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Review

Reconstructive Surgery of Inguinal Defects: A Systematic Literature Review of Surgical Etiology and Reconstructive Technique

KARL SÖRELIUS[1*], LUIGI SCHIRALDI[2*], SALVATORE GIORDANO[3], CARLO M. ORANGES[4], WASSIM RAFFOUL[2] and PIETRO G. DI SUMMA[2]

[1]*Department of Surgical Sciences, Section of Vascular Surgery, Uppsala University, Uppsala, Sweden;*
[2]*Department of Plastic, Reconstructive and Hand Surgery, Lausanne University Hospital (CHUV), Lausanne, Switzerland;*
[3]*Department of Plastic and General Surgery, Turku University Hospital, Turku, Finland;*
[4]*Department of Plastic, Reconstructive, Aesthetic and Hand Surgery, Basel University Hospital, Basel, Switzerland*

Abstract. *Background/Aim: This study aimed to evaluate the literature regarding surgical etiology demanding inguinal reconstructive surgery, associated reconstructive techniques and outcomes. Materials and Methods: A systematic literature search was performed according to the PRISMA statement between 1996-2016. Results: A total of 64 articles were included, comprising 816 patients. Two main subgroups of patients were identified: Oncological resections (n=255, 31%), and vascular surgery (n=538, 66%). Oncological resection inguinal defects were treated with pedicled myocutaneous flaps (n=166, 65%), fasciocutaneous flaps (77, 31%), muscle flaps (7, 3%) and direct closure (3, 1%). Vascular surgery complications were treated with muscle flaps (n=513, 95%). Complications for the respective subgroup (oncological resections, vascular surgery) were: infection (24%, 14%), seroma (34%, 7.5%), flap dehiscence/delayed healing (20.6%, 40.8%,). The total reintervention rate was 20%. Conclusion: Reconstruction of inguinal defects should be addressed on a case-by-case basis. Myocutaneous flaps were favoured after oncological resections, while muscle flaps were preferred after vascular surgery.*

*These Authors contributed equally to this study.

Correspondence to: Pietro G. di Summa, Department of Plastic, Reconstructive and Hand Surgery, University Hospital of Lausanne (CHUV), Rue du Bugnon 46, 1011 Lausanne, Switzerland. Tel: +41 213141111, e-mail: pietro.di-summa@chuv.ch

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The inguinal region represents a crucial intersection of fundamental anatomical structures, such as the femoral artery, vein, nerve, the inguinal node stations and the inguinal canal. This makes the inguinal *carrefour* a common surgical site for interventions that range from surgical lymphadenectomy, diverse oncological resections to a number of vascular, visceral and urological surgical procedures. Such procedures may result in soft tissue defects and exposure of key anatomic elements, requiring reconstruction. However, if radical inguinal oncological surgery is more likely to produce a primary defect or dead space, vascular and general surgery procedures, may incur wound dehiscence, delayed healing, and abscess formation, finally requiring radical aggressive debridement leading to a secondary soft tissue and skin defect.

The anatomical features of inguinal defects in the particular location between the abdominal and the thigh, and in the vicinity of the anogenital region, make the reconstruction of the inguinal region challenging for the plastic surgeon. The poor healing of wounds in the inguinal region has been attributed to wide defects with bacterial contamination, non-collapsible dead spaces, lymphatic leaks and the healing difficulties related to a low vascularized, or eventually irradiated field (1, 2), depending on the primary pathology. The post-operative morbidity associated with inguinal surgery is well documented in the literature, with an incidence of complications as high as 40% (3).

The aims of this systematic literature review were to comprehensively review the last two decades of literature concerning inguinal reconstructions, focusing on etiology, and associated reconstruction techniques and outcomes with complications associated with respective etiology and

reconstructive technique. This might aid everyday clinical decision-making and treatment of complex groin defects.

Methods

A systematic search of the literature was performed on PubMed and Medline on manuscripts in English language between 1st of January 1996 until 31st of December 2016. The following algorithm was used for the research [(groin OR inguinal) AND (reconstruction OR defect) AND (wound OR infection)].

A prefilled excel database was used to enter the records according to a defined exclusion criteria algorithm. Case reports, case series and larger cohorts were all accepted for inclusion. Exclusion criteria applied hierarchically were: (I) not relevant to groin tissues reconstruction; (II) groin as donor site; (III) not in English; (IV) review article.

Abstracts were manually screened by authors LS and PDS separately, and subsequently matched for accuracy. Pertinent full-text papers were retrieved and analysed, and data were extracted on the database. The flow chart of article selection is described following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Figure 1) (4). All papers were graded by PDS and KS according to the GRADE and PRISMA documents (5).

Statistical analysis. Data were analyzed using a statistical software package (GraphPad Prism 5.00, San Diego, USA).

Data were assessed for normality with histograms. Continuous data were expressed as median (range), or mean (standard deviation, SD) and categorical variables as proportions (%).

Results

Study selection. The initial database literature search yielded 1,019 records, including duplicates and non-pertinent articles. After manual screening of the abstracts, 907 records were excluded as non-pertinent to our search. The remaining 112 articles were further assessed for eligibility; 26 articles referred to inguinal donor site, 17 articles not pertinent to inguinal reconstruction, 4 reviews or editorials, and 2 articles not English language, and hence were excluded from data analysis. A total of 64 articles were identified and included for data extraction and quantitative analysis (Figure 1). There were zero randomized controlled trials, 6 prospective studies, and 58 retrospective studies.

Overall demographic data. The 64 included studies comprised a total of 816 patients, who all underwent surgical reconstruction of an inguinal defect. The mean age was 55.7 years (SD±14.25, range=17-92 years), and male sex (57.7%). No meta-analyses were possible to perform due to study heterogeneity, variable end-points and lack of data, and lack of bias assessment.

Thirty-four papers of 255 patients, reported on reconstruction following oncological resection defects (6-39): 122 patients were affected by a primary neoplasia of the inguinal area, and 133 patients were suffering from nodal dissemination from a malignancy of genitalia, perineum or lower limbs.

Twenty-two studies, including 538 patients, reported on inguinal reconstruction following vascular surgery: cannulation of femoral artery or vein, aorto-femoral or femoro-popliteal bypass, and often not specified (2, 5-25). Others causes leading to inguinal defect requiring reconstructive surgery involved trauma (four papers of 11 patients) (26-29), infections (three papers of 10 patients) (2, 26, 30), post burn contractions (one paper of 1 patient) (31), and one paper of a strangulated inguinal hernia with parietal abscess and necrosis of 23 patients (40). All flap types used for each subgroup are presented in Table I.

Hospital stay and follow-up. Fifteen papers reported on the length of hospitalisation (10, 16, 17, 22, 23, 27, 32-39, 41). The average hospital stay after the reconstruction was

Table I. *All types of flaps reported for reconstructive surgery of inguinal defects for each subgroup of patients*.

Types of flaps	Subgroup of onc. resections, n	Subgroup of vasc. surgery, n	Subgroup of misc. etiology, n
Myocutaneous flaps			
RA-MC	71	10	4
ALT-MC	63	3	3
TFL-MC	20	-	2
VL-MC	-	-	4
EOMF-MC	7	-	-
LD-MC	3	-	-
RF-MC	3	5	-
G-MC	2		-
Fasciocutaneous flaps			
ALT-FC	45	8	9
QKIF-FC	20	-	-
TFL-FC	8	-	-
PMT-FC	2	-	-
DIEP-FC	2	-	-
PSA-FC	2	1	-
Local Flap	2	1	1
Muscle flaps			
RA-M	4	2	-
RF-M	1	117	-
S-M	4	293	-
G-M		98	-

Onc: Oncological; vasc: vascular; misc: miscellaneous; n: number; RA; rectus abdominis flap; S: sartorius flap; TFL: tensor fascia latae flap; VL: vastus lateralis flap; DIEP: deep inferior epigastric artery perforator flap; ALT: anterolateral tight flap; G: gracilis flap; RF: rectus femoris flap; QKIF: quadriceps keystone island flap; EOMF: external oblique myocutaneous flap; S-FAP: superficial femoral artery perforator flap; LD: latissimus dorsi flap; ORAM: oblique rectus abdominis flap; PMT: posterior posteromedial tight flap; M: muscular; FC: fasciocutaneous; MC: myocutaneous.

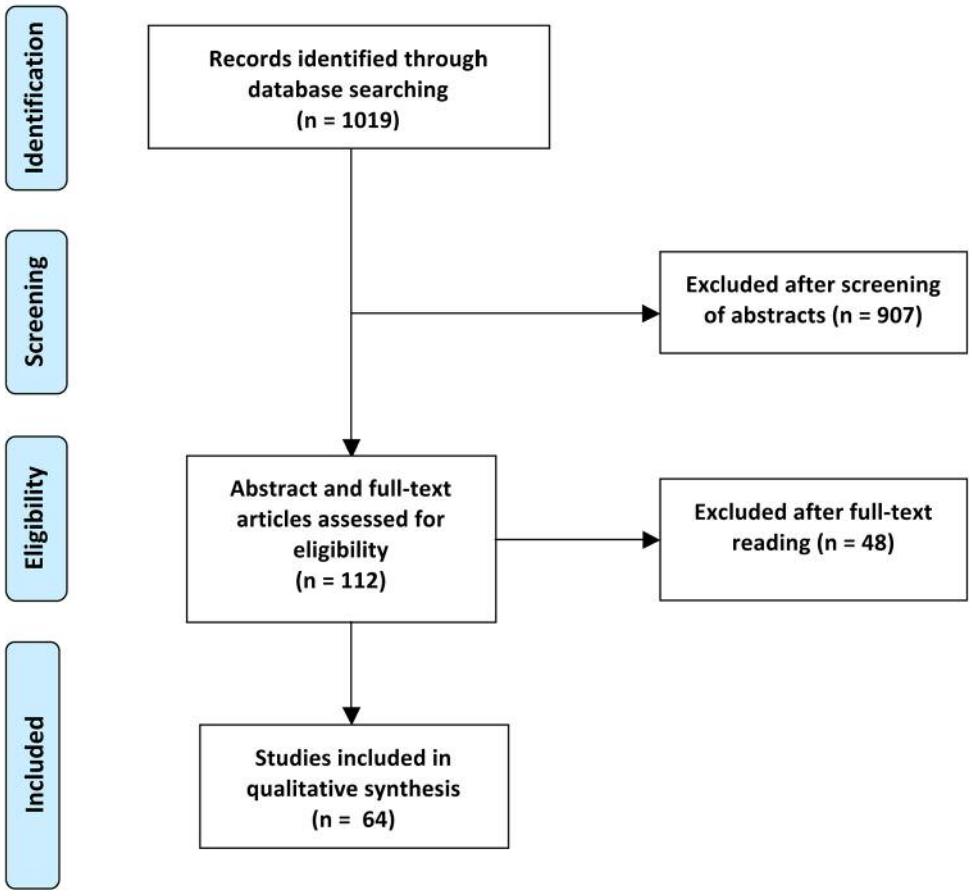

Figure 1. *PRISMA Flow diagram*.

12.1±6.2 days and 14.2±5.8 days (all expressed as mean±SD), for oncological and vascular patients, respectively.

Patients with inguinal reconstruction after oncological resection had a follow-up period of 23.7±18.1 (months, mean±SD) with a range of 0-184 months. Patients with inguinal reconstruction after vascular surgery had a follow-up of 19.0±18.7 (months, mean±SD) with a range of 1-108 months. The other patients had a follow-up of 12.0±7.7 months (mean±SD).

Reconstruction Technique

The subgroup of oncological resections. Out of 255 patients who underwent inguinal oncological reconstruction, 166 had reconstruction with a myocutaneous (MC) flap, 77 reconstruction with a fasciocutaneous (FC) flap 9 muscle (M) flap, and 3 direct closure after debridement. Flaps used in the vast majority of cases were pedicled, only one paper reported on the use of free flaps: Three patients received free latissimius dorsi (LD-MC) flap, and two patients free anterolateral thigh (ALT-FC) flap (26).

The flap was harvested unilaterally in 253 cases, and bilaterally in 2 cases, to cover the inguinal defect. The recipient site was ipsilateral to the flap in 245 patients, and contralateral in 10 patients. The most common used flap in this group of patients was the rectus abdominis myocutaneous (RA-MC) flap (n=71, 28.0%), antero-lateral thigh myocutaneous (ALT-MC) flap (n=63, 25%), and antero-lateral thigh fasciocutaneous (ALT-FC) flap (n=45, 18%). Complete results are summarized in Table II.

After oncologic resection, the average dimension of cutaneous and subcutaneous defect was 252.6±226.1 cm^2 (mean±SD) ranging from 163.1±103.1 cm^2 (mean±SD) to 336.6±284.2, with an average minor and maximal axis of 9.2±3.6 cm (mean±SD) and 22.6±9.8 (mean±SD) cm, respectively. A considerable part of these patients (83.2%) had been treated with prior neoadjuvant radiotherapy.

The subgroup of vascular surgery. Of the total 538 patients treated for diverse vascular surgical procedures, the vascular coverage was performed with a muscle flap in 513 cases (95%); sartorius muscle (S-M) flap in 293 patients (54.5%),

Table II. *Publications including patients with oncological resections demanding for reconstructive inguinal surgery.*

Author, Year	Country	Design	Number of patients	Age (mean)	LN dissemination	Coverage technique	Follow-up (months)	GRADE
Brierly, 1998	UK	R	1	42	1	RA-MC	9	Very low
Melis, 1998	Netherlands	R	1	44	1	S-M	n.a.	Very low
Deo, 2001	India	R	2	42	1	RA-MC	32 (8-68)	Very low
Mohamed, 2000	Egypt	R	1	48	0	RA-MC	48.5(36-56)	Very low
Tabatabei, 2003	USA	R	3	58	3	Abdominal advancement cutaneous flap+S-M	6 (4-8)	Very low
Rifaat, 2005	Egypt	R	6	n.a.	2	TFL-FC	6-24	Very low
Zeng, 2006	China	R	2	36	2	DIEP	n.a.	Very low
Küntscher, 2006	Germany	R	1	57	1	RA-MC	n.a.	Very low
Cedidi, 2006	Germany	R	2	n.a.	0	RA-MC	12	Very low
Evriviades, 2007	UK	P	6	68	6	ALT-FC	6	Low
Parrett, 2007	USA	R	20	56	0	RA-MC	28	Very low
Ng, 2007	China	R	1	69	1	ALT-FC	n.a.	Very low
Qi, 2008	China	R	13	49	10	RA-MC	n.a.	Very low
El-Sherbiny, 2008	Egypt	P	10	39	0	G-MC 2, RA-MC 5, TFL-MC 1, ALT-FC + S-M 1	60	Low
Agarwal, 2009	India	R	15	46	15	TFL-MC	36	Very low
Friji, 2009	India	R	56	n.a.	56	ALT-MC	n.a.	Low
Gravvanis, 2009	UK	R	4	52	4	ALT-FC	11-19	Very low
Ramseier, 2009	Switzerland	R	7	n.a.	0	RA-M 3, RF-M 1, direct closure 3	n.a.	Very low
Lannon, 2010	Canada	R	18	63	4	ALT-FC	n.a.	Very low
Bharath, 2010	India	R	1	65	0	ALT-MC	n.a.	Very low
Daigeler, 2011	Germany	P	6	58	3	RA-MC	66 (7-184)	Very low
Behan, 2011	Australia	P	20	71	20	QKIF-FC		Moderate
Saito, 2013	Japan	R	5	62	0	TFL-MC 2,TF-M (+VL-M) 3	37 (0-116)	Very low
LoGiudice, 2013	USA	R	39	60	0	ALT-FC 28, ALT-MC 2, RA-MC 10	12	Very low
Sánchez, 2013	UK	R	2	67	0	RA-MC	24	Very low
Zhang, 2014	China	R	7	59	0	EOMF-MC	6	Very low
Chao, 2014	USA	R	1	63	1	ALT-FC	2	Very low
Miyamoto, 2014	Japan	R	3	50	0	S-FAP	8	Very low
Miyamoto S, 2014	Japan	R	12	48	0	Pedicled RA-MC 7, free LD-MC 7, free ALT-FC 2	39	Very low
Combs, 2014	USA	R	8	n.a.	4	RA-MC 7, ORAM-MC 1	n.a.	Very low
Lin, 2014	Taiwan	R	1	72	1	ALT-FC	6	Very low
Fujiki, 2015	Japan	R	1	64	0	ALT-FC	14	Very low
Ryu, 2015	USA	R	1	65	1	S-M	14.1 (1-56)	Very low
Scaglioni, 2015	Taiwan	R	2	67	2	PMT-FC	3	Very low
Hulika, 2016	India	R	1	34	0	ALT-MC	n.a.	Very low
Chateau, 2016	Belgium	R	4	66	1	2 G-M, 1 RA-M, 1TFL-MC	n.a.	Very low

RA: Rectus abdominis flap; S: sartorius flap; TFL: tensor fascia latae flap; DIEP: deep inferior epigastric artery perforator flap; ALT: anterolateral tight flap; G: gracilis flap; RF: rectus femoris flap; QKIF: quadriceps keystone island flap; EOMF: external oblique myocutaneous flap; S-FAP: superficial femoral artery perforator flap; LD: latissimus dorsi flap; ORAM: oblique rectus abdominis flap; PMT: posterior posteromedial tight flap; M: muscular; FC: fasciocutaneous; MC: myocutaneous; LN: lymph node.

rectus femoris muscle (RF-M) in 117 cases (21.7%), and gracilis muscle (G-M) in 98 patients (18.2%). A split-thickness skin graft (STSG) was necessary to cover the muscle flap in 21 patients (0.4%). Twenty-eight (0.2%) patients required a fasciocutaneous or a myocutaneous flap to reconstruct the groin region (10 and 18 patients respectively).

Almost all patients had a unilateral harvesting, but bilateral flap harvesting was required in 17 patients (3.2%). Contralateral groin was the recipient site in 16 patients, while in other patients reconstruction was performed ipsilateral. Complete results are summarized in Table III.

In this subgroup the average surface defect size was significantly smaller (63.9±32.9 cm^2 mean±SD) and the vast majority of papers not reported this data. Most of the papers reporting on inguinal reconstructions after vascular surgery were case reports or case series.

Table III. *Publications including patients following vascular surgery demanding for reconstructive inguinal surgery.*

Author, Year	Country	Design	Number of patients	Age (mean)	Coverage technique	Skin graft	Follow-up (months)	GRADE
Maser, 1997	USA	R	14	65	S-M	Yes	36	Very Low
Colwell, 2003	USA	R	9	72	RF-M 3, RF-MC 1, S-M 5	No	n.a.	Very Low
Illig, 2004	USA	R	41	n.a.	RF-M 35, G-M 3, S-M 2,RA-M 1	n.a	n.a.	Very Low
Morasch, 2004	USA	R	18	64	G-M	No	40	Very Low
Schutzer, 2005	USA	R	50	n.a.	S-M	n.a.	n.a.	Low
Pu, 2005	USA	R	1	64	S-M	No	n.a.	Very Low
Shermak, 2005	USA	R	22	n.a.	G-M 19, S-M 1, RA-M 1, RF-M 1	Yes (3)	n.a.	Very Low
Alkon, 2005	USA	R	40	65	RF-M	Yes	n.a.	Very Low
Khainga, 2006	Kenya	R	1	49	RA-MC	No	n.a.	Very Low
Armstrong, 2007	USA	R	86		S-M		n.a.	Low
Fodor, 2008	Israel	R	1	72	RA-MC	No	n.a.	Very Low
Ducic, 2008	USA	R	4	79	G-M	Yes	n.a.	Very Low
Qi, 2008	China	R	2	n.a.	RA-MC	No	n.a.	Very Low
Landry, 2009	USA	P	20	67	S-M	No	n.a.	Very Low
Qi, 2009	China	R	13	49	RA-MC	No	n.a.	Very Low
Chateau, 2010	Belgium	R	4	66	G-M 2, RA-M 1,TFL-MC 1	Yes	n.a.	Very Low
Fischer, 2012	USA	R	146	66	S-M 68, RF-M 69, ALT-MC 9	No	n.a.	Low
Kulkarni, 2012	India	R	1	60	Posterior scrotal artery flap	No	3w	Very Low
De Santis, 2013	Italy	R	1	52	RA-MC + S-M	No	n.a.	Very Low
Wimmers, 2013	USA	R	1	58	RA-M	Yes	n.a.	Very Low
Shih, 2013	Taiwan	R	9	54	G-M 4, Local flap 1, ALT-MC 1, primary closure 1, ALT-MC 2	Yes	14	Very Low
Nelson, 2014	USA	R	43	70	RF-M	No	n.a.	Very Low
LoGiudice, 2014	USA	R	39	60	ALT-FC 28, ALT-MC 2, RA-MC 10	No	n.a.	Very Low
May, 2015	USA	R	17	n.a.	G-M 3, S-M 10, RF-M 4	n.a	n.a.	Very Low
Zelken, 2016	Taiwan	P	8	48	VL-MC 4, ALT-MC 3, ALT-FC 1	No	n.a.	Low
Ali, 2016	USA	R	64	64	G-M	n.a.	n.a.	Low
Ryu, 2016	USA	R	29	65	S-M	n.a	14	Very Low

S-M: Sartorius muscle flap; M: muscle; MC: myocutaneous; FC: fasciocutaneous; RF: rectus femoris flap; G: graficilis flap; RA: rectus abdominis flap; TFL: tensor fascialatae flap; ALT: anterolateral tight flap; VL: vastus lateralis flap.

Table IV. *Complications reported by frequency (%) for the subgroups of oncological resections and vascular surgery.*

Complications	Subgroup of oncological resections	Subgroup of vascular surgery
Seroma	34.4%	7.5%
Infection	22.9%	14.4%
Flap dehiscence/delayed healing	20.6%	40.8%
Partial flap necrosis	18.7%	12.1%
Hematoma	13.3%	8.8%
Flap loss	5.6%	5.8%
Reintervention rate	19.3%	19.8%

The subgroup of miscellaneous patients. Other indications for inguinal reconstruction consisted of trauma, infection, post-burn contractions and visceral surgery. Reconstructive surgery was performed with pedicled fasciocutaneous and myocutaneous flaps harvested from the ipsilateral side of the patient's body, using either ALT-FC, vastus lateralis-myocutaneous (VL-MC) or ALT-MC (Tables II and III). In only one case the flap was used in the contralateral groin.

Complications

The subgroup of oncological resections. In 28/33 papers (85%) concerning oncologic patients reports on complications were included (Table IV) (2, 21, 22, 32-35, 37-39, 41-57). Seroma was the most frequent postoperative complication; six papers reported about this complication and the incidence was 34.4% (2, 21, 32, 37, 45, 58). Other

reported complications were, in decreasing order of percentage, (number of papers, percentage): infection (6, 22.9%) (2, 22, 32, 37, 39, 42), wound dehiscence/delayed healing (6, 20.6%) (2, 37, 39, 47, 52, 53), partial flap necrosis (8, 18.7%) (35, 41, 42, 46, 48, 53, 54, 58), hematoma formation (3, 13.3%) (2, 32, 35) and flap loss (2, 5.6%) (48). Complications not directly involving the flap were abdominal wall hernia in patients treated with RA flap (2, 15%) (35, 54) and lymphedema of the inferior limb (4, 39.3%) (32, 33, 42, 43, 45). The estimated re-intervention rate was approximately 19%, and 26 papers reported these data (26/33, 78%) (21, 22, 32-34, 36-38, 41-45, 47-60).

The subgroup of vascular surgery. In 17/22 (77%) of papers on patients in the subgroup of vascular surgery reports on complications were included (2, 6, 7, 10, 11, 14-19, 21-26). Post-surgical wound dehiscence and consequent delayed healing was the most common complication (40.8%) (2, 7, 17, 19, 21). Other complications in decreasing order of incidence were (number of papers, percentage): seroma formation (6, 7.5%) (2, 6, 17, 19, 21, 23), hematoma formation (5, 8.8%) (2, 6, 16-18) infection (4, 14.4%) (2, 14, 17, 22), partial flap necrosis (4, 12.1%) (6, 16, 23, 24), venous congestion (1, 11.1%) (26). All complications are summarized in Table IV.

The subgroup of miscellaneous patients. In this subgroup of patients, the frequency of complications was underreported with a single dehiscence and partial flap necrosis.

Discussion

The main finding of this systematic literature review of inguinal defects demanding reconstructive surgery was the presence of two main subgroups of surgical patients: those following oncological resections, and those who presented complications following vascular surgery. Another important finding was the lack of prospective studies, and the heterogeneous and disparate reporting on this common complication to surgery of the inguinal region, making meta-analyses impossible to perform. Reporting standards would facilitate research in this field, and could elevate the level of knowledge by defining a more evidence-based guide for reconstruction.

For all patients undergoing reconstructive inguinal surgery, regardless of aetiology, it is essential to fill out dead space, and provide a well-vascularised and metabolically active tissue to serve as a flap.

Patients who underwent inguinal reconstructive surgery for oncological reasons were younger, and had less comorbidities (1). For this subgroup of patients the myocutaneous flaps were the most used, approximately in 2/3 of the patients. These flaps combine the advantages of having a well-vascularised tissue and a cutaneous island to cover the skin defect without employing STSG. Among the myocutaneous flaps RA-MC and ALT-MC were the most used, and both offer an excellent arc of rotation. However, considering the relevant donor site morbidity (resulting in an abdominal wall hernia) of RA-MC flap, ALT-MC seemed to be the flap of choice in unilateral groin reconstruction. Moreover, this flap has a long pedicle lying in a distant and non-irradiated field, with a big arc of rotation and a reliable vasculature and the possibility to be harvested as chimeric flap, with maximal exploitation of its vascularized components, including skin paddle, vastus lateralis and fascia lata (61). Muscle flaps such as G-M, S-M, and RF-M were rarely used for coverage of these wounds. Instead, fasciocutaneous flaps were moderately employed, probably because the absence of a muscle layer was limiting their advantages, especially in cases of deep defects or radical nodal dissection.

Recent literature suggests that the oncological resection subgroup was more likely to suffer from lymphatic leakage and seroma formation, due to the frequently associated nodal radicalisation, reaching almost 90%. Muscle components potentially help treating these conditions (61), making the possibility to harvest the ALT flap associated to the vastus lateralis muscle (composite), particularly appealing (61). In the case of recurrent lymphatic complication such ad leaks or lymphocele, a lymphatic mapping should be considered during surgery (61, 62). Pu *et al*. recently described the use of a lymphatic mapping and a S-M flap to successfully treat a recalcitrant lymphorrea.

Patients undergoing oncologic resections reported higher infection-related complication rates, and a relatively higher flap necrosis rate was reported. These complications may be the result of the remarkably higher average cutaneous defect size when compared with vascular patients (252.64 cm^2 *vs*. 63.88 cm^2), the need for a skin paddle, and the presence of neoadjuvant radiotherapy in a considerable part of these patients (83.2%), features leading to higher flap complications rates (63).

In the subgroup of vascular surgery requiring inguinal reconstructive surgery, the patients were older compared with the oncological group, with a high burden of cardiovascular comorbidity, which is consistent with literature (64). These comorbidities might result in a generally higher risk of complications with secondary infection involving mainly subcutaneous layers, and vascular structures with a relative skin involvement. Vascular surgery site infections can threaten the success of the surgical procedure, but also put the entire limb at risk. Mortality rates up to 58%, and morbidity of 79% have been reported (8, 64, 65). Up to 60% of the chronically infected wounds are from biofilm-producing bacteria, from both gram-positive and -negative species such as *Staph. aureus*, *Streptococci* sp., *E. coli*, and *K. pneumoniae*.

The demonstrated smaller surface defects reported in the literature matches the topographic features of the complications of vascular surgery, where wounds break down because of insufficient vascularisation and contamination. The cutaneous involvement is less striking than the important undermining of the wound edges. Considering these two conditions (particularly prone to infections and presenting cavity spaces), muscle flaps seem to be the best option in the subgroup of patients following vascular surgery. S-M and RF-M flaps were largely the most used. S-M flap transposition is a simple and fast procedure to lower post-operative complication rate without significant donor site morbidity regardless of the type of primary inguinal surgery, but may be insufficient in cases of larger defects, which instead might require a STSG. RF-M flap provides a bigger volume of tissue than SM, and can be harvested with a skin island, however it is technically more demanding and implies higher donor site morbidity in terms of weakening leg extension. Hence, if a moderate size skin island is required, a gracilis myocutaneous (G-MC) flap may be preferred because of minimal donor site morbidity, and ease of harvesting (6). If a large quantity of muscle is required RF-M flap with distal insertion harvesting seems to be the best choice (1). Flaps for covering inguinal defects after vascular surgery, despite presenting an inferior rate of partial flap necrosis, presented a higher incidence of wound dehiscence associated to delayed healing of approximately 40%. This may be due to the large use of the S-M flap in the vascular surgery subgroup, which despite being easily raised, presents a segmentary vascularisation (Type IV Mathes and Nahai classification of muscle flaps) (66), which may lead to suboptimal flap perfusion and consequent wound breakdown. Moreover, the common practice of skin grafting over muscle flaps, which are more abundant in this group, may explain a higher rate of delayed healing issues. Routine preventive use of muscle flaps after vascular procedures might be needed in selected cases. This seems a reasonable option, particularly when considering the preventive use of S-M flap (67, 68).

The lack of reporting on antibiotic therapy is striking, and could hence not be evaluated in this study. Surely, the results of culture and the antibiotic strategy influence the results of inguinal reconstructive surgery, however, it is not reported sufficiently in the literature.

The combination of negative pressure wound therapy (NPWT) and flap surgery was not amenable for analysis because of the rare reporting. NPWT in patients after vascular surgery has been found to be superior to traditional alginate therapy in terms of wound healing and cost-effectiveness (69). However, the results of combining flap surgery and NPWT has not been properly evaluated.

Ideally, the results of inguinal reconstruction, with or without NPWT, should be addressed in randomized controlled trials (RCT). Probably such RCT should be performed separately for the subgroups of oncological resections and vascular surgery, due to differences shown in this study in etiology and demand on reconstructive surgical approach.

Limitations

The majority of included studies were small (27 case reports in the oncological group, and 12 in the vascular group), retrospective case series, and were graded as very low in quality according to GRADE (4). Heterogeneous reporting with lack of detailed data on previous indication for surgery, outcomes and complications, was striking and hampered the possibility to make robust statistical analysis of the data, and thus to make valid conclusions. The lack of data also resulted in the exclusion of a considerable amount of papers. The subgroups of oncological resection, vascular surgery and miscellaneous were different in age, comorbidity and primary surgical procedure with different demands on reconstructive surgery, and hence no inter-group comparison testing was performed.

Conclusion

Reconstruction of inguinal defects following surgery needs to be addressed on a case-by-case basis, considering the initial etiology and the anatomic features of resulting defects. After oncological resection, the threshold for flap surgery should be low, and preferably a musculocutaneous flap should be used. After vascular surgery, the sartorius muscle flap transposition offers a simple and efficient solution, and routine preventive procedure with use of muscle flaps might be needed in a few selected cases. Introduction of reporting standards would facilitate further research in this field.

Conflicts of Interest

The Authors have no conflicts of interest to disclose.

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