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**Lymphoedema Rates in Pedicled Anterolateral Thigh Flaps for Coverage of Irradiated**

**Groin Defects**

Running Title: Lymphoedema in Groin Defect Reconstruction

Manuscript ID: #ANS-2019-00027.R3

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Grant Sponsor/Number: NA

Based on content presented at the 9<sup>th</sup> Congress of World Society for Reconstructive Microsurgery, June 2017 in Seoul, South Korea.

This submission includes: two figures and an abstract of 198 words and text of 1,610 words (excluding abstract, acknowledgements, figure legends and references).

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**This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as doi: [10.1111/ans.15576](https://doi.org/10.1111/ans.15576)**

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## **Lymphoedema Rates in Pedicled Anterolateral Thigh Flaps for Coverage of Irradiated Groin Defects**

### **ABSTRACT:**

#### BACKGROUND:

Limb salvage surgery in conjunction with adjuvant radiotherapy is the preferred treatment for soft tissue sarcoma [1-3]. This study aims to determine if ipsilateral pedicled anterolateral thigh (ALT) flap reconstruction of groin defects post soft tissue sarcoma resection results in acceptable rates of lymphoedema, while also providing good soft tissue cover and minimal donor site morbidity.

#### METHODS:

A retrospective chart audit was conducted with ethics approval, obtaining a case series of sixteen patients operated on at a single institution by the senior surgeon. Patients who underwent ipsilateral pedicled ALT flap coverage of irradiated groin defects following soft tissue sarcoma resection were included. Comparative six point limb circumference measurements were utilised to diagnose lymphoedema, with a difference of 10% when compared to the non-operative side being deemed significant.

**RESULTS:**

Lymphoedema was noted in three patients (18.8%) with an average follow up period of 40.9 (range 8-59) months.

**CONCLUSION:**

Previously published lymphoedema rates in sarcoma limb salvage surgery of 15.5 – 30% [2-6] are comparable to the rates obtained in this cohort. Lymphoedema rates do not appear to be higher in patients undergoing ipsilateral pedicled ALT flap reconstruction, thus making it a useful soft tissue coverage technique in this cohort.

**KEYWORDS:**

Lymphoedema; Sarcoma; Pedicled; Reconstruction, Anterolateral Thigh.

**INTRODUCTION:**

Soft tissue sarcomas are rare mesodermal origin tumours, accounting for approximately one percent of cancers [7]. Historically best practice for management of limb sarcomas was amputation [8]. Subsequently, limb salvage by means of wide resection (of at least 2cm [1]), radiotherapy and soft tissue reconstruction has not been found to increase rates of mortality or recurrence [9] and this has become the new standard [1-3]. The resulting soft tissue defect is often significant and requires soft tissue flap reconstruction in ten to twenty percent of patients [7]. The anterolateral thigh (ALT) flap, developed in 1984 by Song et al [10], has become popular as a means to retain limb function and avoid amputation. Initially used as a free flap, pedicled ALT flap use is becoming increasingly common due to its long vascular pedicle (reported as being 12cm [11]), large arc of rotation, relative ease of dissection, reliability, good vascularity, large skin and soft tissue availability, and minimal donor site

morbidity [12-15]. Benefits of the pedicled ALT flap over free flap reconstruction include a shorter operating time, [16] avoidance of the risks of anastomotic failure and logistical considerations inherent in free flap techniques [17, 18]. A rare, but significantly debilitating consequence (from both psychological and functional perspectives [19, 20]), of sarcoma management, is lymphoedema. Lymphoedema is a pathological accumulation of lymph fluid in interstitial tissues secondary to disruption of lymphatic drainage [3, 21, 22]. Disruption can be secondary to damage to blood vessels, lymphatics, lymph nodes or fibrosis (often caused by ablational surgery and radiotherapy) [3, 23]. The anatomy of the superficial lymphatics of the abdominal wall and upper thigh have been studied by Tourani et al. This work, shown in Figure 1, highlights the arrangement of lymphatic architecture and hence the disruption caused by both primary excision and secondary reconstruction [24]. Given the risk of lymphoedema even prior to reconstruction, we wished to establish whether rates are increased with pedicled ALT flap reconstruction, potentially secondary to further disruption to the existing lymphatic architecture. This study aims to report post-operative complications, in particular lymphoedema, in a series of 16 pedicled ALT flaps performed following sarcoma surgery for groin wound coverage at a single institution by the senior surgeon (DG).

#### **METHODS:**

A retrospective chart audit was undertaken with ethics approval of data prospectively collected by the senior surgeon. Sixteen patients with soft tissue sarcoma of the groin managed by wide excision and pedicled ALT flap reconstruction at one institution by one surgical team were included in the study. Data regarding adjuvant radiotherapy and complications in the post-operative period, in particular lymphoedema was collected. Lymphoedema was detected via circumferential measurement comparing the affected limb to the normal limb with differences of ten percent deemed significant. These measurements

were performed at six points on the limb (mid foot, ankle, mid-calf, knee, mid-thigh and groin). International Society of Lymphology grading (ISL) <sup>[25]</sup> was used to determine severity, and those with grade 2 disease were referred for compression garments and massage. Data analysis was conducted using Microsoft Excel and Stata software, with confidence intervals calculated using the Wilson score for binomial variables.

## **RESULTS:**

All 16 patients underwent immediate reconstruction following sarcoma resection. Surgery involved wide excision of the primary sarcoma and en bloc resection of the inguinal lymph nodes. All donor sites were closed primarily, with wide undermining when required (Figure 2). The average follow up was 40.9 (range 8-59) months.

There were ten men (62.5%) and six women (37.5%). The average age was 57.3 (range 18-89) years at the time of surgery. Fourteen patients received preoperative radiotherapy (50 Gray dose) and two neoadjuvant chemoradiotherapy. The average defect surface area requiring reconstruction was 148 square centimetres (range 90-242cm<sup>2</sup>).

There were no current smokers. Co-morbidities included diabetes, hypertension, atrial fibrillation and two patients who were being treated for recurrent tumour (Appendix – Table S1).

Three patients (18.8%) were noted to have post-operative lymphoedema. One patient (6.3%) required return to theatre for haematoma evacuation, and two patients (12.6%) were readmitted for intravenous antibiotics.

Of the three patients diagnosed with lymphoedema, two were male and one was female. All three patients had ISL grade two lymphoedema. Their ages were 51, 74 and 89 years at the time of surgery and they were followed up for 55, 43 and 22 months respectively.

## **DISCUSSION:**

Reconstruction of irradiated groin defects is difficult. There are inherently high complication rates due to the ablative disruption of lymphatics, high lymph drainage amounts and subsequent seroma formation and infection risk. The senior author has chosen to use pedicled ALT flaps as the primary reconstructive option. Criticism can be levelled at this choice of flap given it theoretically may further disrupt the lymphatic channels of the leg. This is in comparison to the more traditional use of the pedicled vertical rectus abdominus muscle (VRAM) flap.

Anatomically most of the draining lymphatics of the leg and thigh are confined to the ventromedial neurovascular bundle and run parallel to the course of the long saphenous vein [24], as shown in Figure 1. The course of these lymphatics are well removed from both the area of the anterolateral thigh from where the fasciocutaneous flap is taken, and also remote from the major pedicle of the descending branch of the lateral circumflex femoral vessels.

Friedmann et al studied lymphoedema following limb salvage surgery in a series of 289 patients. This large study found an incidence of 28.8%, with the only independent risk factors for lymphoedema development being tumour size and depth [3]. This result is comparable to figures obtained in previous studies of 15.5 to 30% [2, 4-6], and the results from this cohort of patients. Much lower rates of persistent lymphoedema following limb salvage surgery in soft tissue sarcoma were noted by Eilber et al (10% incidence of persistent oedema requiring a compression garment) [8] and Keus et al (3%) [1]. Daigeler et al noted a lymphoedema rate of

32.7% in a cohort of 52 oncologic patients managed with pedicled VRAM flaps <sup>[26]</sup>, highlighting that reconstructive options from the ipsilateral thigh do not appear to increase the risk of lymphoedema development. Other than these studies there is a paucity of literature reporting on rates of lymphoedema following soft tissue sarcoma treatment.

There is also published literature on lower limb oedema following pelvic lymphadenectomy and irradiation in both prostate cancer and gynaecological malignancies <sup>[27]</sup> with reported rates of lymphoedema requiring intervention of 14% <sup>[27]</sup> and zero to 30% respectively <sup>[19, 28-31]</sup>. While pelvic lymphadenectomy is not indicated in soft tissue sarcoma patients, our patients do undergo inguinal node resection at the time of their en bloc surgery and have adjuvant radiotherapy treatment. In both cohorts there is lymphatic architecture disruption and thus a high risk of lymphoedema development.

Radiotherapy has been shown to be an independent risk factor for lymphoedema development <sup>[19, 32, 33]</sup>. In a study by Deo et al in breast cancer patients they showed a prevalence of lymphoedema of 13.4% in surgically treated patients compared to 42.2% in those treated with both surgery and radiotherapy <sup>[21]</sup>. There are additional risk factors including stage of disease, chemotherapy use, cardiovascular disease and obesity which need to be considered when determining the contribution that surgery, radiotherapy and reconstructive method have on lymphoedema development <sup>[21, 27]</sup>.

In soft tissue sarcoma patients, the primary goals of treatment are to cure their malignancy and to salvage the limb. This is best achieved by a combination of wide surgical excision and radiotherapy. Both of these interventions contribute to the risk of lymphoedema by disrupting lymphatic drainage and creating scar tissue. A reconstructive method that does not further contribute to this risk is thus ideal in providing them with the best chance of a complication

free recovery. Simple strategies can be put in place post-operatively such as elevation of the limb and compression stocking use which decrease the risk of lymphoedema development [34]. In the instance of lymphoedema occurring despite this, consideration could be made for microsurgical lymphatic-venous anastomosis, vascularised lymph node transfer or liposuction.

In this study lymphoedema was assessed clinically using circumferential comparative limb measurements by a single experienced Plastic and Reconstructive Surgeon. While methods such as the frustum model [35] exist for the calculation of total limb volume and are deemed the gold standard measurement, in this series circumferential limb measurements were used given their simplicity and ease of use in the clinic setting. They have found to be reliable at detecting lymphoedema [36]. Diagnosis is an ongoing issue in studies looking at lymphoedema, in part due to the fact that there can be an insidious onset and there is a lack of standardised assessment methods [21]. The imprecise and subjective nature of lymphoedema assessment is something that has impacted on previous research endeavours on this topic [3] and highlights the need for the development of quantitative assessment tools that can be easily used and reproduced.

A major limitation of this study is the small sample size which prevents meaningful statistical analysis, but it provides useful insight for a potential larger, multicentre study. The retrospective design is also a limitation that could be addressed in future work. Further information should be collated in future studies including body mass index to determine if this is a statistically significant contributing factor to lymphoedema development in this cohort.

## **CONCLUSION:**

In this study of 16 patients with soft tissue sarcomas treated with wide excision, inguinal dissection and subsequent pedicled ALT flap groin reconstruction, 18.8% were noted to have post-operative lymphoedema. The use of a pedicled ALT flap for reconstruction does not appear to contribute to an increased risk of lymphoedema.

#### **CONFLICT OF INTEREST:**

None disclosed.

#### **FUNDING:**

No funding obtained.

#### **ACKNOWLEDGEMENTS:**

No acknowledgements.

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### **FIGURE LEGENDS:**

#### **FIGURE 1:**

*Collated final radiographs of the left upper and lower abdomen and the upper thigh specimens. Superficial lymphatic collectors and nodes are highlighted in green. The direction of lymph flow in each region (black arrows) and the position of inguinal ligament (yellow dotted line) are shown. Symbol ⊕ indicates where a large efferent collector penetrates through the deep fascia Note that the lateral thigh collectors are not injected in this specimen. Numbers indicate 1) umbilicus, 2) anterior superior iliac spine, 3) pubic tubercle, 4) superficial epigastric vein, 5) external pudendal veins, 6) saphenous bulb, 7) and 8) greater saphenous veins (duplicate in this cadaver), 9) superficial inferior epigastric artery and its VCs, 10) superficial circumflex iliac vein. Reproduced with permission of the Journal of Plastic, Reconstructive & Aesthetic Surgery from "Anatomy of the superficial lymphatics of the abdominal wall and the upper thigh and its implications in lymphatic microsurgery".*

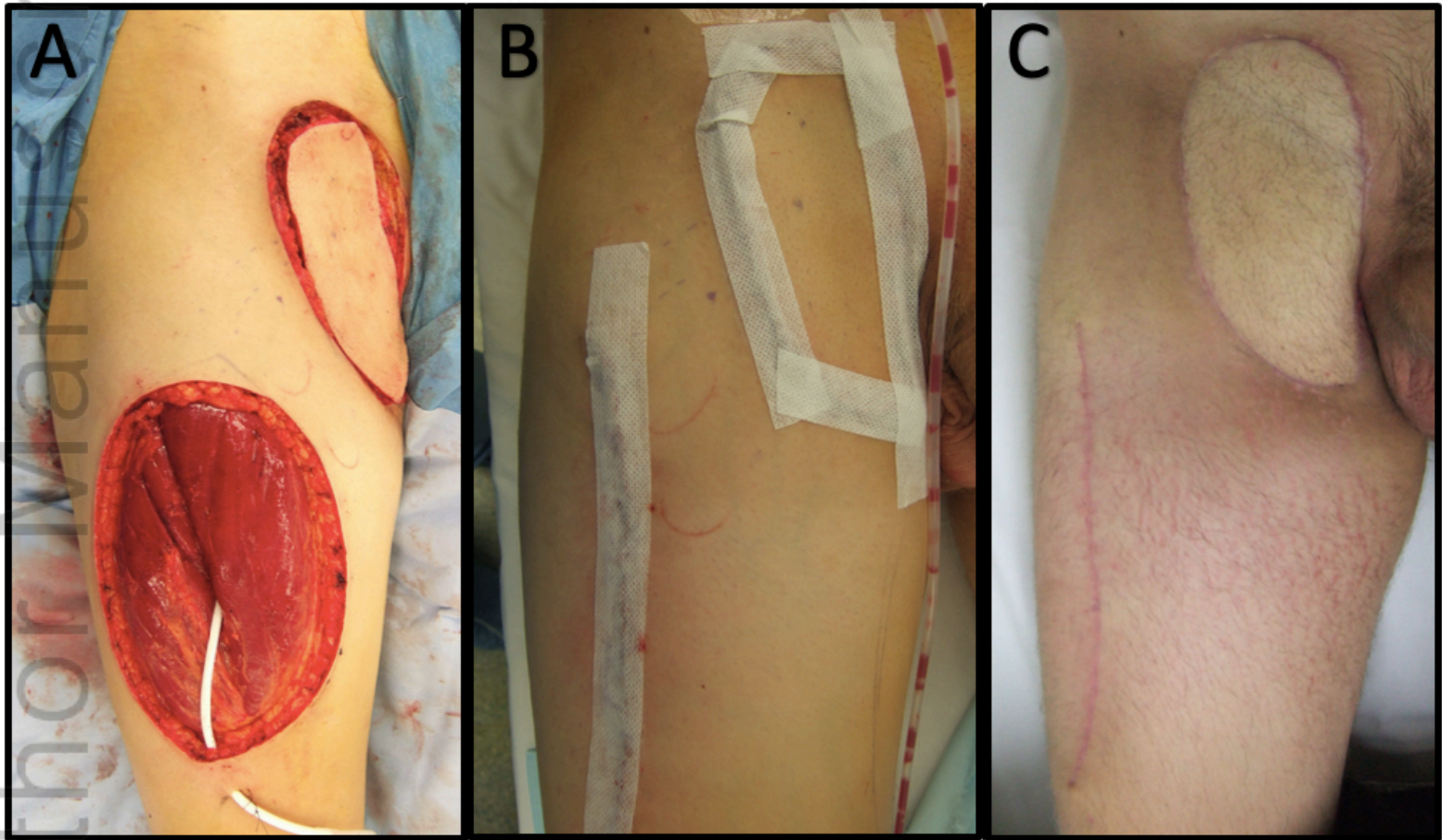
#### **FIGURE 2:**

**A - Groin Defect Following Sarcoma Excision and Pedicled ALT Flap Prior to Definitive Inset**

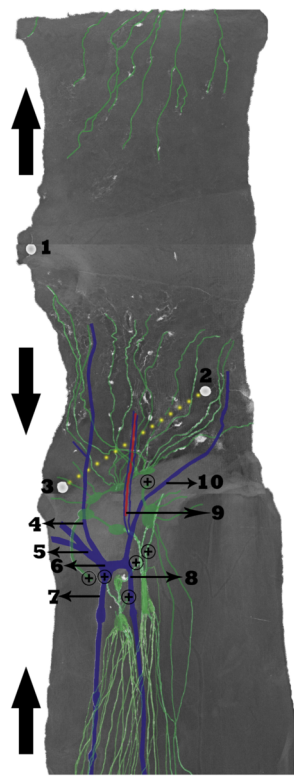
**B - Pedicled ALT Flap Inset with Closed Donor Site Immediately Post Operatively**

**C - Pedicled ALT Flap Post Operatively**

**SUPPORTING INFORMATION:****APPENDIX TABLE S1: Patient Characteristics**



ANS\_15576\_Clinical Photo Series Figure 2 ANZJS .png



ANS\_15576\_Figure 1 ANZJS.tiff