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ARTICLE

Lymphatic flow through (LyFT) ALT flap: an original solution to reconstruct soft tissue loss with lymphatic leakage or lower limb lymphedema

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ABSTRACT

Introduction: The lympho-venous shunt using the distal vein of ALT flap pedicle allowed at the same time the coverage of the inguinal defects and to perform lymphovenous shunt into a run-in vein of the descending branch of the lateral circumflex femoral pedicle, draining the lymph through the flap pedicle. Surgical technique, complications and final outcomes (both clinical and lymphoscintigraphic) are reported.

Methods: Five patients (45.8 y.o.[22–70]) with groin soft tissue loss with lymphatic leakage or lower limb lymphedema, benefited of the described technique. The ALT flap was used to cover the defect and, at the same time, we could perform a lymphovenous shunt between afferent lymphatics to the thigh and the descending branch of the lateral circumflex femoral pedicle, distal to the perforator nourishing the flap. Clinical and lymphoscintigraphic assessment of the limbs, cease of lymphorrhea or cellulitis/lymphangitis episodes, eventual downstaging of physiologic/physical therapy were recorded. LYMphatic Quality Of Life in leg (LYMQoLLeg) and patient satisfaction were evaluated.

Results: Average flap size was 88.8cm^2 (range 84–126). The mean number of multi-lymphovenous anastomosis (MLVA) performed was 1.8 (range 1–3) per patient with 1–3 lymphatics shunted into each vein. Only one hemato-seroma requiring surgical revision. Mean improvement of perometer values was 48.2% (range 27.7–67.7) with an average follow-up of 13.6 months (range 12–17). Lymphoscintigraphy showed disappearing of the lymphatic leak and lymphedema with a high satisfaction of LYMQoL score.

Discussion: The combination of pedicle flap with lympho-venous bypass as lymphatic derivation concept, improving the chronic morbidity scenarios of lymphatic complications.

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Flap; lymphorrhea; lymphedema; lymphovenous bypass; LyFT

Introduction

The inguinal area is a critical site for oncologic debulking surgeries, lymphadenectomies and vascular procedures. Iterative surgeries and radiotherapy can aggravate the clinical picture favouring local wound healing delay, bacterial contamination, infections, lymphatic leaks, chronic lymphorrea and eventually lower limb lymphedema [1,2]. General comorbidities such as diabetes, cachexia and tabagism may further worse local evolution. The post-operative morbidity associated with inguinal surgery with incidence of complications has been reported as high as 40% [3].

When soft tissue defects are associated with the disruption/resection of inguinal nodes and lymphatic pathways, groin defects become particularly challenging with a peak in complication rates. In such cases, key plastic surgical principles such as dead space obliteration and coverage with well-vascularized tissue may not be enough in reason of the lymphatic insufficiency that entertains a chronic lymphorrea, eventually associated to lower limb or genital lymphedema, causing extremely high morbidity and prolonged hospital stays [4].

The coverage of soft tissues defects should be ideally associated to the restoration of a lymphatic drainage to avoid chronic lymphedema. The choice of reconstruction techniques depends on the size of groin defects [5]. Still, the pedicled anterolateral flap (ALT) is considered the gold standard complex groin defects because of anatomical position, versatility, possibility for chimeric muscle harvesting and the relatively low donor site morbidity [6–8].

Micro and supra-microsurgical techniques offer the possibility to shunt lymph into the venous system to by-pass, an obstruction or an area where the lymphatic network is no longer competent [9–11]. Multiple lymphatic-venous anastomoses (MLVA), conveying multiple lymphatics into a single vein with a competent valve, offer a single-site approach for patients suffering from lower limb lymphedema [12]. This last approach has shown to be effective at the groin to treat lymphoceles, and for the prevention and treatment of upper and lower limb lymphedema, thereby improving the patient's quality of life and decreasing health care costs [12,13]. However, techniques of lymphatico-venous shunts impose the presence of competent veins. At the inguinal region, the venous network may be severely compromised with destruction of venous system by large oncologic resections, aggressive lymphadenectomies, adjuvant radiotherapy, multiple vascular procedures and in IV drug abuse. Thus, proximal lymphatico-venous shunts may be technically impossible due to lack drainage veins and

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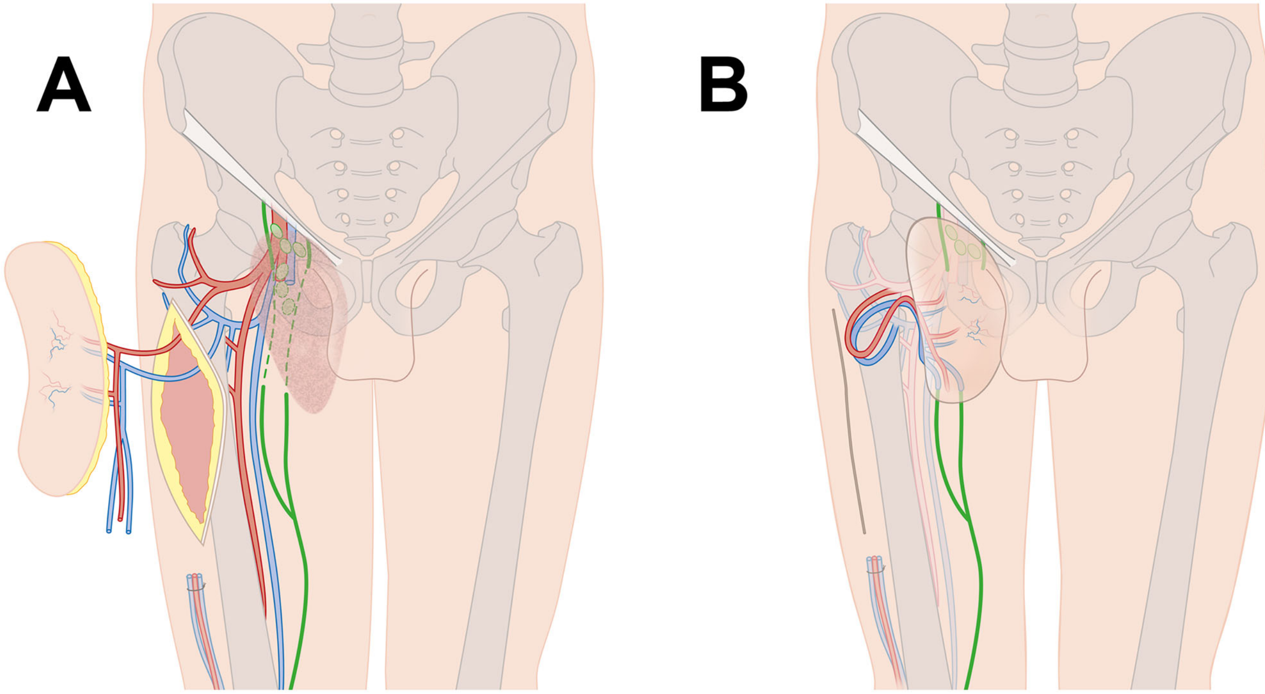

Figure 1. Schematic representation of the LyFT flap technique using the comitans veins of the descending branch (DB) of the lateral circumflex femoral pedicle as receiving veins for lympho-venous anastomosis.

distal LVAs may be ineffective in treating proximal lymphorrea or an already established lymphedema.

Flow-through flap have been well described in literature as useful way to encompass an arterial or venous defect [14]. We developed the concept of using a flap pedicle run-off (in the case of the ALT, the distal part of the descending branch of the lateral circumflex femoral artery) as recipient vein (run-in) for multi lymphatic into vein anastomoses. This flap procedure allows covering inguinal defects, while at the same time it brings a quality vein that can receive lymphatic flow more distally on the thigh, before it reaches their interruption in the resected or jeopardised area [15] (Figure 1).

Combining reconstructive surgery and lymphedema microsurgical by-pass principles, we could find an effective new solution to restore the lymphatic drainage while addressing soft tissue defects of the groin reducing local complications. Surgical technique, complications and final outcomes (both clinical and lymphoscintigraphic) are reported.

Patients and methods

From November 2018 to September 2019, all patients presenting inguinal resections with defects resulting in active lymphorrea or mixed lymphorrea-lymphedema were included in a prospectively maintained database.

Two main inclusion criteria were defined. The first was presence of groin soft tissue defect without direct closure possibilities or failed primary closure needing a flap coverage, while the second was lymphatic leakage or lymphoedema of lower limb non-responding to previous conservative (prolonged drainage >2 weeks) or surgical treatments (attempted lymphatics ligation, negative pressure therapy, previous muscle flaps). Only patient with both inclusion criteria were selected. Patients with follow-up with less than 12 months or other incomplete pre or postoperative data were excluded.

When gathering preoperative data, defect etiologies, previous surgical attempts, timing between initial surgery/resection and plastic coverage were reported together with specific lymphatic-related complications such lymphorrea, lymphocele or lower limb lymphedema.

All anomalies in lymphatic drainage were preoperatively assessed by lymphedema-specialized angiologist (blinded to the study and to the reconstructive technique): clinical analysis was combined with lower limb quantification of lymphoedema by infrared optoelectronic volumeter (Perometer® 1000 M, Pero-System GmbH, Wupertal, Germany). Limb circumferences were taken in both legs beginning at the knee (designated as 0 cm), and at 10-cm intervals proximally and distally up to 30 cm. Venous Doppler ultrasound at the groin was performed by an angiology consultant to evaluate presence, and continence of the vein network at the groin. The International Society of Lymphology classification of lymphedema (ISL) was used as clinical staging system. Lymphatic leakages were quantified with suction drain or in Negative Pressure Therapy (NPT) dressing in milliliter per day.

All patients received preoperative and postoperative lymphoscintigraphy and transport index (T.I.), as described by Kleinhans [16], was calculated by a nuclear medicine senior consultant blinded to the study.

Each patient benefited of inguinal ALT flap coverage with intra-flap multi-lympho-venous anastomosis (MLVA) using as receiving/ascending vein (run in) the comitans vein of the descending branch (DB) of the lateral circumflex femoral pedicle (LCFA). Flaps were all performed at the Department of Plastic Surgery of the Lausanne University Hospital by the same surgical team (PGdS, DG).

Sizes of flaps (in centimeter), number of MLVA performed (and number of lymphatic vessels into each vein), time to complete healing (in days), hospital stay (in days), complications (local infection, wound dehiscence, seroma, return on operative room) were recorded.

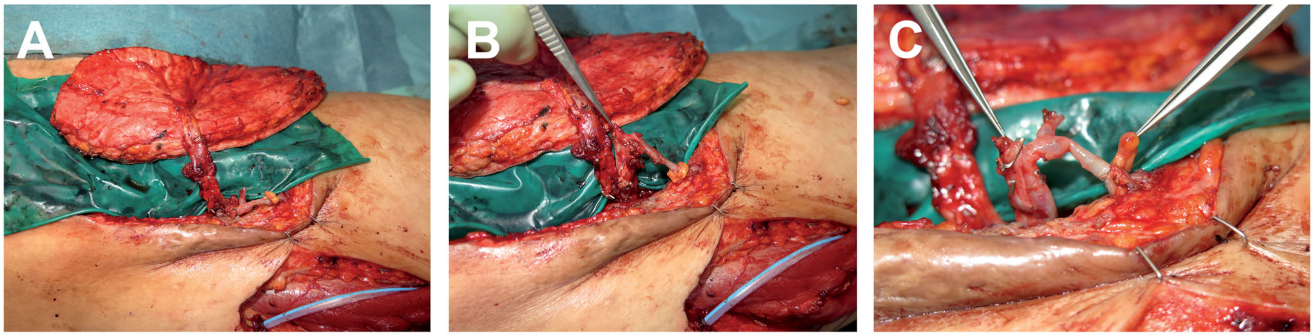

Figure 2. Intraoperative pictures showing perforator ALT flap transposition at the groin (a), and lympho-venous anastomosis through-flap (b,c).

Outcomes metrics for lymphatic surgery were reduction in limb volume, ceasing of lymphorrea or perilesional cellulitis/lymphangitis and downstaging of physical or compression therapy. Patient-reported satisfaction outcomes were rated as unsatisfied (no improvement), bad (weak improvement on circumference/persistence of heaviness), good (significant improvement), excellent (no functional complaint). The Lymphatic quality of Life in leg (LYMQoL-Leg) score was used to assess the impact of lymphedema of the lower limb on the QoL of the patients. The overall QoL' item was scored 0–10 [17].

Surgical technique

Each procedure was performed under general anesthesia. Extensive groin debridement was performed until well-vascularized tissues was achieved. ALT flap perforators were marked using a hand-held doppler. After isolating the paddle on the perforator(s), we dissected out the DB of the LCFA as an ideal source of effective draining veins. The flap was then tunneled under both Sartorius and rectus femoris muscle to cover the inguinal or medial thigh defects as previously described [18]. Lymphatic vessels were individualized in distal part of inguinal defect thanks to blue patent dye and Indocyanine green fluorescence (ICG), detected by fluorescence lamp (Fluoptics Fluobeam® – France). When in doubts whether a genital lymphatic component was inducing the lymphorrea, ICG was injected at the level of scrotum and pubis and Blue dye at the level of the limb.

Particularly, blue dye was injected into the thigh 10 min before surgery. Afferent lymphatics were used to perform MLVA. The number of MLVAs varied according to the location of the lymphatic leaks or to the number of available severed afferent lymphatics. All MLVAs were performed on the DB, using both venae comitans if needed, according to the with LyFT technique [15] (Figure 2). Immediate peroperative patency of MLVAs was appreciated, noticing Indocyanine green fluorescent dye through anastomosis. Veins were always long enough to be for tension-free anastomoses.

Wound closure was performed using gentle suction drain (Cardinal Health™ Jackson-Pratt® - USA). IV Amoxicillin was given as empiric postoperative treatment, unless specific germs had been already identified on previous microbiology samples. Postoperative instructions were bed rest three days and drain removal after mobilization if <0 ml per day. A lower limb compressive garment was started two weeks postop for three months.

Long-term results were evaluated by comparative clinical results and lymphoscintigraphy.

Lymphoscintigraphy

Both subcutaneous injection and intradermic into the dermis of the second webspace of feet were performed. Acquisition on both limbs was done using a dual-head gamma camera system (Discovery NM/CT 670, GE Healthcare, USA) with the radiotracking (Tc-99m Nanocoll – 74 MBq), in order to provide a comparison, regardless clinical swelling. Dynamic lymphoscintigraphic evaluation included variations in lymph obstruction/flow at the lower limb, lymph nodes stations or lymphatic vessel displacement/rerouting. At the end of the dynamic study, acquisitions of total body images were taken in anterior and posterior projections after 30 min (early acquisition), 2 h, and until to 5 h post-injection (delayed acquisitions), depending on tracker progression. Late imaging allowed the assessment of 'dermal backflow' or post-traumatic stagnation. A nuclear radiologist consultant blinded to the study evaluated lymphoscintigraphies (pre-operative and 12 months post-operative) and attributed a transport index (TI) of both limbs according to Villa et al. [19].

The TI evaluated the kinetic distribution of the radiopharmaceutical as a function of time, the number of lymphatic pathways displayed, the direction of lymphatic drainage, the number of lymph node stations visualized, and their respective lymph nodes displayed.

A score of less than 10 implied a normal TI and a score equal to or greater than 10 signified a pathological TI [17].

Results

Four operated patients were men (80%). Mean patient age was 45.8 ± 20 y.o (mean ± SD). None of the patients suffered from primary lymphedema prior to initial surgery. Etiologies of inguinal defect were secondary to locoregional cancer in three cases (groin sarcoma and inguinal lymphadenectomy for penile cancer), and intravenous drugs abuse responsible of infected pseudo-aneurysm of the femoral artery in two cases. Preoperative lymphedema classification according to ISL was evaluated from Ia to IIa. However, four patients out of five presented chronic high output lymphorrea (more than 350 ml/day), which often was masking a more severe lymphedema development and potentially underestimating the lymphatic incompetence.

Indeed, when NPT therapy was in place, preoperative lymphoscintigraphies could clearly show how the negative pressure dressing was avoiding establishing a chronic lymphedema by entertaining a high output lymphorrea due to the continuous suction.

The average number of attempted surgical procedures before coverage by plastic team using a Lyft ALT flap was 4.4 ± 2.8 generally separated by negative pressure therapy cycles. The mean number of MLVA performed was 1.8 ± 0.8 per patient with one to

Table 1. Preoperative and postoperative data for each patient.

N° patient	Data patient				Prior Surgeries			LyFT procedure					Post-operative hospital stay	Perometry volume measurements of limbs			Lymphoscintigraphy		Follow-up	Patient's appreciation
	Age	Sex	Original Surgery	Comorbidities	Number of surgical procedures	Quantification of lymphatic leakage (in ml/day) before LyFT flap	Time between initial surgery and LyFT flap (days)	Size of defect after debridement (cm)	Number of MLVA (number of lymphatics into vein)	Drain removal (postoperative days)	Complete healing (days)	Post-operative complications	(days)	% Pre-operative difference normal / affected	% Post-operative difference normal / affected (at 12 months)	Improvement (%)	Pre-operative Commentary - Transport Index	Post-operative (12 M) Commentary - Transport Index	(mean in months)	Subjective appreciation and LYMQoL LYMPHATIC QUESTIONNNAIRE (Q22) - overall QoL (pre/postoperative)
1	43	M	Infected femoral artery pseudoaneurysm needing femoral artery by pass (CFA to SFA-PFA) Exposed prosthesis + debridement of Infected groin with + NPT	IVD abuse, HIV, HCV, HAV, cachexia, tobacco	8 *(Vascular surgery + 7 debridements - NPT treatments for infected groin)*	Active lymphorrea 500 ml/day Lymphedema stage IIa	30	14x6	3 (2:1, 1:1, 2;1)	6	15	none	22	-20,9375	-7,80487805	-62,7229705	Severe L inguinal leakage, fixation in NPT R : normal - Preoperative T.I. R:1; L:15	Disappearance of lymphatic stasis T.I. R:1; L:11	17, no clinical lymphedema, no compression garments	Highly satisfied (4/7)
2	22	M	Round cell sarcoma of L groin. Resection involving pectineal muscle and GSV	Neoadjuvant radio-chimio therapy	3 *(Resection, treatment of infected sarcoma and inguinal hernia (mesh), repair of iatrogenic lesion on CFV)*	Active lymphorrea >500 ml/day Infected lymphocele Lymphedema stage Ib	79	18x7	1 (2;1)	15	20	hemato-seroma	15	-5,125	-3,7037037	-27,7326107	Lymphatic leak lateral to the L inguinal collection, L nodes reduced in number R : normal - Preoperative T.I. R:4; L:9	Almost disappearance of previous leak, slightly slower flow at the level of mid-thigh T.I. R:4; L:4	13, no clinical lymphedema, no compression garments	Highly satisfied (5/7)
3	42	M	Infected femoral artery pseudoaneurysm needing femoral artery by pass (CFA to SFA) Exposed prosthesis + debridement of Infected groin with + NPT	IVD abuse, HIV, HCV, HBV, cachexia, cirrhosis, endocarditis , tobacco	5 *(Vascular by-pass, debridement and primary closure, debridement + sartorius plasty, debridement, lymphatic ligation, NPT, active bleeding on NPT, arterial patch)*	Active lymphorrea >500ml/day, infected lymphocele Lymphedema stage IIa	37	12x7	1 (2;1)	7	25	none	30	-13,2323232	-6,74157303	-49,0522343	DBF diffused at R thigh and knee. Node reduced in number. Evidence of popliteal nodes. Lymphocele at the medial thigh. L : normal - Preoperative T.I. R:12; L:2	Almost disappearance of previous leak, absence of DBF T.I. R:6; L:2	14, no clinical lymphedema, no compression garments	Highly satisfied (5/8)
4	70	M	Penile cancer requiring inguinal lymphadenectomy. Groin infection needing soft tissue debridement	NIR diabetes, hypertension, alcohol abuse	4 *(Oncologic resection, penectomy, node dissection, two further debridement and NPT)*	Active lymphorrea 350 ml/day Lymphedema stage Ib	30	15x4	2 (3;1, 2;1)	8	18	none	19	-28,989899	-11,1111111	-61,6724739	Severe R inguinal leakage L : normal - Preoperative T.I. R:1; L:14	Almost disappearance of previous leak, absence of DBF T.I. R:1, L:8	12, no clinical lymphedema, no compression garments	Highly satisfied (4/8)
5	52	F	Liposarcoma of L thigh needing resection of adductors muscles, inguinal node dissection and GSV resection	Obesity, gastric bypass	2 *(Oncologic resection, infected seroma debridement and washout)*	Recurrent lymphocele Lymphedema stage IIa	325	15x6	2 (2;1, 2;1)	11	17	none	24	-9,41919952	-5,64285714	-40,0919671	Important DBF medial Leg and knee. No evidence of popliteal nodes. R : normal - Preoperative T.I. R:1; L:14	Persistence of moderate DBF, with faster tracer captation. Improvement of inguinal nodes T.I. R:1; L:9	12, amelioration of lymphedema with increased skin quality. Persistence of compression garments. Diminution of PT	Satisfied (6/7)

CFA: common femoral artery; SFA: superficial femoral artery; PFA: profund femoral artery; NPT: negative pressure therapy; GSV: great saphenous vein; L: left; R: right; IVD: intravenous drugs abuse; HIV: human immunodeficiency virus; HBV: hepatitis B virus; HCV: hepatitis C; virus; HAV; hepatitis A virus; NIR diabetes: no insulin requiring diabetes; MLVA: multiple lymphovenous anastomosis; T.I.: transport index; DBF: dermal back flow; LYMQoL: lymphoedema quality of life.

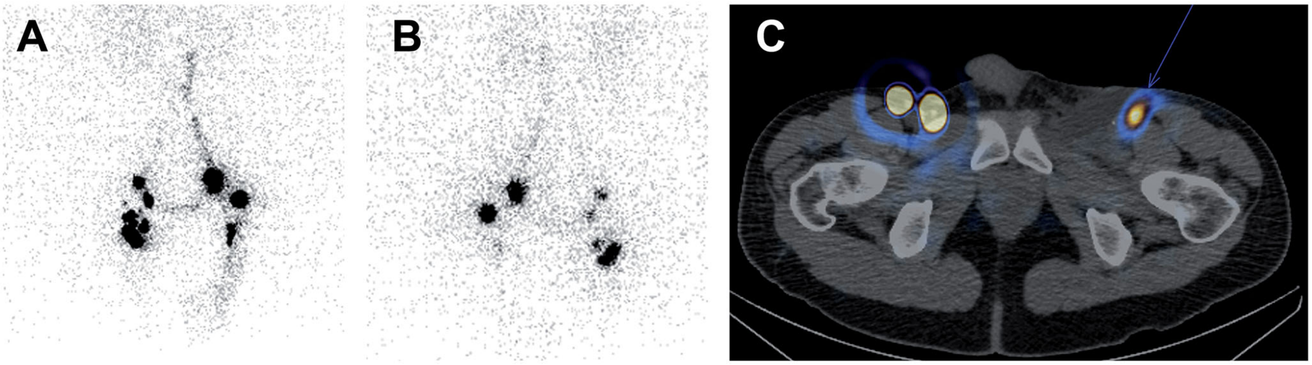

Figure 3. Preoperative (a,b) lymphoscintigraphic images and SPECT/CT (c) of patient 2 showing reduced nodes captation at the left groin, with lymphatic leak associated to inguinal seroma.

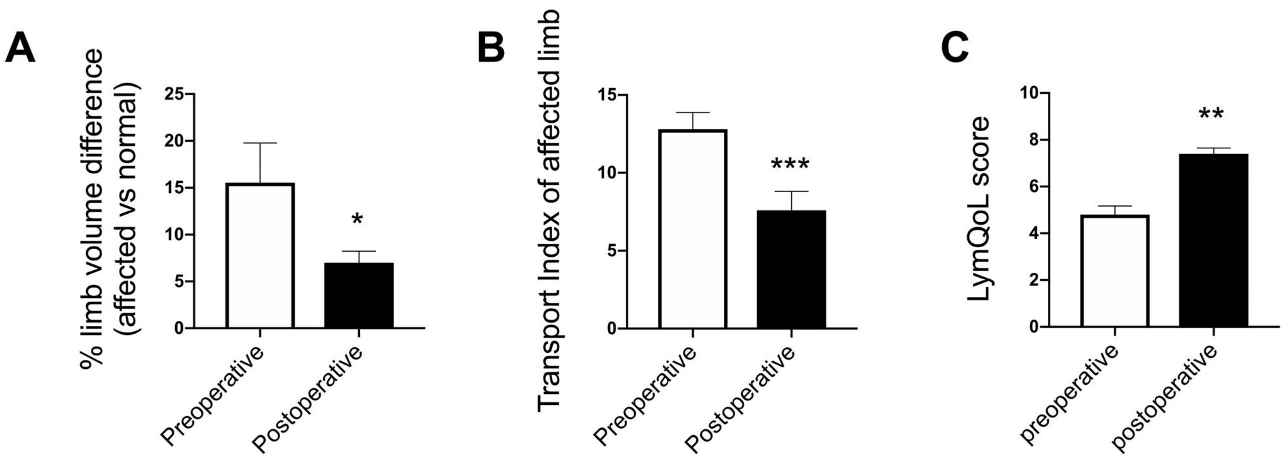

Figure 4. (a) Preoperative and postoperative percentage of lower limb volume difference between affected versus normal side. (b) Preoperative and postoperative transport index scores of affected limb. (c) Preoperative and postoperative LymQoL scores.

three lymphatics shunted into each vein. Mean complete healing was obtained in 19 ± 3.8 days, with an average of 22 ± 5.6 days of hospital stay. Table 1 resumes all preoperative and postoperative data per patient (Figure 3).

Mean improvement of perometry values comparing to preoperative status was 48.2 ± 15% and statistically significant ($p < 0.05$) with an average follow-up of 13.6 ± 2.1 months (Figure 4(a)).

Lymphoscintigraphy results showed disappearing of the lymphatic leak (cases 1–4) and the recurrent lymphocele associated with a lymphedema (case 5), matching the clinical outcome with early drain removal without clinical recurrences of seroma during follow-up, and a general significant improvement of the transfer index (mean improvement = 5,2 ± 0,8 with $p < 0{,}05$) (Figures 4(b) and 5). Only patient n°5 presented a persistent moderate dermal back flow in lymphoscintigraphic stasis at 12 months.

High patient's satisfaction resulted into a significant increase of overall LYMQoL scores with preoperative and postoperative mean scores of 4.8 ± 0.8 and 7.4 ± 0.5 points, respectively ($p < 0.05$)(Figures 4(c), 6, and 7).

Discussion

The poor healing of wounds in the inguinal region can be attributed to wide soft tissues defects with bacterial contamination, non-collapsible dead spaces, lymphatic leaks, multiple iterative surgical procedures, a low vascularized and eventually irradiated field depending on the primary pathology and comorbidities status [1]. Several flaps have been described for reconstruction of the inguinal region in the last decades, pedicled or even free; medial thigh, pudendal thigh, sartorius, gracilis, rectus abdominis, rectus femoris, tensor fascia lata and ALT flaps [5,20,21].

Among these, the ALT flap offers an ideal soft-tissue choice related to its remarkably versatility and the minor donor site morbidity [22–24]. Due to its long vascular pedicle, the ALT flaps can reach all areas from lower abdomen to the knee while remaining pedicled [25,26] and represents on the first reconstructive choices for groin defects [27]. Among its advantages, the possibility of chimeric harvest can be extremely useful when extra tissue components (muscle, skin, fascia lata) are required [28].

However, when the soft tissue defect is associated with disruption of the lymphatic network, flap-only coverage may not be sufficient avoid lymphorrea, wound breakdown, infections and potential secondary lymphoedema. Anatomically, the lymphatic vessels in the lower leg converge in the medial thigh run parallel to the great saphenous vein and continue to the inguinal lymph nodes above the inguinal ligament. The groin lymph-nodal system is divided into superficial and deep planes within the femoral triangle. The superficial lymph node system drains the lymphatic collectors from the lower limb, superficial gluteal region, lower abdominal wall, perineum and external genitalia. The deep inguinal nodes receive some lymphatic flow from the superficial system (minor part) and then drain to the external iliac nodes [4].

When considering this dense lymphatic network, it is clear that radical oncologic resections or multiple invasive vascular procedures may retain a relatively high incidence of short term complications such as wound dehiscence and lymphatic leaks, which will

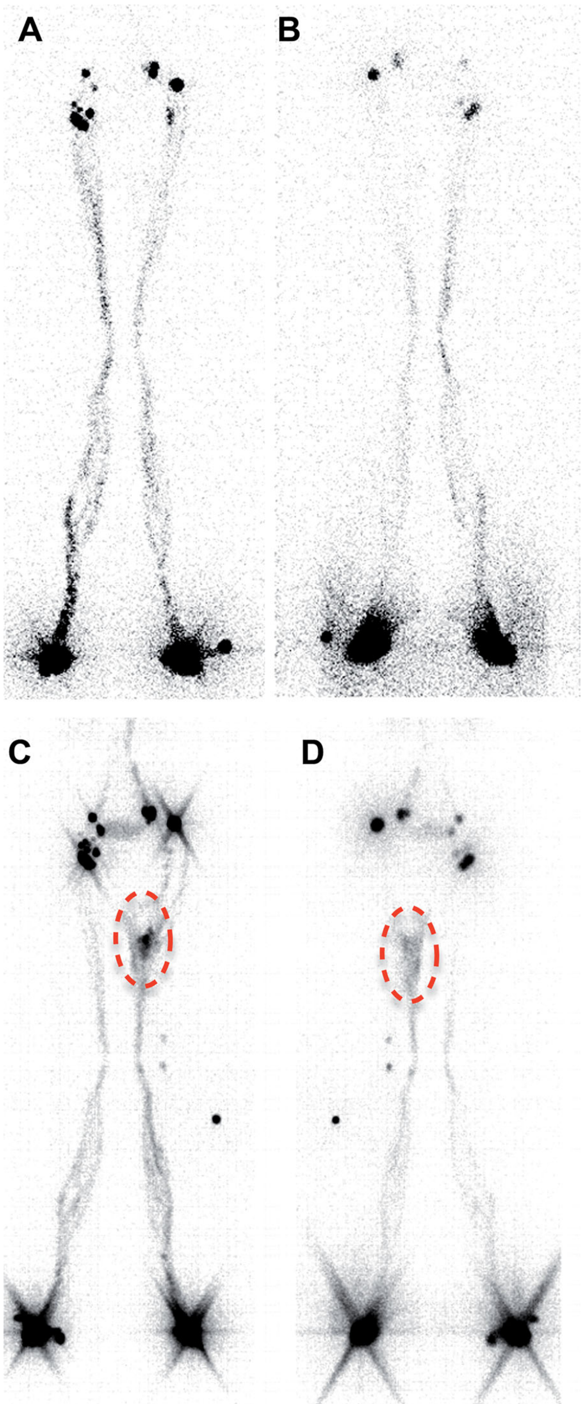

Figure 5. Preoperative (a,b) and 12 months postoperative (c,d) lymphoscintigraphic images of patient 2 showing re-establishment of through-flap lymphatic flow with absence of lymphatic leak and seroma.

predispose the wound to infection and finally prolonged stay in hospital [2]. Moreover, the disruption of lymphatic pathways will evolve into lower limb secondary lymphedema with life-long morbidity.

For this reason, the challenge of reconstruction should re-establish not only the local anatomic feature but also tempt to restore the lymphatic drainage for a total limb restoration and avoid long term complications such as chronic lymphedema. In this sense, shunting the lymph through the ALT pedicle meets the double objectives of providing coverage for defects with well vascularized soft tissues and to restore lymphatic flow with Multiple Lymphatic-Venous shunts.

When individual supramicrosurgical Lymphatico-venous anastomoses are done at multiple sites (multiple LVAs), their number generally ranges from 2 to 5, with some authors underlining how the number of anastomoses is of 'paramount importance' in lymphedema treatment [29–32]. On the other hand, Chen and colleagues described the 'octopus' technique on the model of the Campisi technique [33], in which multiple lymphatic vessels are sutured at one site into a single vein with competent valve (MLVA) as an intussusception as opposed to a single lymphatic vessel-to-vein anastomoses [34].

Both LVAs and MLVAs anastomosis have shown to be effective for the treatment of recurrent lymphocele and persistent lymphorrhea and lymphoceles [12,35]. Again, multiple lymphatic-venous anastomoses (MLVA) showed to be a microsurgical solution for drainage of primary -scrotal lymphedema [4] and reduce of 87–91% the incidence of cellulitis [33].

However, finding efficient recipient veins at the groin after oncologic resection, multiple debridements and eventually radiotherapy may be a challenge. In this work, we applied the concept of a microsurgical multi-lymphatic shunt into flap run-in deep pedicle veins, with excellent outcomes in terms of lymphorrea cease and even satisfactory outcomes in limb lymphatic flow. Our results, with a reduction in excess limb volume of almost 50%, are comparable with recent systematic review of outcomes of Lymphovenous shunt which showed a 48.8 and 56.6% reduction in excess limb circumference and volume [36].

The presented 'Lymphatic Flow Through' (LyFT) principle [15] differentiates conceptually from the Lymphatic Interpositional flap transfer (LIFT), which is a different concept based on axial lymphatic flap linearity [37].

The fact that all cases in this series had high flow active lymphorrea (which ceased postoperatively after LV shunt), suggests a more 'hydraulic' solution of the problem, with the lymph shunted into the venous system through the flap, rather than drained through spontaneous tissue-flap lymphatic links.

If we cannot formally exclude that the innate lymphatics embedded in the ALT flap could join the lymphatics in the groin recipient region to establish a lymphatic bridge, a spontaneous reconnection of ALT lymphatics with groin local lymphatics following flap linearity would imply a longer process and not a rapid lymphorrea cease in the immediate postoperative days. Finally, despite ALT flaps were placed longitudinally and somehow respecting their original axis in the thigh, no ICG control of linearity was performed preoperatively, which is in theoria essential to achieve compatible lymph axiality.

Indeed the potential association of both procedures may result in maximizing benefits in terms of lymphatic drainage and should be considered when indicated.

The concept of performing lympho-venous by-passes using pedicle branches of transposed flaps (pedicled or potentially even free) could theoretically be applied to different flaps providing that a side venous branch of the pedicle is available and preserved. The specific advantage of the ALT flap in this sense is the length of the DB of the LCFA, which allows to inset the flap in different ways, while allowing MLVAs far from the specific defect. Moreover, containing 2 venae comitantes and even smaller branches, multi afferent lymphatic vessels can be shunt through the flap (Figure 8).

Even if literature lacks proper standardization of lymphedema surgery outcomes in the evaluation of clinical and paraclinical results, physiologic surgical treatment of lymphedema results in

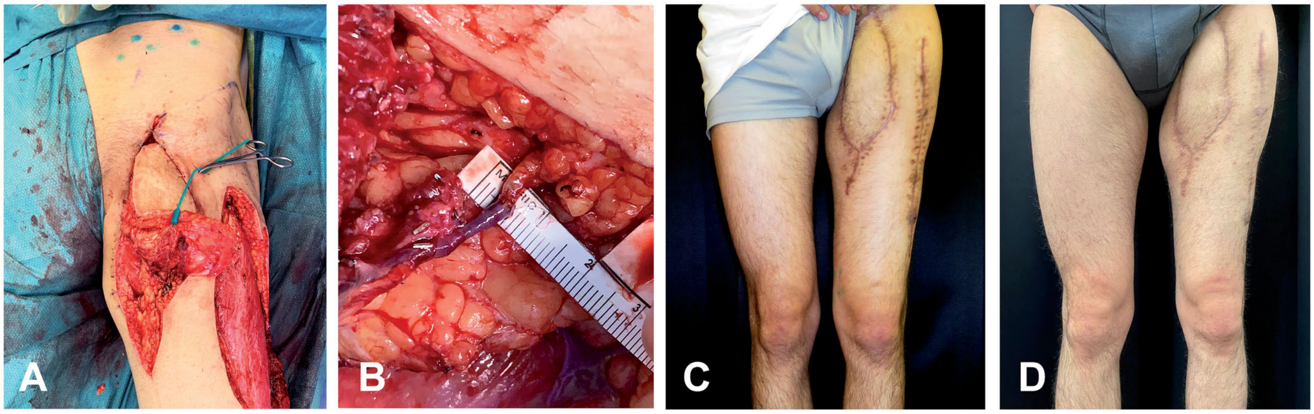

Figure 6. Medial flap transposition in patient 4 and inset for lympho-venous anastomosis (a). Detail of lympho-venous anastomosis where multiple lymphatics are directed into the comitans vein (MLVA) (b). 2 months postoperative outcome (c). 12 months postoperative outcome (d).

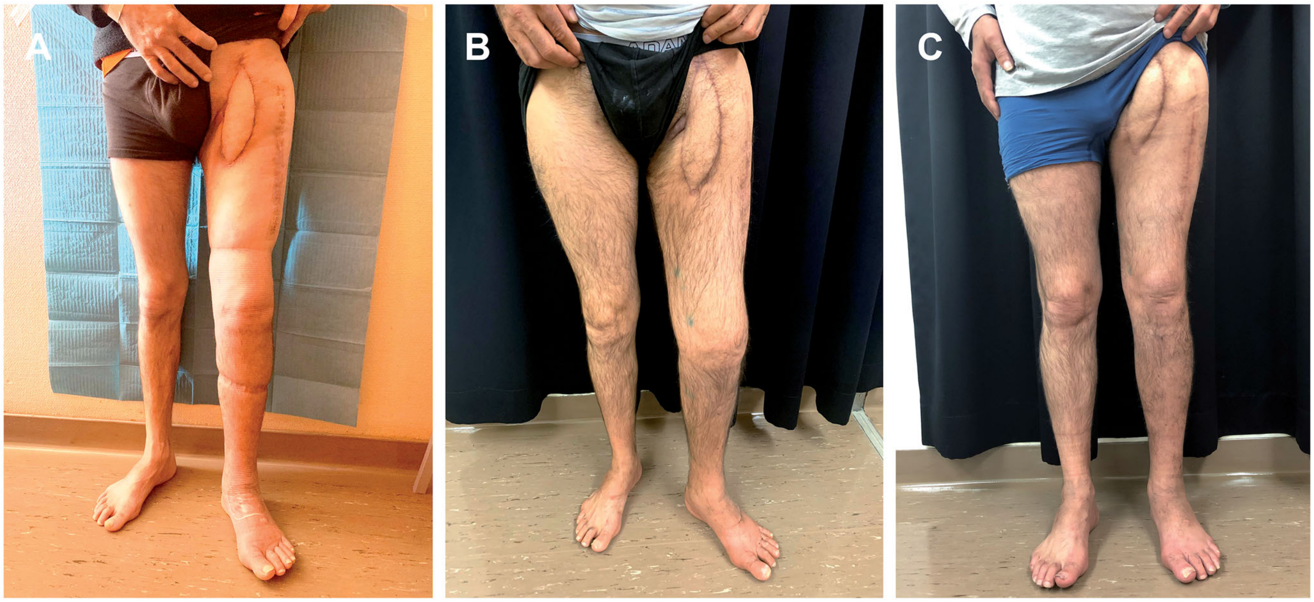

Figure 7. Two weeks postoperative outcome of patient 3, with ongoing compressive garments (a). Outcomes at 3 months (b) and 14 months, with no need of compression therapy (c).

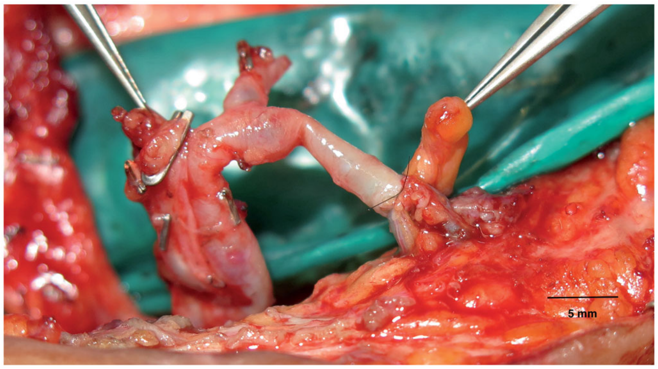

Figure 8. Multiple lymphatics into vein anastomoses in descending branch of anterolateral thigh flap (LyFT procedure).

improved QOL outcomes in most patients. The use of validated patient-reported outcomes such as lymphedema quality of life tool, and the lymphedema life impact scale are increasing, and can be coupled with validated tools including the Lower Extremity Functional Scale for the lower extremity, in order to critically report functional disability [38].

Currently, no reliable technique exists to evaluate permeability at a distance, apart from direct visualization (clinical, IGC lymphography, lymphangiography, lymphoscintigraphy) [39]. However, Maegawa *et al* found 75% patency at 12 months post microsurgical LVA and Kinjo and Kusaba assessed the patency of the lymphovenous derivation with 'octopus' technique in mongrel dogs and found anastomotic patency in 71% of the cases at 180 days postoperatively.

In our experience this technique served as immediate solution to both defects and high flow lymphorrea, with immediate relief for the patients and no recurrences with dramatically shortening hospital stay (in polymorbid patients with months of previous hospitalisations).

Lymphoscintigraphy at 12 months postoperative did not show signs of lymphorrea, with generally ameliorated lymphatic flow through the limb. This was in line with the clinical examination, with reduced swelling of the limb and return to normal activities for all patients. Our study shows the LyFT flap technique could improve LYMQoL by directly shunting the lymphatic leakage, preventing postoperative clinical lymphedema and a decreasing the need of conservative therapy, with only one patient wearing compressive garments at 12 months.

No negative impact (such has edema, intraflap lymphangitis) was found by shunting the lymphatic flow into through venous pedicle run in of the flap. No-reflow was guaranteed by the competent profound valvular venous system and probably the negative pressure from the profunda veins. Wound healing, despite previous groin radiation in some cases, was uneventful and guaranteed by the well-vascularized tissue coming from a distant, not jeopardized area.

As a chronic medical condition, lymphedema has substantial ongoing costs irrespective of the treatment modality. Thus, any potential reduction in lymphatic complications may provide economic benefit through decreased health care costs [40]. In our experience, combining lymphovenous bypass strategies using flap pedicles side branches could dramatically improve chronic morbidity scenarios of lymphatic complications with fast recovery, rapid healing and return to previous activities without long-term lymphedema recurrence.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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