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Versatility of Rectus Femoris Muscle Flap in Groin Reconstruction

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ABSTRACT

We present our experience of pedicled rectus femoris muscle flap for reconstruction of groin defects resulting from different causes. A total of 17 flaps in 17 patients were performed between January 2005 to May 2007. Five groin wounds (29.4%) occurred after infrainguinal revascularization, Four groin wounds (23.5%) occurred after femoral vessel cannulation for cardiac surgery, one groin wound (5.8%) due to posttraumatic degloving injury with exposed vessels, and seven groin wounds (41.1%) after lymphadenectomy due to metastatic inguinal lymph nodes and soft tissue sarcoma of groin. Eleven patients (64.7%) were males and 6 patients (35.3) were females. Age group ranged from 17-70 years (Mean 48.2 yr.). All defects were reconstructed by pedicled rectus femoris muscle flap. Satisfactory coverage of groin defects was achieved in all the seventeen cases. There were no partial or complete flap losses. All muscle flap donor site incisions healed. Complications were few and all patients achieved durable long-term coverage. We found the flap to be technically easy and reliable with low rate of subjective donor morbidity. A postoperative rehabilitation program may improve the outcome.

INTRODUCTION

Complex groin wounds present a serious challenge to patients and the surgeons. They occur commonly in many surgical subspecialty patient populations including those patients undergoing infrainguinal bypass, femoral cannulation for cardiac and transplant surgery, and urologic and gynecologic lymphadenectomy. These wounds account for a large referral basis for the plastic surgeons. The reconstruction of any wound requires careful consideration of a number of factors including the dimensions, type, and location of the wound; available local tissues; local wound factors; and systemic patient factors.

The pros and cons of the various options are assessed in terms of the likelihood of success.

Groin dissection for inguinal lymphadenectomy is associated with considerable morbidity, and several attempts have been made to minimize the morbidity by well-vascularized flaps of adequate bulk to obliterate the dead space and promote wound healing. In the case of recurrence, the overlying skin is usually involved and the reconstructive surgeon is confronted with exposed femoral vessels and complex groin defects **[1]**.

Muscle flap coverage for those nonhealing, often infected wounds including those with exposed vascular prostheses is essential **[2]**.

Commonly used flaps for groin reconstruction are the sartorius, tensor fascia lata, rectus abdominis, rectus femoris, gracilis, anterolateral thigh flap and abdominal flaps.

Sartorius has a segmental blood supply (type IV) and thin muscle belly, which is not suitable in many of the cases. Skin availability is limited in Gracilis flaps, rectus abdominis myocutaneous flap leads to abdominal wall weakness and Tensor Fascia Lata flap creates unacceptable dog ears and there is need for skin grafting at the donor site. There is strong evidence that both sartorius and ALT flap are reliable methods to reconstruct the groin after inguinal lymphadenectomy; they ensure low complication rate with no donor site morbidity, and should be the first line treatment of immediate and secondary groin reconstruction, respectively **[3]**.

The rectus femoris muscle flap is an effective and reliable means of complex groin wound reconstruction. It is well known for its reliable anatomy, the ease with which it can be harvested, and its great versatility. Although the muscle is very reliable, it is rarely used because of its assumed donor site morbidity, such as weakened knee extension **[4]**. Studies about the rectus femoris muscle flap mention a severe donor-site morbidity. However, detailed data are rarely presented to point out the objective effects of harvesting the muscle **[5]**.

Daigeler reported that donor-site morbidity of the rectus femoris muscle flap is evident but well

compensated and the donor site is not problematic, even in the presence of peripheral vascular disease [6]. Because the rectus femoris muscle is undoubtly valuable, the aim of this study is to assess the benefits and disadvantages attributable to its harvesting.

Relevant anatomy:

The rectus femoris muscle is a superficial large fusiform muscle located at the middle of the anterior aspect of thigh. It is the central muscle of the quadriceps muscle group. The rectus femoris becomes tendenious 3-5cm proximal to the patella and is the most superficial layer inserting on to the patella. Some of its fibers continue over the anterior patellar surface and contribute distally to the patellar tendon. It has a Type II pattern of vasculature. The dominant pedicle is from the descending branch of the lateral circumflex artery and vena comitantes. The minor pedicles are from the ascending branch of the lateral circumflex artery and muscular branches of the superficial femoral artery and vena comitantes.

MATERIAL AND METHODS

A total of 17 flaps in 17 patients were performed between January 2005 to May 2007. Five groin wounds (29.4%) occurred after infrainguinal revascularization, four groin wounds (23.5%) occurred after femoral vessel cannulation for cardiac surgery, one groin wound (5.8%) due to posttraumatic degloving injury with exposed vessels, and seven groin wounds (41.1%) after lymphadenectomy due to metastatic inguinal lymph nodes and Soft Tissue Sarcoma of groin. Eleven patients were males (64.7%) and 6 patients (35.3%) were females. Age group ranged from 17-70 years (Mean 48.2 yr.). All defects were reconstructed by pedicled rectus femoris muscle flap.

Operative technique:

All patients underwent aggressive groin wound debridement after initiation of intravenous antibiotics. Intraoperative cultures were taken.

The muscle was harvested through a slightly curved (lazy S) midanterior incision at the distal two-thirds of the thigh. The muscle was dissected from the vastus medialis and lateralis muscles, and the tendon of insertion was divided proximal to patella. Flap elevation continued proximally. The dominant vascular pedicle from the descending branch of the lateral circumflex femoral artery and the adjacent motor branches of the femoral nerve usually enter the muscle from medially in the proximal third approximately 10cm below the inguinal ligament. The vessels were carefully preserved and if necessary, mobilized to extend flap rotation. A subcutaneous tunnel connecting the distal harvest site and the groin defect was created. The muscle was then passed through this tunnel to be insetted into the groin wound. The fascia was removed from the deep surface of the muscle and a split-thickness skin graft was applied. The medial and the lateral vastus muscles were approximated. Donor site closure was performed using subcutaneous and skin sutures after placing two closed suction drains in the donor site and groin wound.

The subjective donor-site morbidity was evaluated by a standardized questionnaire. Pain and a feeling of weakness in the thigh in relation to walking distance; sensory changes of the thigh; and everyday function of the leg, including climbing and descending stairs, walking, running, and satisfaction with the aesthetic and overall functional results were assessed by the patients themselves using the standardized questionnaire.

Results were rated on a scale from 1 to 6 (1 _ excellent, 6 _ poor) Physical examination verified changes in sensitivity, quantified differences in circumferences of the thigh between the operative and nonoperative sides, and determined the range of motion in the hip and the knee.

RESULTS

Seventeen patients with groin defects presented to the division of plastic surgery, Menofyia University hospital, between 2005 and 2007. During this period,17 rectus femoris transposition flaps were performed. Eleven patients were males (64.7%) and 6 patients (35.3%) were females. Age group ranged from 17-70 years (Mean 48.2 yr.). Indications for groin reconstruction were different (Table 1). Five groin wounds (29.4%) occurred after infrainguinal revascularization, Four groin wounds (23.5%) occurred after femoral vessel cannulation for cardiac surgery, one groin wound (5.8%) due to posttraumatic degloving injury with exposed vessels, and seven groin wounds (41.1%) after lymphadenectomy due to metastatic inguinal lymph nodes and soft tissue sarcoma of groin.

Table (1): Indications for reconstruction.

Indications	No. of patients
Infrainguinal bypass	5
Cardiac surgery	4
Lymphadenectomy	7
Traumatic degloving injury	1

Fig. (1-A): Fungating inguinal lymph nodes.

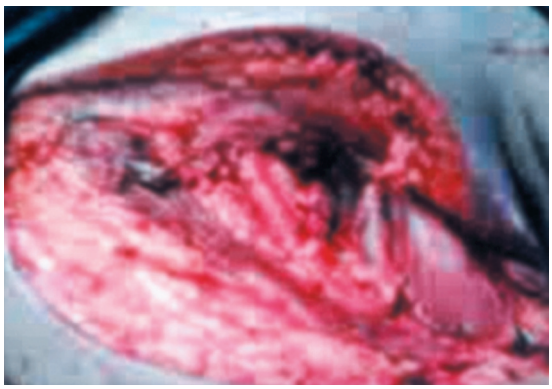

Fig. (1-B): Groin defect after lymphadenectomy with exposure of femoral vessels.

Fig. (1-C): The muscle in the groin.

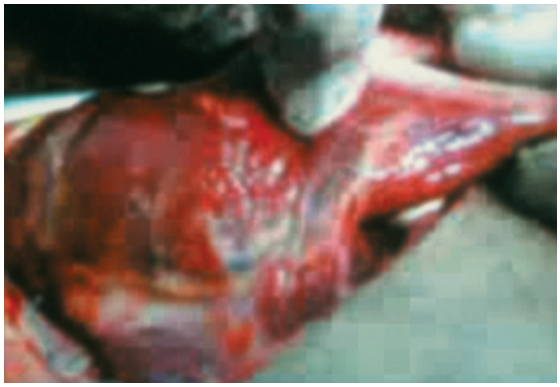

Fig. (1-D): The pedicle of the muscle.

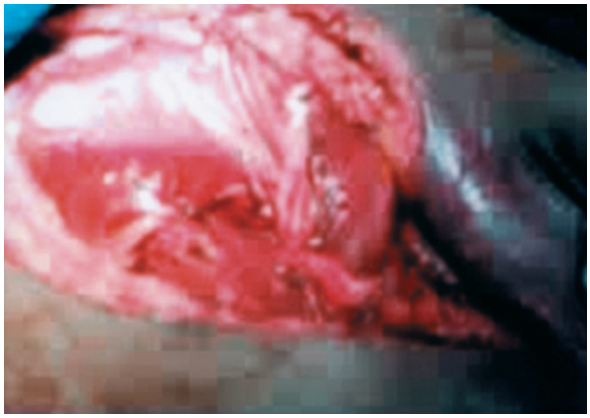

Fig. (1-E): Complete covering of the groin.

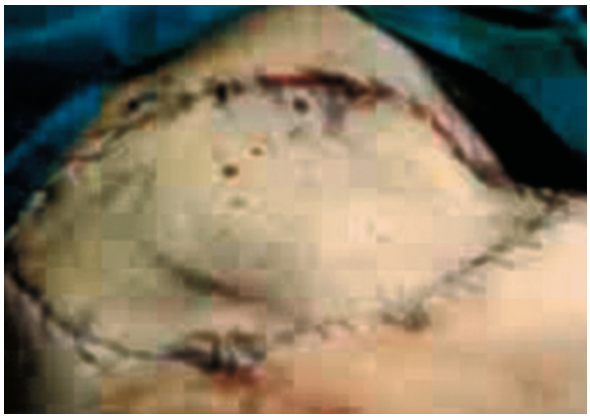

Fig. (1-F): The muscle covered by skin graft.

Fig. (1-G): Complete survival of the flap and overlying graft after one week.

Fig. (1-H): The flap after two weeks.

Fig. (2-A): Post-traumatic gangrene of skin.

Fig. (2-B): Debridement and reconstruction of groin with rectus flap.

Fig. (2-C): Mesh skin graft with residual raw.

Fig. (3-A): Left groin defect.

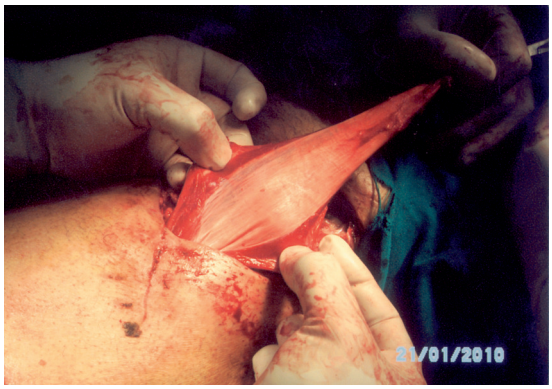

Fig. (3-B): Deep surface of the muscle with its fascia after passing through the tunnel.

Fig. (3-C): Insetting of the muscle.

Fig. (3-D): Split skin graft on the flap.

Fig. (3-E): The flap after one month.

Three patients underwent separate operative debridement before groin wound reconstruction. There were no intraoperative complications. Satisfactory coverage of groin defects was achieved in all 17 cases. There were no partial or complete flap losses. The change in thigh circumference was minimal and the scars were not very noticeable. Reoperation was performed in one patient (5.8%) for flap readvancemente.

Two patients (11.7%) had a mild feeling of weakness in the operated leg. Nine patients (52.9%) complained about hyposthesia in the lateral suprapatellar region in the operated leg.

Walking and climbing stairs were assessed as excellent to satisfactory, and leg function for descending stairs was considered at least sufficient. The overall functional and aesthetic results at the donor site were considered excellent, good, or satisfactory. There was no decrease in range of motion in the hip or knee joint in any of our patients. There were no donor-site complications in our patients, except for one (5.8%) patient developed wound dehiscence (Table 2).

Table (2): Patient data and questionnaire results.

Patient	Pain	Weakness	Hyposthesia	Walking	Climbing stairs	Descending stairs	Aesthetic result	Functional result
1	Yes	No	Yes	3	3	4	3	2
2	No	Yes	No	1	1	2	2	1
3	Yes	N0	Yes	3	1	2	2	1
4	No	No	No	2	2	4	2	2
5	No	N0	No	3	6	1	1	3
6	No	N0	Yes	3	6	1	1	2
7	No	Yes	Yes	3	3	6	1	2
8	No	No	Yes	4	5	4	2	3
9	No	No	Yes	2	2	4	3	4
10	No	No	No	4	2	2	2	2
11	No	N0	Yes	3	1	2	3	3
12	No	N0	Yes	1	1	1	1	2
13	No	No	No	1	4	1	1	1
14	No	No	Yes	1	4	3	1	1
15	No	N0	N0	1	2	3	1	1
16	No	No	No	2	3	2	1	3
17	No	No	No	1	1	2	2	3

DISCUSSION

Complex groin wounds with extension to the femoral vessels represent the most serious surgical complication **[7]**. Adequate and durable coverage of these defects is extremely important to prevent the exposure of femoral vessels which may lead to life-threatening blow-outs. They demand well vascularized flaps of adequate bulk to occupy a tissue dead space created by infection, necrosis, and surgical debridement **[8]**.

Flap closure of the groin has many advantages: The flap brings well-vascularized tissue from a distant area to the groin. It covers the dead space in the femoral triangle and decreases seroma formation and Pre and postoperative radiotherapy can be safely given **[9]**.

Reconstructive options for groin defects can be sartorius, gracilis, rectus abdominis, rectus femoris, tensor fascia lata muscle, anterolateral thigh flap and local skin flaps.

Tensor fascia lata is the most commonly used flap for groin defects, but the donor site closure almost always requires a skin graft and forms a big dog ear (standing cone deformity) at the pivot point **[10]**.

The sartorius muscle transposition flap has been previously reported as a flap of choice for groin wound reconstruction and prosthetic graft coverage **[11]**. Dissection and mobilization of this flap, however, is limited by its type IV segmental blood supply **[12]**. The volume of tissue required for groin reconstruction exceeds that which is provided by sartorius muscle transposition **[13]**.

The rectus abdominis flap has also been used for groin and perineal Reconstruction [14]. Only the contralateral muscle can be used, because the inferior epigastric vessels on the ipsilateral side are divided during inguinal block dissection. The reported abdominal wall donor-site. Complications have included abdominal wall laxity, frank hernia, recurrent seroma formation, and wound dehiscence [15].

The gracilis myofasciocutaneous flap is another alternative that has been proposed for groin wound reconstruction. The key to successful elevation is precise marking of the skin paddle. Modified harvesting techniques aimed at including perigracilis fasciocutaneous perforators have helped improve flap perfusion [16]. It can be used in the setting of pelvic post malignancy resection defects reconstruction [17].

Several studies have demonstrated unacceptably high partial flap necrosis rates with its use. It was concluded that a contraindication to the use of the gracilis myofasciocutaneous flap would be major vascular occlusive disease of the profunda artery. The limited muscle volume and potential donor site complications have limited its usefulness in groin wound reconstruction [18].

Anterolateral thigh flap is a perforator flap based on the descending branch of the lateral femoral circumflex artery either through the septumbetween the rectus femoris and the vastus lateralis or through either muscle. The skin territory of this flap is very wide and can be raised as a very thin flap, but is technically more demanding [19].

The use of the rectus femoris muscle for reconstruction has been criticized for its potential for loss of full knee extension. The rectus femoris muscle flap is well known for its constant and reliable neurovascular pedicle. Harvesting is technically easy and quick. The flap can be taken as a pure muscle flap, a myofascial unit including parts of the iliotibial tract, or a myocutaneous flap [20]. As a free flap, it is used in therapy of facial paralysis to cover soft-tissue defectsand to reconstruct motor function after muscle loss or nerve injury [21]. The pedicled flap is used for abdominal wall reconstruction and for covering defects within its arc of rotation, including the lower abdomen, the groin, and the trochanteric or ischial region [22].

Alkon et al., have reported an impressive 96 percent success rate using the rectus femoris flap for groin reconstruction. They have advised that the rectus femoris flap is the ideal option for groin flaps [18].

Whereas versatility and reliability of the pedicled rectus femoris muscle flap are not disputed, donor-site morbidity is controversially described by different authors.

Knee extension power following the use of the muscle has been reported to decrease by 24 to 28 percent on computerized dynamometer testing compared with a patient 's contralateral nonoperated limb [5]. However, these same studies have also demonstrated the ability of a postoperative physical therapy regimen to reverse this temporary deficit. Several authors, however, have reported no loss of knee extension capacity following their use of the rectus femoris muscle flap [20]. Others have reported similar strength recovery, ambulation ability, and stair climbing capacity [23]. A mild but functionally not significant deficit in terminal knee extension was mentioned by Bhagwat et al. [24]. Wei et al., reported no significant loss of leg function and minimal patient complaint [21]. Rohrich et al., described harvest of the muscle as being associated with some donor morbidity, particularly, weakening of quadriceps function [25]. Freedman noted that transposition of the flap would not permanently affect active knee extension, particularly if the remaining quadriceps muscles were centralized [26]. Koshima denied any loss of leg function [27] whereas Bostwick et al., described a significant functional deficit [2]. Only Caulfield described a decrease in concentric strength and eccentric strength after rectus femoris flap [5]. Daigeler described a decrease in true maximal capacity of 18 percent and maximal voluntary contraction force of 22 percent and these data approximately concur with the results of Caulfield et al. [6]. Daigeler proposed to leave as much as possible of the tendon of insertion of the muscle in place to allow the force of the remaining muscles to be conducted to the patellar tendon close to the regular biomechanical situation [6].

Subsegment of rectus femoris muscle could certainly be harvested for smaller wounds, which may allow preservation of knee extension function [28].

In our study, the rectus femoris muscle flap for groin reconstruction has performed in 17 patients. Total of 17 flaps in 17 patients were performed. Nine flaps were used for groin defects after infrainguinal vascular reconstruction with exposed vessels, five cases of metastatic inguinal lymph nodes, one case of post traumatic degloving injury with exposed vessels and two cases of soft tissue sarcoma of groin. The muscle was easily harvested. There were no partial or complete flap losses. Reoperation

was performed in one patient for flap readvancement. There were no donor-site complications in our patients, except for one patient developed wound dehiesence. The change in thigh circumference was minimal, and the scars were not very noticeable, the aesthetic and functional results were considered by the patients to be satisfactory. There is no decrease in active range of motion in the knee and hip. Almost all patients developed feeling of weakness within the first month after surgery; these problems resolved by 6 months. Two patients reported pain in the postoperative thigh. Nine patients complained about hyposthesia in the lateral suprapatellar region in the postoperative limb. Most patients did not realize the deficit and reported no decrease in everyday function.

We conclude that donor site morbidity of the rectus femoris is evident but well compensated and we found the flap to be technically easy and reliable with low rate of subjective donor morbidity. A postoperative rehabilitation program may improve the outcome.

Conclusion:

We conclude that, the rectus femoris muscle flap is an attractive and reliable tool for reconstruction of complex groin defects. Technically the flap is easy to harvest and meets the recipient site requirements adequately. Donor site morbidity is evident but well compensated with and low rate of subjective donor morbidity.

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