of normal scrotal temperature to allow spermatogenesis. [12]

Patient and Methods
Thirteen patients with scrotal defects were admitted to our plastic unit in general surgery department Benha university hospital from 2015 to 2018 for scrotal reconstruction after obtaining approval from the local ethical committee and after fully informed written consent which was signed by the patient. The cause of the defect was Fournier's gangrene In 9 patients, trauma in 3 patients and animal bite in one patient. The mean defects area was from 7 to 18 cm2. All patients were examined for general condition systematically to evaluate and control any life-threatening conditions, and supportive treatment was given. Then local wound care was done by surgical debridement of all necrotic tissues then daily dressing applications performed using saline irrigation and bovine iodine. Swap was taken from the wound for culture and sensitivity and the proper antibiotic was taken.

Inclusion criteria were scrotal defect with major skin loss, while exclusion criteria include minor skin loss that can be treated with release and primary closure, and patients with significant co-morbidities (cardiopulmonary problems, advanced liver or renal diseases) that interfere with surgery. Of these 13 patients 6 need bilateral flaps and 7 need unilateral. Eight patients were diabetic under control with insulin treatment. Sex patients were smokers and we asked them to stop smoking 7 days before surgery. Semen analyses were done in the biochemistry laboratory of our university hospital with proper semen samples taken from patients before surgery.

Surgical Technique:
The patient lied in the lithotomy position under general anesthesia or spinal anesthesia, then we measured the size of the scrotal defect using a large gauze swab. The site of the perforator on the base of the flap was detected using the perforator on the base of the flap was detected using ultrasound or Doppler. The perforator was the site of the flap. The flap was designed being rectangular in shape with its distal end tapering to allow direct closure of the donor area without dog ear formation.

The flap was designed so that the groin crease was located its midline to allow the donor-area scar to be hidden in the groin crease. The measurement of the flap (width and length) were designed based on the size of the defect of the scrotum. The assessment of closing the defect directly is checked by a finger pinch test. The flap was raised from distal to proximal as a fasciocutaneous flap. We stopped Dissection once the length of the flap raised is adequate to be wrapped around the testis-spermatic cord complex. The flap was then turned about 90 degrees with the deep part of raised flap facing the testis-spermatic cord complex was with its distal edge subcutaneous tissues sutured to fibro adipose tissues at the other side making one flap cranial and the other caudal to cover the raw area .The two flaps were sutured together with the cranial one sutured to the root of the penis and the caudal one to the lower border of the defect using vicryl 30. Tow drains are inserted one under each flap and the donor area was closed primarily.

Postoperative care
After surgery the patients were followed in bed in the supine position with flexion and internal rotation of the thighs to relieve tension on the flap and donor site for at least 5 days. We allowed the patient to start Mobility out of bed one day postoperative. Postoperative antibiotics were given. We removed the drain 2-3 days after surgery. No postoperative anticoagulants were given. On the 6th post-operative day the patients were discharged and followed as outpatients. Removal of skin sutures were done after 10-14 days. All patients were followed up for 1 year and semen analysis was done 6months and 1 year after surgery.

Statistical analysis
Obtained data were presented as mean± SD, median, inter-quartile range (IQR), numbers, and percentages. Results were analyzed using Man-Whitney and Wilcoxon tests. Statistical analysis was conducted using the SPSS (Version 20, 2006) for Windows statistical package. P value <0.05 was considered statistically significant. Version 21 (IBM Corp., Armonk, NY, USA)

Results
The median follow-up period was 13 months (range: 12-14 months). The study included 13 patients with a mean age of 38.6 years (range, 20 to 58years). Nineteen pudendal thigh fasciocutaneous flaps were used to cover scrotal defects in 13 patients. Of these patients bilateral flaps used in 6 patients and unilateral flap used in 7 patients. The average width of the flap was 8 cm, ranging from 5 to 12 cm. all Flaps survived well and the scar of the donor site healed primarily except one case of wound sepsis and disruption that followed by daily dressing then grafting. The patients were satisfied of the aesthetic results of the flap as the flap was thin and its texture was the same as that of scrotal skin, also the scar of the donor site was hidden in the groin crease.

In this study we aimed at introduction and evaluation of posteriorly based pudendal thigh flap in scrotal reconstruction and studying its effect on testicular functions.
This table shows patient mean age 38.6 (range from 20 to 58 years), cause of scrotal skin loss was Fournier gangrene in 9 cases (69.2%), trauma in 3 cases (23%), and animal bite in one case (7.6%), of the studied group there was 6 smokers (46.15%), 8 diabetics (61.53%), and 2 hypertensives (15.38%). Regarding the scrotal defect, 7 cases were having total scrotal skin loss (53.85%) and 6 cases with partial scrotal skin loss (46.15%).

Table 2 shows the causative organism of scrotal wound which was Group A streptococci in 6 cases (46.15%), Pseudomonas in 4 cases (30.77%), and proteus and klebsiella in 3 cases (23.08%).
Table 3 shows early post-operative complications where 2 cases show flap congestion (15.38%) that was relieved by removing some stiches, flap necrosis was not detected in any case, wound disruption was observed in one case (7.7%) occurs in the donor wound it was managed by daily dressing then split thickness skin graft. Hematoma under the flap was observed in 2 cases (15.38%) it occurred after removal of the drain and was evacuated by removing a stich. Regarding wound infection it was noticed in 3 cases and was subsided by antibiotics and dressing.

Table 4 long term outcome of the 13 cases there was no ulcer formation, no problems with waking, preserved sensation in 10 cases (76.9%) while 3 cases showed lost scrotal sensation (23.1%). Regarding sexual function there was no affection on sexual function in 12 cases (92.3%).

Table 5. Semen analysis In our study, we used semen volume (in mL), sperm count per milliliter (in million/mL), total motility (in %), progressive motility (in %), and normal morphology criteria. Before surgery, 6 month after surgery, and 1 year after surgery there was non-significant changes (p≤.005) in all parameters.
Table 6. Hormonal analysis.

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<th>Preoperative</th>
<th>6m. post-operative</th>
<th>1 year post-operative</th>
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<tr>
<td>Testosterone (ng/ml)</td>
<td>6.2 (±1.5)</td>
<td>5.9 (±1.2)</td>
<td>6.1 (±1.8)</td>
</tr>
<tr>
<td>FSH (mIU/ml)</td>
<td>4.6 (±1.6)</td>
<td>5.2 (±1.9)</td>
<td>4.8 (±2.1)</td>
</tr>
<tr>
<td>LH (mIU/ml)</td>
<td>3.3 (±1.1)</td>
<td>3.9 (±1.5)</td>
<td>3.6 (±0.9)</td>
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Table 6 shows hormonal analysis regarding serum testosterone, FSH, and LH there was non-significant changes (p≤.005) to the hormonal level 6 month and 1 year after surgery.

Fig 1a. Shows preoperative marking of bilateral flap.

Fig 1b. Shows intraoperative results after closure of the flap and donor area.

Fig 1c. Shows intraoperative results after closure of the flap and donor area.

Fig 1d. Shows post-operative results after 3 months and 1 year of surgery.

Fig 1e. Shows post-operative results after 3 months and 1 year of surgery.

Fig 2a. Shows intraoperative dissection of unilateral flap.
Subcapsular thyroidectomy with methylene blue marking (TT-MB), relied on local injection of diluted MB to provide 0.8 mg/ml normal saline and only 1-3 ml was injected per site. Moreover, MB injected in the subcapsular space allowed excision of tissues retained MB with the excised thyroid gland, this minimal dose and local injection of MB had safeguarded against documented complications secondary to MB systemic absorption [23,24] that were documented with the use of larger doses [25] or intravenous route [25,26] and also points to safety of the concentration used as it coincided with doses documented in literature. [27]

TT-MB is associated with acceptable preservation of serum calcium; total and ionized, and PTH and despite of the detected decreased levels in comparison to preoperative levels, the extent of decrease was lower than in patients of the control group. Moreover, two patients developed manifest HPT on POD1, but only one patient failed to restore normal PTH level on POD6 but did not develop permanent HPT with significant difference compared to control patients. These data point to the possibility of evaluation of outcome of TT using a combination of estimation of serum calcium and PTH. Similarly, Silges-Serra et al. [27] reported that combining both serum calcium and PTH estimations may guide medical treatment and monitoring of post-thyroidectomy prolonged HPT and predicts the likelihood of recovery of the parathyroid function with >90% accuracy.

The MB marking during TT allowed marking of the plane of dissection and perfect identification of thyroid subcapsular plane with easy satisfying dissection in 38 cases (86.1%) and concomitant faster surgery. Such success rate could be attributed to the marking color that allowed easier visualization of the plane of dissection, and to the space occupying effect of the injected fluid which allowed opening of the plane for dissection.

These data go in hand with studies previously used MB during thyroidectomy where Sari et al. [12] reported different wash-out times for MB after its spraying during thyroidectomy where recurrent laryngeal nerve and arteries were not stained, PTG were washed out of the blue stain within three minutes, thyroid tissue wash-out time was ≥15 minutes; peri-thyroid muscles, tendinous and lipoid structures wash-out time was ≥25 minutes and concluded that the differential wash-out time of MB allowed safe preservation of PTG and recurrent laryngeal nerves during dissection for thyroidectomy. Also, Candell et al. [28] and Hacıyanlı et al. [29] found blue dye injection is a safe and effective method of localizing PTG. Moreover, Salman et al. [30] documented that preoperative intra-arterial MB infusion appears to be an effective and safe method for localization of ectopic mediastinal parathyroid adenomas and allows rapid identification during thoracoscopic resection. Recently, Hillary et al. [31] reported that PTG especially enlarged glands fluoresce from MB more intensely than thyroid glands and this auto-fluorescence may aid PTG detection.

In line with the space-occupying effect of injected fluid, Choi et al. [32] reported that procedure of subcapsular saline injection effectively spared the parathyroid gland during thyroidectomy and compared with non-subcapsular saline injection patients and significantly reduced the frequency of transient and permanent HPT.

**Conclusion**

Local MB subcapsular injection during TT facilitates safe thyroid dissection sparing PTG with easy successful dissection rate of 86.1%. Despite of decreased serum PTH, its extent was minimal and only 2 patients developed manifest HPT, but no patient developed permanent HPT.
References


