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Correspondence and Communications

Sentinel node biopsy for melanoma: New Zealand indication guidelines in practice☆

Dear Sir,

Current New Zealand cutaneous melanoma management guidelines[1] note thin melanomas (<1 mm) can usually be cured by primary tumour removal, and while unnecessary in most cases, sentinel node biopsy (SNB) may be considered for patients with poor prognostic factors, such as ulceration or dermal mitoses (T1b[2]). For patients with intermediate thickness melanomas (1–4 mm: T2 and T3), it is suggested SNB is useful for identifying small nodal metastases, allowing more accurate staging, better prognostication and improved regional tumour control. For thick melanomas (>4 mm: T4), from which haematogenous metastasis is thought more likely, it comments there is little evidence about SNB's role, but the procedure may be considered in select cases. With this background, it is recommended patients with T1b or higher cutaneous melanomas should be referred to a surgical specialist for consideration of SNB at the time the initial biopsy site is re-excised with wide margins determined by Breslow thickness.

We retrospectively audited application of these SNB guidelines by a New Zealand specialist melanoma facility. During the year ending February 2016, 143 unique patients were admitted to Waikato Hospital, Hamilton, for cutaneous melanoma surgery. Most had their tumour diagnosed and treated during the study year. Some had excision biopsy before February 2015, and then received definitive surgical treatment (wide local excision, sentinel node biopsy and/or complete regional lymph node dissection) during the study period. Others had excision biopsy during that year, with subsequent definitive treatment after February 2016. All patients were included in this analysis (Table 1).

Sixty-six patients (46.2%) underwent SNB. All except one had simultaneous wide local excision. That patient's T3a melanoma (Breslow thickness 2.1 mm; no ulceration) had been resected with horizontal and deep clearances of 12 mm and 5 mm, respectively.

For the 65 SNB patients (98.5%) for whom the original cutaneous specimen histology was available, mean Breslow thickness was 2.3 mm (standard deviation [SD] 1.5 mm; range 0.6–7.5 mm). This was not statistically different ($p = 0.9$) from that of the 72 (93.5%) patients who did not have SNB (non-SNB), but for whom histology was available and not melanoma-in-situ (mean thickness 2.3 mm, SD 3.3 mm; range 0.2–20.0 mm). However, the median SNB and non-SNB thicknesses were 1.8 mm and 0.8 mm, respectively.

Although the guidelines do not suggest consideration of SNB for patients with T1a melanoma,[1] six (20.0%) had SNB. Their tumours were significantly thicker ($p < 0.001$) than those of non-SNB T1a patients, 83.3% (20) of which were ≤ 0.75 mm (mean 0.58 mm, SD 0.19 mm). Given that the SNB group mean thickness was 0.99 mm (SD 0.02 mm), bordering on being T2a, surgeons may have decided to offer SNB to these patients. Also, given that all were Breslow 0.76–1.0 mm, it is possible that surgeons may have been influenced by the United States' National Comprehensive Cancer Network's (NCCN) 2014 melanoma guidelines,[3] recommending T1a melanomas >0.75 mm thick be offered SNB. No non-SNB/SNB statistical difference was found for gender ($p = 1.0$), age ($p = 0.5$), primary site (head/neck, trunk, limb; $p = 0.4$), or horizontal ($p = 0.4$) or deep ($p = 0.5$) clearance margins. Overall, these characteristics probably did not influence the decision to perform SNB.

The guidelines suggest consideration of SNB for patients with T1b melanoma.[1] Seventeen (68.0%) T1b tumours did not lead to SNB. These (mean Breslow 0.63 mm, SD 0.21 mm; 13 [76.5%] ≤ 0.75 mm) were significantly thinner ($p = 0.005$) than the SNB T1b tumours (mean 0.88 mm, SD 0.14 mm; 7 [87.5%] 0.76–1.0 mm). Again, surgeons may have been cognisant of the NCCN guidelines, which recommend T1b melanomas ≤ 0.75 mm thick not be offered SNB.[3] Additionally, location of the primary tumour may have contributed to the SNB decision. With head/neck/trunk T1b melanomas less likely ($p = 0.002$) to have SNB than those on limbs, this may reflect perceived little gain for thin melanomas sited where lymph may drain to multiple node fields.

It is recommended that patients with $\geq$ T1b melanomas (T2, T3 and T4) be considered for SNB.[1] At Waikato Hospital, 16 (26.7%) patients with T2 or T3 did not have SNB. Although difference in primary mean thickness between the SNB and non-SNB groups approached significance ($p = 0.08$), of characteristics examined, only difference in mean age was significant ($p < 0.001$), with the non-SNB group (mean 78.4 years, SD 9.6 years) being older (SNB mean 67.3 years, SD 9.9 years). Of patients with T4 melanomas, 13 (65.0%) did not have SNB. There was no non-SNB/SNB significant difference for any characteristic considered, including age ($p = 0.3$) and Breslow thickness ($p = 0.2$). However,

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Table 1 Patient characteristics and tumour staging of 143 resected primary cutaneous melanomas according to whether sentinel node biopsy was performed.

Characteristic			Sentinel node biopsy performed		No sentinel node biopsy performed		All	
			$N = 66$ (100%)		$N = 77$ (100%)		$N = 143$ (100%)	
Gender	Female		30	(45.5%)	29	(37.7%)	59	(41.3%)
	Male		36	(54.5%)	48	(62.3%)	84	(58.7%)
Age	Years	Median (range)	67.3 (36.7-86.8)		72.4 (30.9-100.2)		70.4 (30.9-100.2)	
Cutaneous melanoma tumour stage	No histology available		1	(1.5%)	1	(1.3%)	2	(1.4%)
	Melanoma-in-situ		0	(0%)	4	(5.2%)	4	(2.8%)
	T1: Breslow thickness $\leq$ 1.0 mm, but could not be further classified because ulceration and mitosis information was missing		0	(0%)	2	(2.6%)	2	(1.4%)
	T1a: Breslow thickness $\leq$ 1.0 mm, with no ulceration and mitotic figures $< 1/mm^2$		6	(9.1%)	24	(31.2%)	30	(21.0%)
	T1b: Breslow thickness $\leq$ 1.0 mm, with ulceration and/or mitotic figures $\geq 1/mm^2$		8	(12.1%)	17	(22.1%)	25	(17.5%)
	T2-T3: Breslow thickness 1.01-4.0 mm		44	(66.7%)	16	(20.1%)	60	(42.0%)
	T4: Breslow thickness $>$ 4.0 mm		7	(10.6%)	13	(16.9%)	20	(14.0%)

in patients with T2-T4 melanomas, tumour thickness and advanced patient age are likely to influence the decision not to proceed to SNB. So too, but not investigated, are poor general health and presence of metastases.

Although interventions should be in keeping with practice guidelines, management will be determined ultimately by influences such as surgeon experience and the general health and wishes of an informed patient. Overall, allowing for the discretionary nature of guideline application, it appears that the New Zealand guideline indications for melanoma-related SNB inform practice at this specialist melanoma facility.

Conflict of interest

None

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Single surgeon series of outcomes of 897 consecutive endoscopic carpal tunnel releases stratified by disease severity

Dear Sir,

The safety and efficacy of multiple endoscopic carpal tunnel (eCTR) techniques have been established in the literature.[1-3] High rates of symptomatic relief and low risk of complications are reported, similar to those seen with open CTR.[2] A stratification of postoperative results and relief of carpal tunnel syndrome (CTS) based on objective preoperative disease severity has not been established. This information would allow more individualized preoperative counselling.

A retrospective review was performed of consecutive eCTR performed by a single, fellowship-trained hand surgeon between 2011 and 2016 in an academic-affiliated private practice setting. A proximal, uniportal technique was performed using the Synchronized Endoscopic Guide System by S.E.G.-WAY Orthopedics, Inc (Carlsbad, CA). Post-operative immobilization and therapy were not routinely used. Chart review was conducted to assess demographic data, preoperative nerve conduction studies (NCS), and history of prior CTR. Patients without preoperative NCS were excluded. Outcomes including sensory symptom relief, postoperative complications, recurrent CTS, and need for additional surgery were also evaluated. Subgroups were analyzed using Chi-square contingency tables based on preoperative CTS severity—mild, moderate, or severe—as reported objectively on preoperative NCS. *P*-values < 0.05 were considered statistically significant.

A total of 522 patients underwent 897 eCTR—375 bilateral and 147 unilateral. The mean age was 58.9 years, and 68% were female. Only eight patients (ten hands, 0.8%) had recurrent symptoms at an average of eight months postoperatively. Seven hands resolved without intervention, one resolved with corticosteroid injection, and one with open CTR. One failed to achieve symptom resolution despite revision open CTR. Rates of residual sensory deficit (0.11%), neuropraxia (0.67%), nerve injury (0%), and arterial injury (0%) were minimal (Table 1).

Six patients (nine hands) had previously undergone open CTR with another surgeon. Complete resolution of symptoms following revision eCTR was seen in eight hands. One patient required additional surgery—an open CTR with hypothenar fat pad, and then went on to symptom resolution.

All patients had preoperative NCS performed with results reported as mild, moderate or severe disease. Comparison of resolution of symptoms, complication rates and need for revision surgery between these classifications revealed a significant difference only in neuropraxia rates, with higher rates occurring in the mild group (Table 2). This was likely skewed due to the very low rates of these postoperative findings.

Table 1 Outcomes after endoscopic CTR.

Post-operative outcomes	n (%)
Resolution of Symptoms	1272 (99.4%)
Residual objective sensory deficit	5 (0.4%)
Transient neuropraxia	14 (1%)
Nerve injury	0 (0%)
Arterial injury	0 (0%)
Recurrent symptoms	10 (0.8%)
- Resolved without surgery	— 8 (80%)
- Resolved with open CTR	— 1 (10%)
- No improvement with open CTR	— 1 (10%)

CTR – carpal tunnel release

When performed by a high-volume, hand surgeon, eCTR consistently treats CTS effectively in almost all patients with a very low complication rate, regardless of the preoperative severity and even in those having previously failed open CTR. Based on these results, patients with severe CTS should expect relief of symptoms after endoscopic release of the carpal tunnel.

While the safety and efficacy of multiple techniques of eCTR, have been well-established in the literature, the limitations of these techniques have been less clearly defined.[1-4] Widely accepted recommendations regarding which patients which patients are likely to benefit from endoscopic release versus open carpal tunnel release do not currently exist.

Prior studies using similar techniques have reported that patients with severe CTS, with sensory latencies greater than 6 milliseconds, weakness and/or widened two-point discrimination, were less likely to have a good outcome with eCTR.[3,4] Although different criteria for classification of disease severity were utilized in this study, our experience with a similar eCTR technique demonstrated the safe and effective use in patients classified as having severe CTS using the electrodiagnositic severity classification system described by Werner and Andary in 2011.[5]

While the revision rate for CTR is generally low, the high numbers of CTRs performed worldwide mean that a significant number of revision surgeries are performed. As such, it is important for hand surgeons to have the skills necessary to perform revision CTR with good results and low complication rates. The present study adds additional support that those surgeons experienced in eCTR may accomplish these goals endoscopically.

Despite the limitations of this study due to its retrospective nature and subjective outcomes, this large series of cases does add additional support to the literature regarding the safety and efficacy of eCTR, particularly in patients with severe disease, and eCTR can be a valuable tool in select revision cases.

Table 2 Outcomes and complications by severity on nerve conduction studies.

Characteristic	Mild CTS	Moderate CTS	Severe CTS	*p*-value
Total	106	485	306	
Unilateral eCTR	24 (23%)	75 (15%)	50 (16%)	0.196
Bilateral eCTR	82 (77%)	410 (85%)	256 (84%)	
Corticosteroid injection	64 (60%)	172 (35%)	64 (21%)	0.390
- Symptom resolution	– 59 (92%)	– 150 (87%)	– 54 (84%)	
- Persistent symptoms	– 5 (8%)	– 22 (13%)	– 10 (16%)	
Resolution of symptoms	104 (98.1%)	481 (99.2%)	305 (99.7%)	0.286
Residual sensory deficit	1 (0.9%)	0 (0%)	0 (0%)	0.239
Neuropraxia	3 (3%)	2 (0.4%)	1 (0.3%)	**0.014**
Nerve injury	0 (0%)	0 (0%)	0 (0%)	–
Arterial injury	0 (0%)	0 (0%)	0 (0%)	–
Recurrent symptoms	2 (2%)	8 (0.2%)	0 (0%)	0.732*
- Resolved without surgery	– 2 (100%)	– 6 (75%)	– 0 (0%)	
- Resolved with open CTR	– 0 (0%)	– 1 (12.5%)	– 0 (0%)	
- Persisted with open CTR	– 0 (0%)	– 1 (12.5%)	– 0 (0%)	
History of prior open CTR	2 (2%)	7 (1%)	0 (0%)	0.071

CTS – Carpal tunnel syndrome, CTR – carpal tunnel release.
*Compared mild and moderate only due to no recurrent symptoms in severe group.

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None

Statements

Conflict of interest

Dr. David Person is a shareholder for S.E.G.-WAYTM Orthopaedics but received no funding for this work.

Statement of informed consent

Informed consent was not performed for this study as the patient present is not identifiable and no risk or harm was incurred by the patient as a result of the study.

Statement of human and animal rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was not performed for this study as the patient present is not identifiable and no risk or harm was incurred by the patient as a result of the study.

Statement of funding

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Shear wave elastography of median nerve at wrist and forearm. Heterogeneity of normative values

Dear Sir,

We have read the Letter by Paluch and collaborators about the potential usefulness of wrist-forearm ratio of the median nerve stiffness measured by shear wave elastography (SWE).[1] The paper is very interesting and we completely agree with the authors about the use of relative values instead of absolute ones to increase the diagnostic meaning of the SWE findings. A similar approach of ratio between two segment of the same nerve has shown high usefulness in other measurements, like nerve cross sectional area.[2] In the paper by Paluch and colleagues, thirty-four median nerves were used as control. In the sample of controls, the mean value of median nerve stiffness at wrist was 43.65 KPa, while in the two sides of the forearm was about 44 KPa. As the authors stated, the variability of the stiffness in the control group was very high with a large value range.[1]

We would like to present our normal values of median nerve stiffness at wrist and 10 cm proximally. We enrolled 10 patients (20 wrists) of Asian ethnicity, with no history of neuropathies. Our sample was constituted by 5 women and 5 men, with mean age of 31 years, mean weight of 58 Kg, mean height of 162 cm and mean body mass index of 22.67 Kg/m^2. The subjects were right-handed except one. The SWE was performed with a 4–15 MHz linear-array transducer (SL15-4, Version 6.1; Supersonic Imagine, Aix-en-Provence, France). Median nerve dimensions and SWE parameters were collected in transverse plane.[3] In order to assess the statistical differences between nerve stiffness in wrist and forearm, we evaluated the distribution by Shapiro-Wilk test. Statistical significance was set at $p < 0.05$. Due to the normal distribution, we used *t*-test for dependent samples, for the comparison of the nerve stiffness in the two sites. The cross sectional areas of the examined nerves were within normal values in all subjects. The values of nerve stiffness at wrist was significantly higher than the value at forearm (Table 1). In our sample, median nerve stiffness was in general lower than the values found by Paluch and collaborators, with a marked difference between the two evaluated sites. Consequently, the wrist-forearm ratio stiffness was in our group of 1.91. Finally, the median nerve stiffness at wrist, in our sample, was similar to the values shown by Kantarci and colleagues.[4] Some elements could be considered to explain the differences in the different samples. Probably same variables of the valuated subject should influence the nerve stiffness results: anthropometric features, age, sex, ethnicity. Furthermore, the body segment position, the US machine and probe and the exact site of measurements may be considered as important variables. Additionally, the scanning procedure should be contemplated. In particular, we evaluated the nerve in transverse scan, while the modality adopted by the authors is not clear.

Table 1 Mean and standard deviation of the stiffness values af the median nerve, measured by shear wave elastography at wrist and forearm. Statistical significance of the differences between the two sides is shown.

Variable	Mean	Standard deviation	p
Stiffness at wrist	20.78	5.11	<0.01*
Stiffness 10 cm prox.	11.43	6.30	

We have appreciated the approach described by Paluch and collaborators, but we underline the necessity, for each lab, to build its own normal values, because of the potential high variability of SWE parameters in nerveassessing.

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None.

Conflict of interest

Authors declare no conflict of interest.

Informed consent

Informed consent was obtained from the subjects included in the study.

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Shear wave elastography of median nerve at wrist and forearm. Heterogeneity of normative values: Response to authors

Dear Sir,

We read with interest the letter of Abdelmohsen Bedewi, et al. concerning the heterogeneity of the normative values of the median nerve in shear wave elastography.[1] The authors investigated 20 wrists of healthy patients of Asian ethnicity with an average age of 31. The mean value of nerve elasticity at the wrist was 20.78 kPa which was lower than the normal wrist values observed by Kantarci, et al. (31-32 kPa)[2] and much lower than the normal values observed by our group (43.6 kPa).[3] There may be several reasons for these discrepancies, although we believe that it probably results from two main differences. The measurements of Abdelmohsen Bedewi, et al. were collected with a different transducer and in the transverse plane, while our measurements, like those of Kantarci, et al. were collected in the sagittal nerve plane. Our experience shows that measurements from the nerve cross section are characterized by lower repeatability.

Secondly, all of the healthy volunteers invited by us to the control group had carpal tunnel syndrome (CTS) ruled out through electrodiagnostic evaluation (EDX). This, however, influenced our sample selection since the patients who agreed to participate probably expected there to be health benefits in these additional, unpleasant tests. We invited 29 women and five men with an average age of 57 (+/−10 years), receiving a control group much older than that of Abdelmohsen Bedewi, et al. All of the volunteers were engaged from the Hand Surgery Outpatient Department where they had been referred due to minor symptoms of osteoarthritis. As a result of their age, a number of them could be in the CTS risk group and have the onset of the nerve entrapment,[4] despite the fact that they had not declared any symptoms and had negative EDX results. These patients might have had slightly swollen nerves that were easier to detect during ultrasonography, as well as probably in elastography, rather than in EDX. Among the subjects we examined, 19 had nerve stiffness in the wrist assessed at > 39 kPa which correlated positively with CSA. The presence of this subgroup was the reason for the high values of the elastography norm in our work. Only in five of our patients was the nerve stiffness similar to that in the study of Abdelmohsen Bedewi, et al. and was between 20 and 29 kPa.

Although low, the values of median nerve stiffness at the wrists were almost twice as high as in the forearms of the healthy subjects examined by Abdelmohsen Bedewi, et al. Consequently, the wrist-forearm ratio proposed by these researchers was 1.98. We observed a similarly high difference between the wrists and forearms in CTS patients only. In our control group, however, the relevant wrist-forearms values were more approximate which consequently resulted in a ratio of 1.48. These differences between researchers indicate the need to assess the physiological range of nerve stiffness on larger groups of asymptomatic persons, including volunteers of different ethnic origins, different age groups, and with different comorbidities. These patients should also be invited for neurophysiological examinations since as many as 18% of them could have a median neuropathy that is only recognizable.[5]

Conflict of interest

On behalf of all authors whose names are listed below I certify that we have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Lukasz Paluch, Piotr Pietruski, Jerzy Walecki, Bartlomiej Noszczyk

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The meshed biological matrix in immediate, definitive breast reconstruction

Dear Sir,

Introduction

Two different materials are generally used in immediate breast reconstruction: synthetic materials, such as polypropylene, or biological materials.[1] When biological matrices are used, profuse secretions can require continuous aspirations for many months and sometimes, infections can occur. In such cases, breast implant removal is mandatory.[2,3] The authors developed a new surgical technique using a meshed biological matrix *(U.I.B.M.-Italian Patent No. 283625)*, which combines the benefits of biological with those of synthetic ones, surpassing the limitations of the traditional use of biological devices.

Methods

At the Unit of Plastic Surgery of the IRCCS – Referral Cancer Center of Basilicata, 46 cases of immediate breast reconstruction with permanent prosthesis were collected from November 2014 to July 2016. A total of 25 out of 46 patients underwent a nipple/areola complex-sparing mastectomy, 21 patients had a skin-sparing mastectomy.

The patients, after having signed the informed consent, were randomized into the two trial arms: meshed biological matrices (study arm) vs. intact biological matrices (control arm).

All the patients, after the mastectomy with axillary node dissection, underwent an immediate breast reconstruction with definitive implant. The pocket for the breast implant was performed as follows: the pectoralis major muscle was detached from its inferior costal insertions and, for the patients randomly selected into the study arm, the inferior pole of the prosthetic pocket was created completely meshing the bovine pericardium prosthesis (Figure 1) in the proportion of 1 × 2 and sized 12 × 24 cm, in order to have a very pliable but resistant *"meshed bag"*. The biological mesh was sutured medially to the inner edge of the residual breast cavity, inferiorly to the costal insertions, superiorly to the lower border of the pectoralis major muscle. A wide prosthetic pocket was obtained, supple and well distensible, in which the breast implant was inserted. Later on, the pocket was completely closed suturing the lateral margin of the biological device to the medial margin of the pectoralis minor muscle.

For the control arm patients the inferior pole of the prosthetic pocket was performed, using a 12 × 12 cm intact matrix of bovine pericardium, as it is regularly marketed and sutured in the same way to the surrounding breast tissues, after a breast implant was previously inserted.

Table 1 shows the study recorded parameters: the amount of fluid secretion in cc, the days of hospitalization, the degree of capsular contraction according to Baker clas-

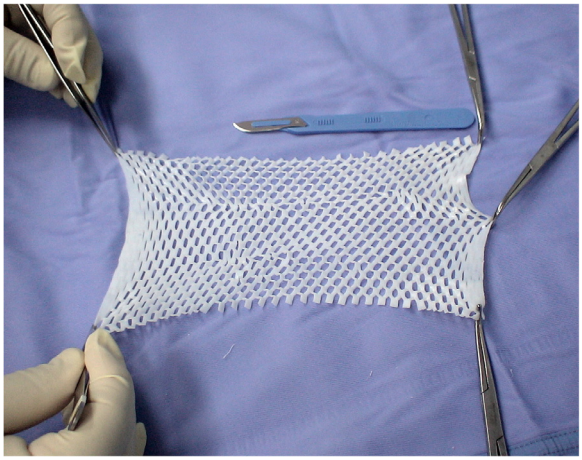

Figure 1. Meshed biological matrix, obtained with a standard meshing machine.

Table 1. Study recorded parameters. Meshed vs. control cases results.

	Controls	Meshed	*p*
Pocket secretion, cc			
mean ± sd	268.3 ± 42.5	25 ± 5	*0.0093*
median (range)	270 (225 - 310)	25 (20 - 30)	
Pocket secretion, days			
mean ± sd	16 ± 5.3	2.7 ± 0.57	*0.0472*
median (range)	18 (10 - 20)	3 (2 - 3)	
Hospitalization, days			
mean ± sd	20 ± 1	4.7 ± 0.57	*0.0001*
median (range)	20 (19 - 21)	5 (4 - 5)	
Contracture (Baker)			
I-II	0	3 (100%)	*0.05*
III-IV	3 (100%)	0	

sification, the duration of secretion and thus the days of permanence of the drainage, which was removed in all cases when the amount of liquid in 24 h was less than 25 cc. All patients were followed-up for not less than 12 months.

Results

Postoperative checks were cadenced periodically every week. Considering the amount of secretion from the prosthetic pocket, the mean cc value in the patients with meshed biological matrix was 25 ± 5 while that of patients with usual unmeshed matrix was 268.3 ± 42.5. This difference was statistically significant ($p = 0.0093$). Similarly, duration (in days) of secretion and hospitalization were shorter and statistically significant for patients with meshed biological matrix, (2.7 ± 0.57 vs. 16 ± 5.3 for secretion and 4.7 ± 0.57 vs. 20 ± 1 for hospitalization, respectively $p = 0.0472$ and $p = 0.0001$). Finally, all the patients with meshed biological matrix had a Baker classification of I-II, while patients with usual unmeshed matrix had a Baker classification of III and IV ($p = 0.05$), not actually significant in terms of statistics.

Discussion

This is the first study describing the utilization of a totally meshed biological matrix in immediate breast reconstructive surgery.

It demonstrates that the use of a meshed matrix reduces the problem of profuse secretions and greatly facilitates the aspiration of those formed, just by drainage, during the regular period of hospitalization.[4] The authors hypothesize such an advantage would be a consequence of less surface-area interaction between the breast tissues and the meshed biological matrix. The perfect physiological integration of the meshed biological matrix with the recipient tissues is the proof of the authors' hypothesis. It is the different physical state of the biological matrix, that is completely meshed, that drastically reduces the complications.[5]

Conclusion

The preliminary results obtained with the described method demonstrate that the meshed biological matrix is the effective way to perform an immediate, medium or large sized, breast reconstruction with definitive implant.

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Utilization of installation wound vacuum device for breast implant salvage: Approach and results

Dear Sir,

Negative pressure wound therapy allow for an increase in fibroblast migration, a decrease in cell death and stimulation of angiogenesis, all to allow for more rapid wound healing. With irrigating vacs, wounds can be continually washed without painful dressing changes, while concurrently providing the benefit of intermittent negative pressure.

In implant-based breast reconstruction, the incidence of infection has been reported as high as 53%.[1] When an infected implant does not respond to conservative manage-

Table 1 Patient demographics, treatment and outcomes. PPX = prophylactic, NSM = nipple-sparing mastectomy, SSM = skin-sparing mastectomy, TE = tissue expander, ADM = accelular dermal matrix, unk = unknown.

Patient	Side	BMI	Age	PPX?	Pathology	Type of mastectomy	Type of re-construction	Radiation	Implant placement	Days from surgery to infection	Alloderm	Days vac used	Culture	Status
1	Right	20.86	29	Yes	Prophylactic	NSM	Implant	No	Partially sub-muscular	49	Yes	7	Serratia marcescens	Complete
2	Left	unk	34 (at aug-mentation)	N/A	N/A	N/A	Augmentation	No	Augmentation	35 years	No	5	No growth	Complete
3	Right	24.37	65	No	Recurrent infiltrating lobular carcinoma	SSM	Implant	Yes	Sub-muscular	320	No	7	No growth	Complete
4	Right	27.6	29	No	Infiltrating ductal carcinoma	SSM	TE	No	Pre-pectoral	19	Yes	3	S. aureus	Patient waiting for autologous
5	Right	23.4	39	No	Ductal carcinoma in situ	NSM	TE	No	Partially sub-muscular	166	Yes	2	No growth	Expansion
6	Left	22.4	69	No	Invasive ductal	NSM	TE	No	Partially sub-muscular	191	Yes	5	No growth	Expansion
7	Left	29.5	46	Yes	N/A	NSM	TE	No	Partially sub-muscular	19	Yes	3	No growth	Expansion
8	Left	23.7	43	No	DCIS	NSM	TE	No	Pre-pectoral	45	Yes	5	Serratia marcescens	Expansion
9	Left	22.2	69	No	Invasive ductal	NSM	TE	No	Partially sub-muscular	175	Yes	5	No growth	Expansion

Figure 1 Placement of irrigating wound vac in 29 yo F who underwent bilateral nipple-sparing prophylactic mastectomy with tissue expander placement complicated by infection.

ment and necessitates removal, a new device is typically not inserted immediately to prevent re-infection. This setback of reconstruction can be devastating for a patient and can result in soft tissue changes that complicate subsequent reconstruction.

We have adopted a strategy for managing breast implants necessitating removal with the placement of an irrigating vac at time of explant followed by insertion of a new prosthetic within a week. This approach has allowed us to address nine patients with infected implants with 88.8% success and no adverse reactions.

When cellulitis of the breast prompted surgical exploration, the implant was removed and Alloderm was excised if not well incorporated. The capsule was irrigated with triple antibiotic solution. An installation wound vac was placed with saline for three to seven days. Antibiotics were utilized as directed by culture or with Ancef. The patient returned within a week for wound vac removal, irrigation of the capsule and replacement of tissue expander or implant.

This technique has been utilized on nine breasts in nine patients. One patient had undergone breast augmentation 35 years prior and presented with a late cellulitis and seroma for which ALCL was initially investigated. Two patients underwent direct to implant reconstruction after mastectomy and six patients had tissue expanders placed at time of mastectomy. For one patient, a second bout of cellulitis prompted patient request for tissue expander removal. There were no adverse reactions to the irrigating wound vac and patients tolerated it well. Details can be found in Table 1. An example can be found in Figure 1.

Options for breast implant salvage are somewhat limited once cellulitis is apparent and there is little evidence based medicine to guide treatment. The mainstay for treatment remains antibiotics. While the most common bacteria responsible are *Staph aureus* or coagulase-negative *Staph*, intraoperative cultures can be negative. Thus, post-operative antibiotic regimen may not be adequately targeting the responsible bacteria, even with tissue culture.

With irrigating vacs, wounds can be continually washed without painful dressing changes, while concurrently providing the benefit of intermittent negative pressure.

Our novel approach allows for continuous washout of the capsule to encourage a further reduction in bacterial load after explant. This allows for reinsertion of an implant within as week as opposed to waiting months and delaying reconstruction. Thus, there is no loss of soft tissue expansion or skin contracture. We have utilized this approach successfully on eight out of nine breasts without any complications. We will continue to monitor our results to refine it and determine the optimal number of days for negative pressure therapy.

Conflict of interest

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A retrospective study on surgical outcomes and patient satisfaction of EGIS® ADM in one-stage implant-based breast reconstruction

Dear Sir,

Implant-based breast reconstruction (IBBR) is the most performed breast reconstruction method. It is performed either as a one-stage (i.e. direct-to-implant) or two-stage (expander/implant) procedure. In both methods, an acellular dermal matrix (ADM) can be used. The ADM provides support of the implant and improves implant coverage, which facilitates a one-stage reconstruction and results in a more natural ptotic breast.[1] Reported complication rates after IBBR with an ADM vary widely, from less than 5% up to 50%. Complications comprise of minor or severe complications including infection, wound dehiscence, necrosis and subsequent implant removal.[2] Data on patient satisfaction after ADM-assisted breast reconstruction is scarce.[1]

EGIS® is a porcine-derived ADM that is used in abdominal surgery, e.g. for abdominal wall reconstruction and extensive hernia repair.[3] To our knowledge, no articles are currently available reporting on the use of EGIS ADM in IBBR. This study aims to assess the surgical outcomes and patient satisfaction of immediate one-stage IBBR with EGIS® ADM.

All patients who underwent immediate one-stage IBBR with an EGIS ADM at Tergooi Hospital, Hilversum, The Netherlands, were retrospectively identified from the hospital registry. Baseline demographics, surgical characteristics, peri- and postoperative complications, (neo)adjuvant therapies and reoperations due to complications and secondary revisions were recorded. Patients at least 6 months after placement of the definitive implant were invited to fill out the BREAST-Q reconstruction module.[4] To assess the predictive value of patient and surgery related factors for seroma and implant loss, uni- and multivariable logistic generalised estimating equations (GEE analyses) were performed. Because data were analysed per breast, GEE was used to adjust for the dependency of the observations within one patient. Factors with a univariable p-value below 0.20 were selected for multivariable GEE analyses. A backward selection procedure was used to obtain the final models.

BREAST-Q scores were reported as mean scores. Differences in patient and surgery related factors between responders and non-responders on the BREAST-Q were assessed with student's *t*-test, Chi square test and Mann-Whitney U. For the analyses, IBM SPSS statistics version 22 was used.

The study was performed in accordance with the Declaration of Helsinki, guidelines for Good Clinical Practice and STROBE guidelines.[5] The study protocol was approved by the local medical ethical committee (Commissie Toetsingsprotocollen Tergooi Ziekenhuizen, reference number 17.020). Written informed consent was obtained digitally from all participating patients. This study was (partially) funded by Tergooi Wetenschapsfonds. None of the authors has a (financial) tie to the ADM product.

Eighty-seven patients underwent IBBR with EGIS ADM (Figure 1 and Table 1). Implant failure was observed seen in 6.0% of the reconstructions ($n = 7$ breasts, $n = 6$ patients). In one patient, who underwent bilateral reconstruction, bilateral implant failure was observed. All patients with implant loss underwent mastectomy for oncological reasons and had a periareolar/transverse incision. The majority of patients ($n = 5$ patients, $n = 6$ reconstructions) with implant loss received a bilateral procedure. None of the patients with implant failure had chemo- or targeted therapy. As reconstruction after implant failure, an expander/implant was chosen in two patients and a latissimus dorsi flap was in one. Three patients (4 reconstructions) had no new reconstruction yet.

Table 1 Baseline characteristics and breast Q-scores.

Mean + SD	Included patients ($n = 84$; $n = 117$ reconstructions)
Age (in years)	48.0 ± 11.3
BMI* (kg/m^2)	23.9 (18.3; 32.6)
Chronic disease	33.3% ($n = 28$)
Previous breast surgery	6.0% ($n = 7$)
Augmentation	3.4% ($n = 4$)
Reduction	0.9% ($n = 1$)
BCS	0.9% ($n = 1$)
Mastectomy	0.9% ($n = 1$)
Current or previous smoker	22.6% ($n = 19$)
Side of reconstruction	
Unilateral	60.7% ($n = 51$)
Bilateral	39.3% ($n = 33$)
Reason	
Preventive	35.0% ($n = 41$)
Oncologic	63.2% ($n = 74$)
Mastopathy	1.7% ($n = 2$)
Incision	
Nipple sparing	**64.1% ($n = 75$)**
Periareolar	60.7% ($n = 71$)
Vertical scar, Wise	2.6% ($n = 3$)
Skin sparing	**35.9% ($n = 42$)**
Periareolar/transverse	29.9% ($n = 35$)
Vertical scar	6.0% ($n = 7$)
Mastectomy weight* (gram)	
Median - range	381.0- 110; 1008
Size inserted prosthesis* (gram)	
Median + range	335.0 - 175; 580
Chemotherapy (per patient)	
Neoadjuvant	39.3% ($n = 33$)
Adjuvant	17.9% ($n = 15$)
Hormone therapy	46.4% ($n = 39$)
Targeted therapy	7.1% ($n = 6$)
Radiotherapy (per breast)	26.5% ($n = 31$)

(*continued on next page*)

Table 1 (*continued*)

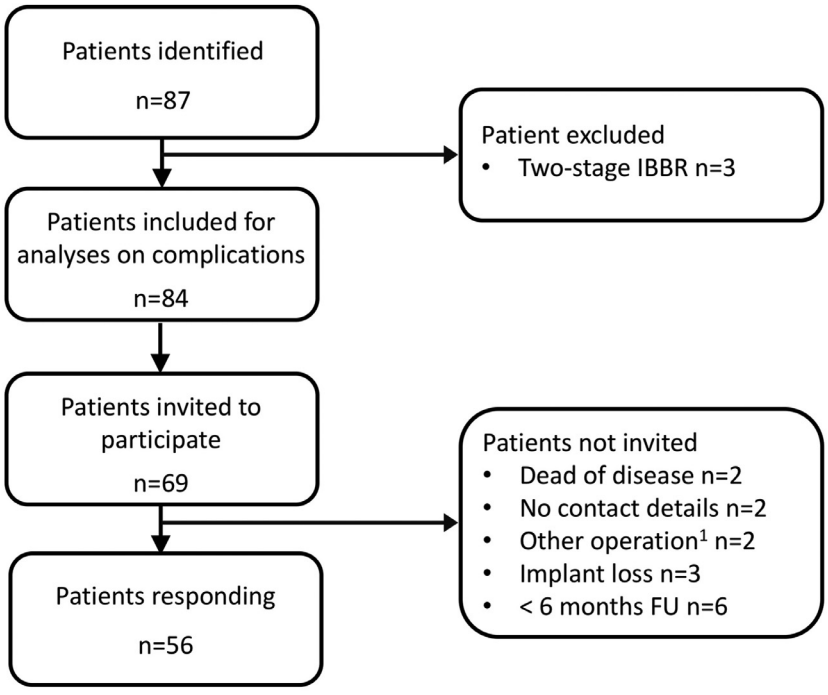
Mean + SD	Included patients ($n=84$; $n=117$ reconstructions)
Hospital admission* (days)	
Median - range	3.0 - 2; 7
Clinical follow-up* (months)	
Median—range	14.0 - 0; 26
Follow-up BREAST-Q (months)	
Mean ± SD	18 ± 6.4
BREAST-Q (mean ± SD)	**Responders ($n=56$)**
Satisfaction with Breast (Q1; $n=56$)	59.0 ± 14.5
Satisfied with implant rippling / wrinkling (Q2; $n=56$)	2.8 ± 1.1
Visible	2.7 ± 1.2
Feeling	
Satisfaction with outcome (Q3; $n=54$)	71.2 ± 19.6
Psychosocial well-being (Q4; $n=54$)	72.0 ± 18.7
Sexual well-being (Q5; $n=53$)	57.3 ± 24.9
Physical well-being: Chest (Q6; $n=54$)	67.3 ± 14.4
Satisfaction with nipples (Q10; $n=7$)	59.7 ± 30.6
Satisfaction with information (Q11; $n=54$)	75.5 ± 15.5
Surgeon (Q12; $n=54$)	96.5 ± 8.5
Medical staff (Q13; $n=54$)	84.1 ± 21.4
Office staff (Q14; $n=54$)	89.6 ± 18.4

* Non normal distribution.

Minor complications that did not require implant removal were infection (8.5%, $n=10$ reconstructions) and minor skin necrosis (6.8%, $n=8$). Surgery was performed for infection (rinsing of the implant, 3.4%, $n=4$) and necrotectomy (6.8%, $n=8$). In 35 breasts (29.9%), one or more needle aspirations of seroma were performed (median 1.0, range 1; 5). In the multivariable model, a larger difference between mastectomy weight and inserted prosthesis (OR1.54 (1.12; 2.11), $p=0.007$) and use of hormone therapy (OR2.62 (1.05; 6.55), $p=0.039$) were associated with an increased risk on seroma.

Sixty-nine patients were invited via email to fill-out the BREAST-Q (Figure 1). The response rate was 81.2% ($n=56$ patients). There were no significant differences in any of the baseline characteristics between responders and non-respondenders. The mean follow-up between surgery and completing the BREAST-Q was 18 ± 6.4 months. The mean satisfaction with breasts BQ1 was 59.0 ± 14.5 and the satisfaction with outcome was 71.2 ± 19.6. Three patients with an explantation were invited to fill-out the BREAST-Q, of which two responded and reported a mean satisfaction with breasts of 54.0 ± 29.7.

The use of EGIS ADM in implant-based breast reconstruction was associated with a low explantation rate (6.0%, $n=7$ reconstructions) and good patient satisfaction (59.0 ± 14.5). Patients should be informed regarding a relative high seroma rate associated with this procedure. Future studies are necessary to investigate the additional value of ADMs in general and which ADM should be used in particular.



1 Two patients underwent autologous reconstruction with a DIEP flap, but first received IBBR due to the waiting time

Figure 1 Flow chart of study participation.

Presentation

Not applicable.

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Conflict of interest

None.

Financial disclosure statement

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The study was performed in accordance with the Declaration of Helsinki, guidelines for Good Clinical Practice and STROBE guidelines.

Informed consent

Written informed consent was obtained digitally from all participating patients.

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Readability and quality of breast reduction on-line resources

Dear Sir,

Breast reduction is the second most common cosmetic surgery procedure in the UK with 4043 procedures performed in 2017.[1]

Traditionally, patients receive medical information from their surgeons. Nowadays many patients are using the Internet as a resource for health-related information with the common starting point often a search engine rather than a medical portal or website of a professional surgical organisation.[2]

While health-related websites are readily accessible to the public, the readability and quality of their content is a key factor in their effectiveness.

Readability is an objective measure of the reading skills an individual must possess to understand that material. Health literacy has been shown to be a predictor of an individual's health status[3] and therefore, medical information on the Internet should be comprehensible to lay people. The American Medical Association (AMA) and the National Institutes of Health recommend that the readability of patient education materials should be equal to or less than 6th grade level or at an 11–13-year-old reading level.

The aim of this study was therefore to evaluate both the readability and quality of websites related to breast reduction.

With location filters disabled, the keyword 'breast reduction' was entered into the Google search engine. The first 10 suitable websites which yielded 112 articles were assessed. Private or commercial cosmetic surgery websites were excluded.

Ten established readability tests (Flesch Reading Ease Score (FRES), Flesch-Kincaid Grade Level (FKGL), Gunning Fog Index (GFI), the Coleman-Liau index, the Simple Measure Of Gobbledygook (SMOG), Raygor estimate, New Fog Count, New Dale-Chall, Fry Graph and FORCAST) were performed using Readability Studio Professional Edition software. Assessment of website quality was performed using the DISCERN instrument. Statistical analysis was performed in GraphPad Prism (GraphPad Software, San Diego, CA, USA).

Our study demonstrated a mean reading grade level of 11 (i.e. suitable for 16–17-year-olds, Table 1) which is higher than the maximum 6th grade level recommended by the National Institute of Health and the AMA.

The Fleish Reading Ease (FRE) analysis, which reports an index score ranging from 0 to 100, with 100 being easiest to read, produced a mean score of 45, consistent with "difficult'' to read.

Websites were then assessed individually (Table 1). Reading levels ranged from 9.3 (Medic8.com) to 15.5 (Wikipedia.org) when all tests were included. Every web site exceeded the recommended sixth grade level using all analyses (Figure 1).

The DISCERN instrument is a validated tool that determines the quality of websites based on 16 questions with a maximum score of 80. We found that the average DISCERN score for the 10 websites was 56.75 ($\pm$12.65, Table 1). The highest quality website was NHS Choices with a score of 75. The American Board of Cosmetic Surgery website received the lowest quality score of 36. Two websites (NHS Choices and NHS Wales) achieved the maximum DISCERN score of 5 in the final section relating to the overall quality of the site. The BAAPS website achieved a score of 4. The BAPRAS website had a moderate overall quality rating score of 3 indicating that the website is of fair quality and can be considered a useful source of information about treatment choices but has some limitations.

When the DISCERN score of each web site was plotted against grade reading age, a strong statistically significant negative correlation was noted ($r = -0.83$, $R^2 = 0.69$, $p = 0.0027$). This indicates that the websites with a higher quality score were more appropriately written for their target audience and hence were more readable.

More and more patients are accessing medical information on the internet. They expect up-to-date, easy, fast and reliable access.[4] However, the Internet often contains unregulated content with little peer review.

The aim of this study was to objectively assess the quality of health information regarding breast reduction that is currently available on the internet. The two measures of readability and quality were used to assess the selected websites.

Every website in this analysis exceeded the recommended sixth grade level with a mean information grade level of 11 (16–17 year-old reading level). Quality of websites also varied considerably. Overall, websites for breast reduction are written at a reading grade level that may be too high for the average patient to understand even if the information on these websites is of good quality.

Surgeons should be aware that patients are using the internet as a source of health information even though a sizeable proportion of patients do not discuss this information with their doctor.[5] The results of this study could enable

Table 1 Reading level and quality (DISCERN) scores of all websites.

	USA reading Grade level	DISCERN max score 80	DISCERN overall quality score. Max 5
Americanboardcosmeticsurgery.org	13.5	36	1
Baaps.org.uk	11.47	62	4
Bapras.org.uk	9.58	59	3
Christie.nhs.uk	11.23	67	4
Medic8.com	9.35	67	4
NHS Choices	8.77	75	5
Nhsdirect.wales.nhs.uk	10.37	63	5
Plasticsurgery.org(ASPS)	10.7	51	3
WebMD.com	10.4	52	3
Wikipedia.org	15.5	39	1
Mean	11.09	56.75	

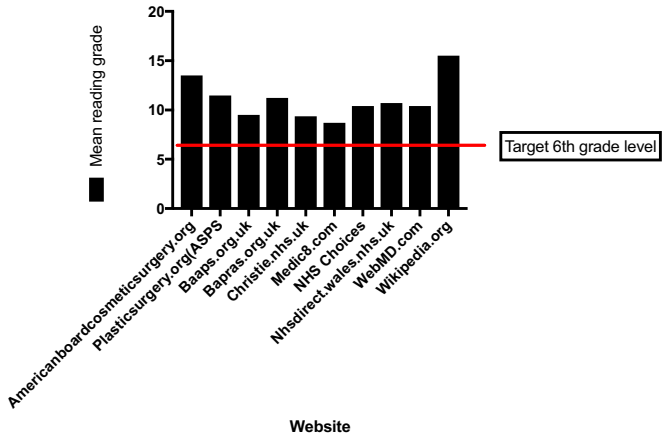

Figure 1 Mean reading grade of all websites.

surgeons to recommend sources of information for patients considering breast reduction as well as helping patients to evaluate the quality of medical information available on the Internet(5). Furthermore, this study could act as stimulus to revise existing on-line material and develop patient resources that are easier to understand.

Conflict of interest

The authors declare they have no conflicts of interest.

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Differential visualization of arterial and venous flow in deep inferior epigastric perforator imaging with vector-flow perforator Phase Contrast Angiography (pPCA)

Dear Sir,

Perforator flaps are commonly used in reconstructive surgery, with decreased donor site morbidity and increased flexibility in flap design cited as advantages over traditional techniques.[1] Vascular imaging is often obtained preoperatively in order to facilitate flap design and execution.[2,3] Computed tomographic angiography (CTA) is widely used in a variety of different perforator flaps, but possesses a number of drawbacks. CTA utilizes ionizing radiation, which is of particular concern to the patient population receiving perforator flap surgery as many of them are young and with greater than usual susceptibility to radiation induced neoplasia due to risk factors such as BRCA gene mutations and Li-Fraumeni Syndrome. The average radiation dose of an abdominal CT is 8 mSv, which is equivalent to 2.6 years of natural background radiation.[4] In addition, CTA requires the administration of exogenous iodine-based contrast medium, which has potential adverse effects including nephrotoxicity and anaphylaxis. Lastly, CTA predominately delineates arterial anatomy, whereas both arteries and veins are of interest in perforator flap surgery. To address these limitations, we developed a novel imaging technique, perforator Phase Contrast Angiography (pPCA), which does not require use of ionizing radiation or exogenous contrast medium. In an earlier publication, we reported an initial application of pPCA to deep inferior epigastric artery perforator (DIEP) imaging and assessed its performance against CTA.[5] In this communication, we describe a further refinement of the pPCA technique that provides the ability to differentiate between arteries and veins, which is likely to be of potential use to reconstructive microsurgeons in both clinical practice and research.

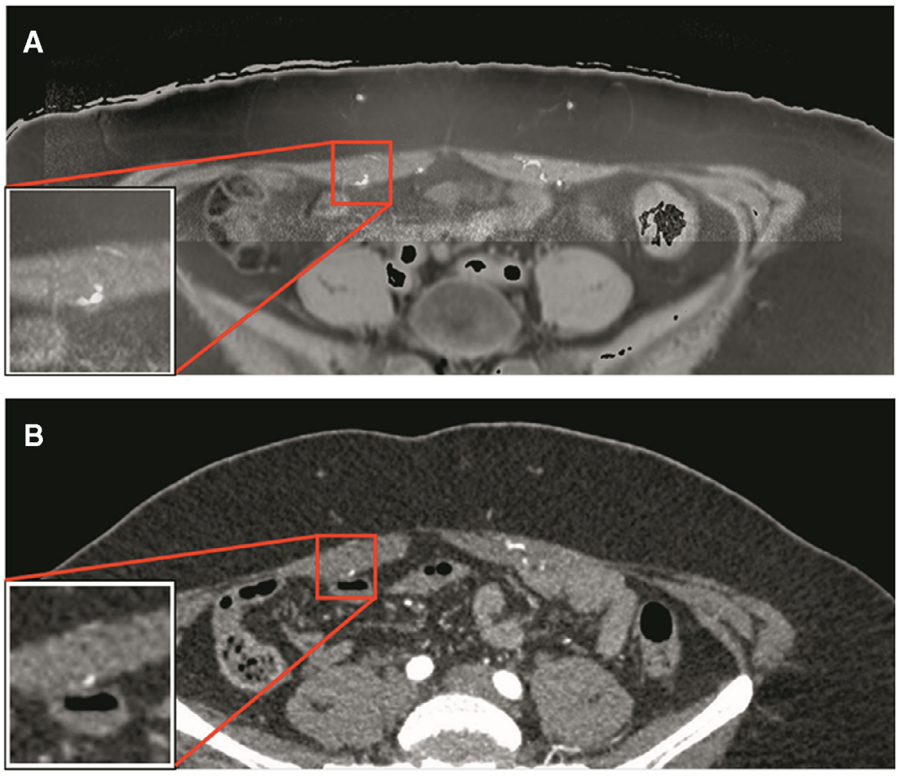

Figure 1 Deep inferior epigastric artery perforator flap pPCA and CTA data (both 1.5-mm-thickness) from a 50-year-old female patient with BMI 31.6. The pPCA images (A) demonstrate a higher degree of contrast, and less noise than CTA images of the same slice thickness (B). Inlets in (A) and (B) demonstrate that pPCA visualizes not only perforator arteries, but also perforator veins that are invisible in CTA images.

Perforator phase contrast angiography is a magnetic resonance (MR)-based technique that entails the acquisition of two image sets. Vessel images acquired with a phase contrast angiography (PCA) sequence and anatomic images acquired with a grayscale-reversed T2-weighted Turbo Spin Echo (T2-TSE) sequence are fused together to yield a combined representation of both vascular and soft tissue structures. The fused pPCA images exhibit a high degree of vessel contrast and substantially lower noise than CTA images with comparable slice thickness (Figure 1). With our current implementation, it takes 15 to 25 minutes to conduct a high-definition ($0.5 \times 0.5 \times 1.5$ mm) DIEP pPCA study over a 20-cm scan range.

In pPCA images, vessel contrast arises from bulk motion of water molecules in flowing blood. This technique is therefore sensitive to both arterial and venous flows. Inlets in Figure 1 demonstrate that pPCA can visualize perforator veins that CTA fails to detect. However, this image also reveals a limitation of pPCA that it depicts both arteries and veins as hyperintense (bright) structures indiscriminately. This limitation is due to the commercial PCA sequence in our DIEP pPCA protocol, which only exports the magnitude of flow velocity and discards all direction information. We sought to address this limitation by refining the pPCA technique with a more sophisticated PCA post-processing approach. This new approach allows the user to extract three phase maps from the MRI raw data. Each phase map corresponds to one of the three orthogonal components of the flow velocity vector. With this vector representation of velocity, arteries and veins are readily discernible based on their different direction of flow.

We applied this refined vector-flow pPCA approach to two healthy volunteers (age: 33/26 years, BMI: 26.2/26.8) under Institutional Review Board approval. The volunteers were imaged in prone position on a 3T MRI (Philips Healthcare, Cleveland, OH) using a DIEP pPCA protocol previously described.[5] Our preliminary results demonstrate clear distinction between perforating arteries and veins within close proximity to each other. Figure 2 shows an example of a perforating artery/vein pair and the associated subcutaneous vascular network in the left hemi-abdomen of a volunteer. Maximum intensity projection (MIP) pPCA reveals a type I (single trunk) DIEA branching pattern[6] that further diverges into one inferior and three superior vessels in subcutaneous fat (Figure 2A/2B). While these vessels have similar appearance in conventional PCA images representing flows by the magnitude of their velocity (Figure 2C), the anterior-posterior (AP) phase map reveals different flow directions within the three superior vessels. The hyperintense appearance of the lateral vessel indicates distal arterial flow in the posterior-to-anterior direction. Both the central and middle vessels are hypointense (dark), suggesting that they are veins carrying proximal flows along the anterior-to-posterior direction (Figure 2D). Similarly, the inferior vessel is determined to be a vein based on the foot-to-head flow direction identified on the head-foot (HF) phase map.

Our preliminary experience with the refined vector-flow pPCA approach suggests that pPCA might be a more fa-

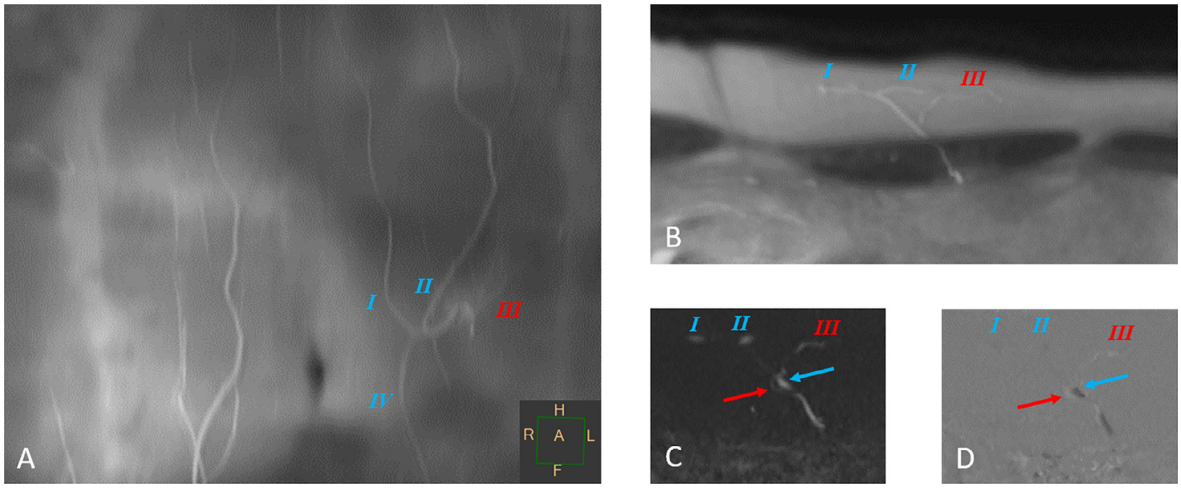

Figure 2 Coronal (A) and axial (B) DIEP pPCA maximum intensity projections (~20 mm thickness) obtained from a 33-year-old male volunteer with BMI 26.2 reveals a Type I perforating artery/vein pair slightly superior to the umbilicus on the left hemi-abdomen. The perforators diverge into three superior (I/II/III) and one inferior (IV) vessels in subcutaneous fat. In a 1.5-mm-thick axial PCA vessel image near the exit point of the perforators (C), arteries and veins are well delineated as separate vascular structures, but both are depicted as hyperintense (bright) structures with the magnitude representation of velocity. Additional post-processing steps can be applied to pPCA raw data in order to extract three phase maps corresponding to the three orthogonal components of the velocity vector. Using this vector representation, arterial and venous flows can be differentiated by their direction. In the anterior-posterior (AP) phase map (D), the hypointense (dark) appearance of the central (I) and middle (II) superior vessels suggest they are superficial veins with a proximal (anterior-to-posterior) flow pattern. The lateral superior vessel (III) has a hyperintense appearance, suggesting that it is an artery with a distal (posterior to anterior) flow pattern. This assessment is also supported by the analysis of flow patterns along the other two directions (left-right and head-foot). The perforating artery (red arrow) and vein (blue arrow) are also discernible with this approach.

vorable preoperative imaging technique than CTA and MRA in DIEP flap breast reconstruction. It potentially provides a more reliable preoperative demonstration of perforator anatomy that is not prone to errors associated with timing of image capture relative to contrast administration, and incomplete identification of the continuity of the vascular system. This novel imaging technique not only yield clear delineation of pertinent anatomic structures in a form familiar to plastic surgeons, but also provide the additional benefit of vessel differentiation based on flow direction. Clinically, it may facilitate decision-making, such in regards to perforator selection based on a separate evaluation of both perforator arteries and veins. The ability to clearly visualize and differentiate between perforator arteries and veins may also be of utility in research, such as by allowing for more accurate investigation of the sizes and branching patterns of perforator arteries and veins. Lastly, the pPCA technique and its vector-flow refinement are readily applicable to other types of perforator flap surgery. They can be carried out on equipment currently available at many centers, and thus may not require any additional capital investment.

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An alternative approach to the intraoperative Indocyanine Green angiography (ICGA) in reconstructive surgery

Dear Sir,

Indocyanine Green (ICG) is a nontoxic, near- infrared fluorescent dye that has been used for imaging since the 1950s to evaluate liver perfusion and in cardiology.[1] It has more recently gained traction in other key areas of reconstructive surgery such as sentinel node biopsy in breast and melanoma skin cancers, lymphangiography in the surgical management of lymphedema and in assessing flap viability in free tissue transfers.[1,2]

Indocyanine Green is a water-soluble dye that is excited by laser lights in 2 min following intravenous injection.[1-5] Following administration, illuminating the tissue of interest at the excitation wavelength in the near infra-red spectrum (750–800 nm) will cause the ICG dye to fluoresce, identifying the underlying anatomical structures where the dye is present. There are numerous light detection devices for this purpose available commercially, such as SPY Elite System (Novadaq), PDE-Neo System (Hamamatsu Photonics) and Fluobeam 800 System (Fluoptics).[3] These, however, are considerably expensive, costing up to $250.000 per machine plus $650 per case for the SPY System.[3] As such they are not commonly present in hospitals, and when they are, literature suggests that they should only be used in high-risk patients because of their cost ineffectiveness.[4]

We performed the ICGA using the laparoscopic infrared imaging device as a light source, which is widely available because of its utility in general surgery and cheaper to use.

The first patient was a 40-year-old female lady, undergoing bilateral mastectomy for confirmed breast cancer in association with BRCA 1 gene, followed by breast reconstruction. She received radiotherapy pre-operatively to shrink the tumor and was at a risk of breast skin flap necrosis. Intraoperatively, following the removal of the breast tissue bilaterally, the patient was administered 0.3 mg/kg of ICG intravenously and the laparoscopic near-infrared device was used as a light detection device to identify the breast skin perfusion. Areas of hypo-vascularity in the flap were subsequently identified successfully and removed before the implant reconstruction (Figure 1).

Figure 1 Intraoperative ICGA to identify the breast skin flap perfusion.

The second patient was 65 years old male patient with open tibia fracture IIIB (Gustilo Classification) reconstructed with internal fixation and soft tissue coverage with free musculocutaneous latissimus dorsi flap. The pedicle of the flap was anastomosed end-to-end with the posterior tibial artery and the concomitant vein. ICG was used to confirm the patency of the anastomosis, especially the venous part. After the anastomosis, the flap had rapid capillary with signs of venous congestion. The ICG angiography confirmed that the venous anastomosis was patent (Video Graphic 1).

The third case was a 38 years old gentleman with a confirmed melanoma of the upper back undergoing excision and sentinel lymph node biopsy of the neck region. Following ICG administration, the laparoscopic infrared light was able to correctly identify the neck sentinel lymph node, which was subsequently excised and sent for biopsy (Figure 2).

The laparoscopic infrared imaging is a simple, fast and widely available approach to identifying flap perfusion, vessel anastomosis patency and lymph nodes. It is a practical alternative to performing ICGA in plastic surgery in hospitals in which specialized light detection devices are not present.

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Statement of financial interest

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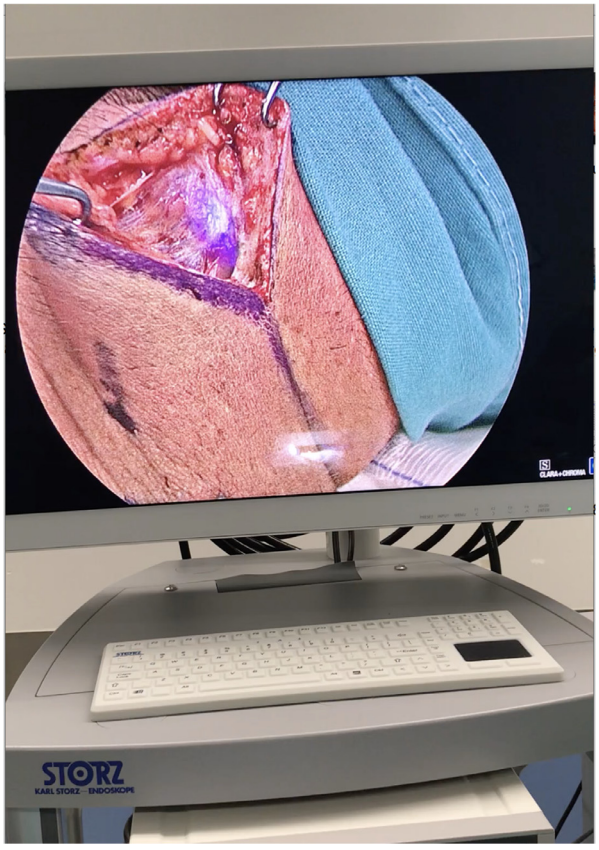

Figure 2 Intraoperative ICGA to identify the sentinel lymph node of the neck during melanoma excision.

Products used

KARL STORZ OPAL1®

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.bjps.2018.09.009.

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A feasibility study of indocyanine green fluorescence mapping for sentinel lymph node detection in cutaneous melanoma

Dear Sir,

Sentinel lymph node biopsy (SLNB) is the standard of care for staging regional lymph nodes (LN) in stage AJCC IB-IIC melanoma.[1] The technique utilises dual localisation with a radiolabelled colloid and a blue dye such as Patent Blue (PB). Combining these give an excellent sensitivity and specificity.[2,3]

Potential drawbacks associated with the use of radioisotopes as tracer agents for localisation of SLN. include cumulative radiation exposure for healthcare workers, problems with surgical waste disposal and potential repeat of the 2009 European shortage of radioisotopes. Furthermore, co-ordinated efforts between different disciplines is essential.[4] Adverse events associated with the blue dye include prolonged skin-staining and anaphylaxis.[5–7] Localisation techniques using another non-radioactive tracer which has comparable accuracy to PB and Tc^{99} therefore warrants investigation.

A potential alternative is inodcynanine green (ICG). Potential benefits include the absence of serious adverse reactions, (allergic reactions are rare[8]). ICG is utilised as an optical enhancer and fluoresces light in the near-infrared range. It also emits fluorescence when it makes contact with plasma proteins in the lymphovascular systems of the extracellular compartment.

The principle of fluorescence imaging has been applied to SLN mapping in early breast cancer The advantage of using ICG in these cancer types is that their lymphatic drainage

is relatively predictable, often obviating the need for pre-operative LSG. In contrast, lymphatic drainage of cutaneous melanoma is notoriously unpredictable[9] necessitating the need for LSG to determine SLN location and potential nodal fields. Preliminary work with melanoma have been published, but with only a limited number of patients.[10-12]

The primary aim of this study was to assess the feasibility of utilising ICG to detect SLN in cutaneous melanoma; we aimed to achieve this by determining the sensitivity of ICG fluorescence imaging in SLN identification when combined with Tc^{99} and PB. Secondary endpoints included evaluation the accuracy of percutaneous visualisation of lymphatic channels and nodal fields intra-operatively compared to pre-operative LSG. Standard patient demographics and tumour characteristics were also collected.

Primary cutaneous melanoma patients over the age of 18 years diagnosed with pT1b-pT4b tumours, clinically N0, undergoing wide local excision and SLNB were identified at specialist skin MDT and recruited in a prospective and consecutive manner over a 6-month period at a tertiary melanoma referral centre. Exclusion criteria included prior LN surgery, previous history of cutaneous melanoma, failed pre-operative LSG and contraindication to ICG such as pregnancy, lactating patients and those with thyroid problems.

All patients underwent standard pre-operative LSG using 20–40 MBq of Tc-99-radiolabelled nanocolloid (ELUMATIC III) in addition to intra-operative PB (Bleu Patente®; Guerbet).[12] ICG was administered as a third tracer agent intra-operatively.

This study protocol was approved by the Research Ethics Committee and MHRA (Eudra CT number: 2012-002244-25).

62 patients (33M:29F) were recruited with a median age of 61 years (31–78 years). The distribution of melanoma and LN drainage characteristics are described in Table 1. Median melanoma Breslow thickness was 1.6 mm. None of the patients experienced anaphylaxis.

144 specimens were excised, average 2.3 specimens per patient. 135 SLN were included in the histological analysis. The concordance rate for all 3 tracer agents was 88.1% (119 of 135 LNs - Table 2). The concordance rate between radio-isotope and PB was 88.2% (95% CI: 82.2−93.7%). There were no discordant pairs between radio-isotope/PB compared to radio-isotope/PB/ICG fluorescence. One extra LN demonstrated fluorescence and blue staining only. All positive SLN were radioactive, blue and fluorescent ($n = 19$).

Radio-isotope and ICG fluorescence significantly increased the sensitivity of detecting SLN to 98.5% (95% CI: 94.8−99.8%; $p < 0.00001$) compared to radio-isotope or PB alone.

In 98.4% (61/62) of patients, lymphatic channels were visualised prior to incision using ICG. In 38 patients (62.3%), percutaneous visualisation with PDE showed greater detail or extra channels when compared against pre-operative LSG. However in 10 cases (16.1%), less details or less channels were visualised with PDE;this would have translated to missing a lymphatic drainage basin in 3 cases. Percutaneous LN visualisation was variably dependent on the depth of LN beneath the skin, however this was not consistent when compared to different LN drainage sites.

According to our data, sensitivity of ICG with PB was 88.9%, which is lower than gold standard.[3,13] Moreover, there is a level of inaccuracy when interpreting ICG; only 22.6% of patients had exact corresponding lymphatic channel imaging when comparing PDE and pre-operative LSG. This is likely due to the high variability of lymphatic drainage in melanoma,[9,14] and thus a challenge when using ICG.

Of our cohort, only 14.5% ($n = 9$) patients presented with a head and neck (H&N) primary melanoma; however this translated to a quarter of the LN drainage basin. It is difficult to conclude wthether ICG would contribute a better operative achievement in H&N melanoma.

PB alone only identified 120 of 135 SLNs (88.9% sensitivity)which correlates with data on development of dual technique.[2,3] Although the data suggests PB adds very little to the SLNB technique combined with Tc^{99} or ICG,

Table 1 Melanoma and lymph node characteristics of cohort.

	Number (*n*)	Percentage (%)
Melanoma staging		
pT1b	14	22.6
pT2a	24	38.7
pT2b	3	4.9
pT3b	7	11.3
pT4a	4	6.5
pT4b	3	3.9
Unknown	1	1.6
Site of primary tumour		
Head and neck	9	14.5
Trunk	28	45.2
Limb	25	40.3
Ulceration		
Present	15	24.2
Absent	46	74.2
Unknown	1	1.6
Perineural invasion		
Present	1	1.6
Absent	60	96.8
Unknown	1	1.6
Lymphovascular invasion		
Present	1	1.6
Absent	56	90.3
Possible	4	6.5
Unknown	1	1.6
Lymph node drainage basin		
Axilla	70	50
Neck	37	26.4
Groin	26	18.6
Interval	7	5
Number of drainage basins		
1	44	71
2	15	24.2
3	2	3.2
4	1	1.6
Number of lymph nodes		
1	17	27.4
2	22	35.4
3	16	25.8
4	4	6.5
5	3	4.8

Table 2 Sensitivity of tracer agents in the detection of SLN. 135 SLN excised in total.

Tracer agent	SLN detected	Sensitivity (%)	95% CI	Significance: McNemar's test (vs. radioisotope/ICG)
Radio/PB/ICG	119	88.2	(82.2−93.7%)	$p = 1.0000$
Radio/PB	119	88.2	(82.2-93.7%)	Reference
ICG/PB	120	88.9	(82.3-93.7%)	$p = 1.0000$
Radio/ICG	133	98.5	(94.8-99.8%)	$p < 0.0001$
Radio	134	99.3	(95.9-100%)	$p < 0.0001$
PB	134	99.3	(95.9-100%)	$p < 0.0001$
ICG	120	88.9	(82.3-93.7%)	$p = 1.0000$

SLN - sentinel lymph node, Radio - radioisotope, PB - Patent Blue, ICG - indocyanine green, CI - confidence interval.

practically it may aid the surgeon in SLN visualisation intra-operatively. Interestingly, radio-sensitive and positive fluorescence alone identified all but one SLN with a sensitivity of 98.5%; however utilisation of ICG was associated with some technical problemsPoor visualisation of lymphatic channels using ICG pre-operatively in obese patients makes it challenging to plan incisions. This is in keeping with studies that have found that when SLNs located deeper, such as the axilla or inguinal region, there is unreliable tracking percutaneously using fluorescence.[15,16]

Other tracer agents such as Tc-99m Tilmanocept (Lymphoseek®; Navidea) have been trialled in two near-identical non-randomised phase III trials that compared it to blue dye. Results have shown that it identifies 98.7% of blue nodes.[17] This shows promising results for an alternate tracer agent. Other studies have investigated the use of hybrid radioactive and fluorescent tracer (ICG-^{99m}Tc-nanocolloid in SLNB for H&N malignancies with favourable results [18,19]; however further studies are required to establish its use in melanoma outside the H&N region.

In this successful feasibility study, we have demonstrated that ICG, in combination with Tc^{99} radio-labelled nanocolloid has excellent sensitivity (98.5%) in detecting SLN in melanoma. However, in practice, the requirement for additional equipment, the relatively impracticality of being unable to follow the fluorescent imaging whilst using standard operating lights severely limits its application. Whilst we have identified some positive aspects to the technique, replacement of Tc^{99} or PB with ICG in SLNB for cutaneous melanoma is not recommended and we suggest that further developmental work is required.

Conflict of interest

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Microvascular anastomosis with fish-mouth suturing and adhesive sealants

Dear Sir,

The primary drive in microvascular surgery is to ensure reliability of patency and flow. Conventional interrupted suturing (CIS) is the current gold standard, despite the known complication of intimal damage and exposure of the media layer[1]. Numerous techniques have been described to remove suture dependency and reduce vessel trauma, including vessel clips, stents, and laser-assisted bonding with no clinical success.

Herein the following hypothesis is challenged: Exploiting intima apposition surgical techniques with tissue sealing adhesives optimizes throughput, reduces post-operative bleed, with reduced surgical complications. Non-thrombotic tissue adhesives are in development,[2] but fibrin sealants and cyanoacrylates are the only commercially available tissue adhesives with known hemostasis. Four Corner Fish-Mouth technique (FCFM) is compared to CIS to reduce the number of sutures, decrease surgical time, and reduce microvascular complications by preventing subintimal structure exposure. Intima apposition is surgically modified and vessel trauma is minimized through a four corner stay suture followed by cyanoacrylate sealant. This study compares patency, anastomosis time, bleeding time and histopathology between the conventional and FCFM techniques. The paired *t*-test and Wilcoxon signed-rank test compared anastomosis time and bleeding time, respectively, with $p < 0.05$ considered statistically significant

An overview of the complete surgical method is given in Figure 1. The post-operative photo (Figure 1, right) demonstrates the end-results of the two techniques under physiological blood pressure. Four Corner Fish-Mouth (FCFM) technique in combination with 2-octylcyanoacrylate sealant was combined to anastomose ten New Zealand White Rabbit blood vessels. Patency (day zero and seven), anastomosis time (insertion to clamp release), bleeding time and histopathology between the CIS and FCFM techniques were compared. The right common iliac artery (CIA) served as control ($n = 10$, CIS with Ethilon 10-0) and the left CIA was the FCFM group ($n = 10$). FCFM technique is combined with any tissue adhesive capable of wet tissue bonding, herein exemplified with 2-octylcyanoacrylate glue.

The rabbits were anaesthetized using intramuscular Ketamine 50 mg/kg and Xylazine Hydrochloride 10 mg/kg. A low midline laparotomy incision was made, and the infrarenal abdominal aorta as well as its bifurcations to the CIAs were dissected. The right CIA was divided and was anastomosed using the CIS method. For the left CIA (FCFM) group, two parallel 1 mm longitudinal incisions of 180° apart were made at the distal and proximal end of the transected vessels. Incision length was less than vessel radius. Two simple stay 10/0 sutures were then placed 180° apart between these vessel wall flaps, followed by another 2 sutures for the

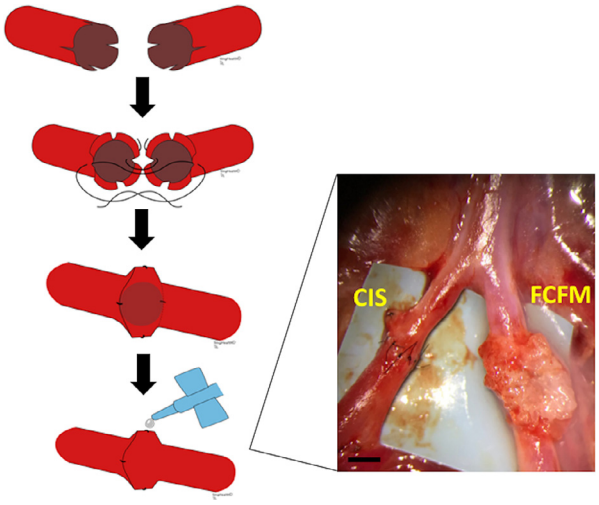

Figure 1 Chronological description of the FCFM technique with 2-octylcyanoacrylate glue. Sutures are placed on all four corners of the fish-mouth flaps, allowing good vessel eversion and intima contact between two adjacent sutures when placed under tension. Bar = 1 mm.

adjacent flaps. Four equal-sized full-thickness fish-mouth flaps 90° apart on both vessel ends, resulted in a total of four sutures for the vessel anastomosis (Figure 1). Gentle traction prior to tissue adhesive application.

Adhesive is gently applied to the fish-mouth flaps, ensuring vessel wall eversion and intima contact. After 30 seconds, clamps released and bleeding time recorded. Vessel patency was assessed at day 0 and day 7 by the Acland empty and refill test[3]. At day 7 the anastomosis site was then harvested and stored in 10% formalin/saline before histopathological evaluation. Inflammation and fibrosis were assessed blindly by an independent pathologist.

Anastomoses patency rates were 100% in FCFM and CIS groups at day 0 and day 7. The mean anastomosis time for the FCFM was significantly shorter compared to the conventional interrupted group by 5 min (CIS: 31 ± 16 min, FCFM 26 ± 15 min). The mean bleeding time for the FCFM group was insignificantly shorter comparable to the conventional interrupted group by 1.1 min (CIS: 1.5 ± 1.6 min; FCFM: 0.4 ± 0.7 min)

FCFM group has greater degree of inflammation and fibrosis compared to CIS, which is expected of cyanoacrylate adhesives. Fibrosis and inflammatory cells surrounded the 2-octylcyanoacrylate adhesive and less pronounced around the suture material. Acellular zone is seen in the CIS vessel wall adjacent to the suture knot indicating an increase in strain (Figure 2). Suture tying causes compressive stresses, resulting in migration of cells away from site of injury, intima and media necrosis, followed by anastomotic failure.[4] FCFM method results in a smaller acellularity zone.

The advantages of the FCFM/tissue adhesive technique:

1. Reduction in the number of sutures prevents blunt trauma to the intima layer and necrosis of the tunica media.
2. Good intima contact with adequate vessel wall eversion through side slits, avoiding the risk of thrombotic surface exposure.[5]

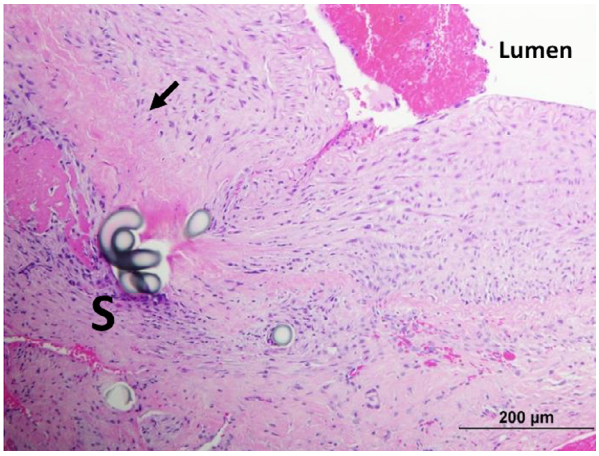

Figure 2 Cross sections of the CIS sample with 20× microscope magnification. The arrow shows a more distinct acellular zone adjacent to the suture site indicating an increase in strain.

3. Technique is applicable to other, more biocompatible tissue adhesives that allow bonding to wet tissues.

With this in mind, the paradigm of microvascular anastomosis should aim towards stress distribution, sutureless anastomosis, and to apply a resorbable tissue adhesive without toxic leachants. The proof-of-concept demonstration supports the inclusion of tissue adhesives for microvascular sealants and anastomosis. With the FCFM technique and the new developments in photo- and voltage-curing tissue adhesives, rapid anastomoses with minimal complications is on the horizon.

Conflict of interest

All named authors hereby declare that they have no conflict of interest to disclose.

Acknowledgments

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.bjps.2018.10.031.

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A simple method for lymphedema self-measurement using the Zozosuit bodysuit

Dear Sir,

Several methods are used in clinical practice and research to monitor lymphedema, including water volumetry, tape measurement, perometry and bioimpedance spectroscopy. There is currently no agreement on a gold standard measurement instrument for lymphedema, nonetheless such an instrument must be accurate, precise, affordable, quick, and easy to use for both clinicians and patients.[1]

The volume of an affected body region varies with patients activity, time of day, environment and with weight changes unrelated to lymphedema, hence in practice, multiple serial measurements are often of more clinical value in management decision making.[2] Self-measuring techniques save the patient time and resources as well as encourage patient participation in management. Apart from tape measurement, the use of other methods for frequent self-measurement in a home setting is currently impractical.

Figure 1 Zozosuit bodysuit.

The Zozosuit (Start Today Co., LTD., Chiba, Chiba Prefecture, Japan) is a stretchable bodysuit with over 300 marks that is used in combination with a smart phone application to measure different body parts (Figure 1).[3] The user wears the bodysuit and takes a series of pictures using the smart phone camera which the application then uses to calculate multiple body dimensions at once. The entire process takes only a few minutes to complete. In contrast to other measuring bodysuits or motion suits, the Zozosuit does not use any sensors or extra electronic components hence its low cost. Though originally designed for remote clothing size measurement, it is also ideal for lymphedema self-measurement. It is inexpensive, simple to use and allows patients to consistently self-measure body parts such as the arms which would otherwise be difficult by tape measure (Figure 2). Additionally, the smartphone application automatically stores all measurements making long-term monitoring easy.

A major disadvantage of the Zozosuit is that the measurement landmarks differ from those used in clinical practice. In addition, with the current software application patients need to wear the entire suit to measure a particular region, however the advantage of taking serial measures with ease still makes it ideal for home use and provides a guide for clinicians on patient progress. Future software

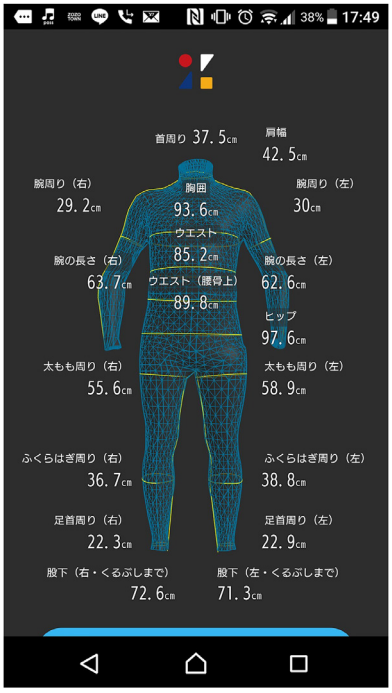

Figure 2 Smartphone application showing the calculated body measurements.

improvements may allow for the suit measurement points to be streamlined with those used in clinical practice further improving its application in lymphedema treatment.

Conflict of interest

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Gingko flap: The development of a novel flap technique to reduce dog ear formation

Dear Sir,

The occurrence of dog ears is a cosmetically problematic by-product of simple excision and suturing.[1,2] In serial excision of a round pigmentary lesion, spindle-shaped excision is commonly employed. If the spindle-shaped line is designed around the lesion, excess normal skin should be removed. However, if the design is made inside the lesion, the area of excision is limited. To solve this problem, we developed a novel simple flap technique, named the 'gingko flap' (due to the design resembling a gingko leaf) that enables the excision of a wider area of the lesion and reduces dog ear formation. We applied the gingko flap to lesions of various shapes, and assessed its effectiveness in comparison to simple sutures.

The simple suture group included 33 lesions and was composed of aged patients (mean ± standard deviation [SD], 59.7 ± 24.3 years). Most cases involved tumor treatment. The lesions were excised along the shape of the lesion, and the defect was simply sutured. The resulting initial suture possessed dog ears at its edges, which were then corrected by a standard correction method,[2,3] forming the final suture. The design lengths and width of the initial lesions, dog ear height, and initial and final suture lengths were recorded. The gingko flap group was composed of infants (mean ± SD, 6.3 ± 15.4 years) with a total of 30 lesions. The gingko flap creation methods are described in the Figure 1 legend. A representative design and the results of a gingko flap are shown in Figure 1, and the design length, width, dog ear height, and suture length as shown in the panels were recorded.

Because the dog ear size is influenced by both the shape and size of the design, we calculated the proportions of the dog ears relative to the design length, and expressed the proportions as follows: (dog ear height/design length) × 100%. The shape of a lesion was expressed by the length/width ratio (l/w ratio) of the excision design, with a value of 1 indicating that the defect is round-shaped. In

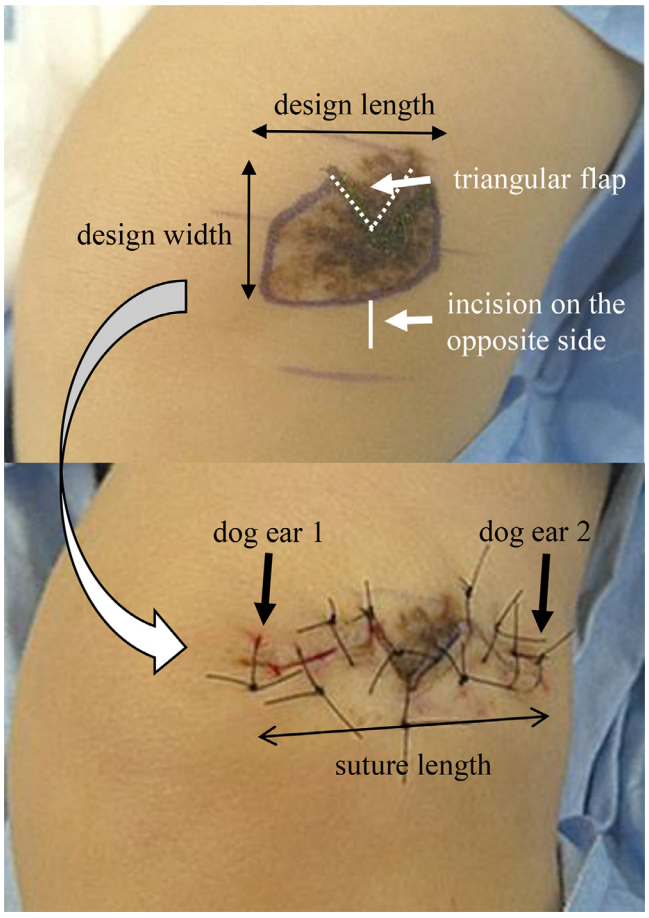

Figure 1. Excision design and results of a gingko flap. The excision line (blue line) is designed around a pigmentary lesion and a triangular flap design (while broken line), and an incision on the opposite side (white line) is added. The baseline length and height of the flap is 30–40% of the design length. After excising the lesion, a triangular flap is adapted to an incision on the opposite side. Therefore, a small triangular lesion is left on the suture line (lower photo). Possible dog ears are indicated by arrows. Because dog ear correction was not performed, the suture length of the gingko flap represents the final suture length. The remaining small pigmentary lesion and linear scar were finally resected by W-plasty.

simple sutures of designs with an l/w ratio of < 2.0, many plots of (dog ear height/design length) $\times$ 100% were distributed over 20% (Figure 2). In contrast, gingko flaps always produced dog ears with the values of $< 10\%$, and 50% of the dog ears had a value of $< 2\%$, while 38% produced no dog ears. A clear significant difference in the dog ear height/design lengths ratios was seen between the simple suture and gingko flap groups in every l/w ratio category. Thus, the superiority of the gingko flap technique in suppressing dog ear formation was statistically confirmed.

Next, the suture lengths were compared between the simple suture and gingko flap groups. The initial and final suture lengths in the simple suture group and the suture lengths in the gingko flap group demonstrated excellent relationships with the design length ($r^2 = 0.8$–0.9, Spearman's correlation). The initial suture length of the simple suture group was approximately 1.2 times as long as the design length, and the final suture length was approximately 2.2

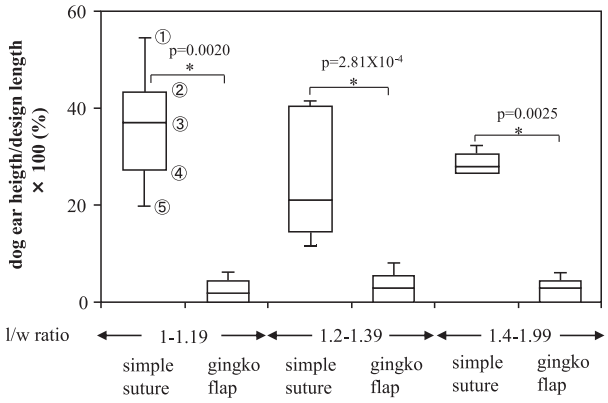

Figure 2. Comparisons of the sizes of dog ears between the simple suture and gingko flap groups. The (dog ear height/design length) $\times$ 100% values in both groups were compared. The l/w ratios were divided into the categories indicated on the horizontal axis. All of the data groups are expressed in box plots. The illustrations in the panel indicate the following: (a), 90th percentile value; (b), 75th percentile value; (c), median value; (d), 25th percentile value; (e), 10th percentile value. The (dog ear height/design length) $\times$ 100% values are indicated on the vertical line. The gingko flap and simple suture groups are indicated on the bottom. The results were analyzed using the Mann-Whitney U test. The combinations used for the comparison are indicated by horizontal bars in the panel. Asterisks indicate statistically significant differences ($p < 0.05$); the actual p values are shown.

times as long (data not shown). In the gingko flap group, the suture length was about 1.2 times of the design length, and thus the suture length was equivalent to the initial suture length in the simple suture group. The suture length in the gingko flap group was significantly shorter ($p = 3.99 \times 10^{-7}$, Mann-Whitney U test) than the final suture length in the simple suture group (data not shown). These data indicate that the gingko flap can produce a suture length much shorter than the final suture length in the simple suture group.

The suturing of a wound with excess tension yields a central depression and dog ears on both sides.[1,4] The gingko flap features an incision made on the opposite side of the triangular flap. Because the incision spontaneously opens due to the skin tension, the tension along the longitudinal axis is relieved. It is hypothesized that the relief of the longitudinal tension reduces the depression in the central area of the suture, limiting the formation of dog ears at the wound edges. We developed a novel and simple flap, named the gingko flap, and showed that it could greatly reduce the formation of dog ears, and also it restricts the wound length. Because the gingko flap is simple and easy to make, this method can be applied in various clinical settings. The most applicable setting is in the reduction of near-round pigmentary lesions during serial excisions. A wider excision of the lesion is thus possible, resulting in fewer operations. It is expected that this novel method is re-examined by many surgeons in order to confirm its usefulness.

Conflict of interest

The authors declare that they have no conflict of interest.
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Recycling full thickness skin graft from failing free flaps in salvage procedures☆

Dear Sir,

Free flap loss is a dreaded complication in microsurgery. When a second free flap is harvested, the enlarged donor site may not be amenable to primary closure, and a split thickness skin graft (STSG) is necessary. If we salvage the skin portion of the failing flap for subsequent wound closure, we not only minimize additional donor sites, we also reap the many functional and cosmetic advantages of full thickness skin grafts (FTSG) over STSG. The recyclability of salvaged skin is mainly dependent on the warm ischemia time. So here we would like to share our case series experience in which FTSG, with a range of ischemia times, are harvested from unsuccessful free flaps for coverage of various skin defects with good results.

Cases were collected from 2011 Oct to 2018 March (Table 1). Patients are selected if they suffered flap failure or impending failure, and subsequently had FTSG harvested from the failing flap. The post-operative progress was followed up in ward and clinic appointments. Scar assessments are done using the Hamilton Scar Scale, by independent observers based on clinical photographs when possible. Our FTSG were secured by tie-over dressing or negative pressure wound therapy and graft take is assessed after one week.

Ischemia times were estimated for all cases. For cases where the free flap showed vascular compromise during harvest (e.g. due to intraoperative pedicle damage or where no sizable perforators were found), the ischemia time of the FTSG was measured from when the flap showed vascular compromise to the moment of grafting onto donor site. For cases of arterial and venous insufficiency, the ischemia time was estimated from the time clinical notes indicated flap vascular compromise (e.g. loss of Doppler signal, color change) to the time salvage procedure started.

From October 2011 to March 2018, a total of 14 cases were collected (Table 1). The average age of patients in this series is 54.5, ranging 26 to 75 years old. Two thirds of patients had intraoperative findings of either pedicle damage (6/14) or no sizable perforators (3/14). The ischemia times for these cases were 2–3 h. One third of the cases (5/14) had either arterial (3) or venous insufficiency (2) with estimated ischemia times of up to 50 hours. The overall average ischemia time for the salvage FTSGs is 13.7 h. The graft take rate was excellent; 100% for all but 2 cases. There were 2 cases that still needed STSG as the FTSG were too small for complete donor site coverage. 2 cases of hyperpigmentation and 1 hypertrophic scar were noted. All patients reported satisfaction with donor site scar and returned to normal daily activities without long-term issues.

The exact warm ischemic tolerance of skin has not been studied in detail. Pang and Neligan[1] quotes only 6–8 h of warm ischemia time for skin. Two thirds of our cases had an ischemia time of 2–3 h. Good skin graft quality is expected from these cases as the duration is unlikely to be detrimental to graft survival and quality. Shores and Lee[2] gives a more lenient ischemic window of 24 h. Thus, at 24 h's warm ischemia duration, while it is understandable surgeons may feel uneasy in using pale mottled skin for salvage, the skin may still be within harvest-able limits, as is demonstrated in our 3 cases of arterial insufficiency.

In addition, we had 2 flaps that were facing failure due to venous thrombosis. Their estimated ischemia times were 48 and 50 hours. This duration far exceeds the time frame quoted in present literature. The viability of these skin grafts may be attributed to the initial partial ischemia in

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Table 1 ALT-anterolateral thigh flap, FTSG-full-thickness skin graft, STSG-split-thickness skin graft, AMT-anterior medial thigh flap.

No	Sex/age	Etiology	Ischemic time	Salvage procedure	Flap size	FTSG take (%)	Remarks	Hamilton scar scale	Outcome
1	Female/26	Left ankle open fracture	50 h	FTSG	15 × 7 cm	100	Venous insufficiency	5	
2	Male/58	Left buccal cancer	2 h	Free AMT flap, donor site FTSG + STSG	6 × 5 cm	100	Pedicle damage	4.5	
3	Male/60	Left buccal cancer	2 h	Free AMT flap, donor site FTSG	9 × 6 cm	100	Pedicle damage	3	
4	Male/59	Left buccal cancer	48 h	Free AMT flap, donor site FTSG + STSG	16 × 7 cm	90	Venous insufficiency	8.5	Hyperpigmentation
5	Female/58	Left buccal cancer	24 h	Free AMT flap, donor site FTSG	9 × 6 cm	100	Arterial insufficiency	6.5	Hypertrophic scar
6	Male/65	Right tongue cancer	2 h	Free ALT flap, donor site FTSG	12 × 7 cm	100	Pedicle damage		
7	Male/48	Right buccal cancer	2 h	Free AMT flap, donor site FTSG	12 × 8 cm	95	Pedicle damage	6	
8	Male/43	Hypopharyngeal cancer	3 h	Free vastus lateralis muscle flap and FTSG for recipient site	8 × 6 cm	100	No sizable perforator	7	Hyperpigmentation
9	Male/59	Left buccal cancer	3 h	Free AMT flap, donor site FTSG	9 × 6 cm	100	No sizable perforator	2.5	
10	Male/75	Right recurrent tongue cancer	3 h	Free AMT flap and donor site FTSG	10 × 8 cm	100	Pedicle damage		
11	Male/43	Left Buccal cancer	3 h	Free AMT flap, Donor site direct closure. FTSG	10 × 6 cm	100	No sizable perforator		
12	Female/56	Right tongue cancer	24 h	Free AMT flap, donor site FTSG	15 × 6 cm	100	Arterial insufficiency	3.5	
13	Male/46	Recurrent Oropharyngeal	2 h	Free medial sural flap, donor site FTSG	12 × 6 cm	100	Pedicle damage		
14	Male/61	Soft palate, lower lip cancer	24 h	AMT flap, donor site FTSG	15 × 7 cm	100	Arterial insufficiency		

the early phase of venous congestion. The current assumption is arterial inflow will continue for a variable time during venous congestion before complete stasis.[3,4] While the clinical signs of transition from partial into total ischemia are not well defined, we were keen to utilize the congested appearing skin in our venous insufficiency cases, and were able to achieve good results.

It is presently difficult to judge when a skin graft becomes unsalvageable. In the context of acute limb ischemia, large coalescing areas of dark mottling with presence of blisters are a sign of irreversibility.[5] No blisters were seen in our small series. Due to the small number of the patients in this case series, further studies are needed to clarify signs of irreversible ischemic insult that makes a skin graft unsalvageable. The association between graft ischemia and subsequent hyperpigmentation and hyperkeratotic scar complications are also worth investigation.

For now we have demonstrated the possibility of harvesting full thickness skin grafts from failed and failing flaps, and hope to encourage a "waste nothing" attitude amongst surgeons, maximize the use of all soft tissue resources.

Financial interest

None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this manuscript.

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Anatomic location of a sensory nerve to the transverse upper gracilis (TUG) flap: A novel option for sensate autologous tissue reconstruction

Dear Sir,

Introduction

A January 2017 article in the New York Times, "After Mastectomies, an Unexpected Blow: Numb New Breasts," made the concept of hypoesthesia after mastectomy mainstream. This, along with advances in cadaveric nerve grafts, has led to a surge in the number of publications regarding sensate autologous breast reconstruction. Autologous breast reconstruction typically utilizes an abdominal donor site and the majority of research in sensate autologous tissue has been performed in DIEP or TRAM flaps.[3,4] However, not all patients are candidates for abdominally-based autologous breast reconstruction. As public interest increases, reconstructive surgeons must become familiar with alternative donor sites for sensate autologous breast reconstruction.

The transverse myocutanoues gracilis (TUG), and its variations, the diagonal and vertical upper gracilis (DUG and VUG) flaps, utilize excess skin and fat in the posterior thigh and upper buttock region based on the gracilis branch from the medial femoral circumflex artery.[5] However, a sensate TUG flap has yet to be described for anybody region's reconstruction. To that end, we have performed cadaveric dissections to determine the anatomic location and ease of locating the sensory branch to this flap in order to permit sensate TUG flaps.

Methods

Ten bilateral cadaveric dissections were conducted to locate the sensory branch to the TUG flap. Measurements were made in each cadaver from the anterior superior iliac spine (ASIS) and the pubic tubercle. For the last cadaver, green dye was injected subcutaneously prior to incision at the mean measurements from all cadavers from the ASIS and pubic tubercle. Based on our experience, we then determined the most efficient and safest way to access to sensory branch during flap elevation.

Results

The sensory nerve was on average 14.69 cm (SD 1.1 cm, range 12.5–16.5 cm) from the ASIS was and 14.54 cm (SD 1.1 cm, range 12–16 cm) from the pubic tubercle. The average caliber of the nerve was 1.1 cm (SD 0.47 cm, range 0.5–1.5 cm) (Figures 1 and 2). For the last cadaver that was

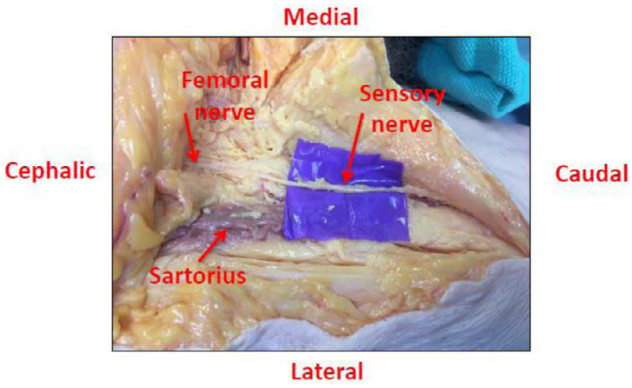

Figure 1 Location of sensory branch to TUG flap with sensory nerve branching off femoral nerve to enter flap.

injected with green dye bilaterally, the sensory nerve was easily located bilaterally in the dyed subcutaneous tissue.

Discussion

The field of sensate autologous reconstruction is rapidly expanding. Most studies performed in sensate autologous breast reconstruction have been performed utilizing abdominally-based donor sites.[3,4] However, not all patients are candidates for abdominally-based autologous breast reconstruction or have more amenable donor sites. A recently published study examined the sensation at the recipient site (breast) and donor sites for commonly used autologous options including the DIEP, lateral thigh, PAP, transverse musculocutaneous gracilis and SGAP [68]. This study highlights the potential providing sensate breast reconstruction with donor sites other than the abdomen. However, while the sensory innervation to each of these flaps is known based on anatomical textbooks, the location of the sensory nerve in the context of flap dissection in three dimensions has yet to be reported. Microsurgical reconstruction without providing neurotization already requires difficult, tedious dissection and long operating hours. Thus, unless a surgeon is intimately familiar with the location of a potential recipient sensory nerve, the nerve is likely to be transected or sensate reconstruction will not be attempted. To that end, we have begun to explore the anatomical location of the sensory nerve for commonly utilized non-abdominal autologous breast reconstruction.

The transverse myocutanoues gracilis (TUG), and its variations, the diagonal and vertical upper gracilis (DUG and VUG) flaps, utilize excess skin and fat in the posterior thigh and upper buttock region based on the gracilis branch from the medial femoral circumflex artery.[5] However, a sensate TUG flap has yet to be described for any region's reconstruction. Our early cadaveric dissections required localization of the femoral nerve within the femoral triangle and identifying a sensory branch that supplied the medial thigh. However, operating within the femoral sheath is risky due to the presence of the artery and vein and could potentially lead to lymphatic disruption. Thus, we sought to identify a means by which a surgeon could reliably predict the location of the sensory nerve to be harvested to allow for efficient dissection. We found that when we injected the cadaver with green dye based on the mean measurements from the ASIS and pubic tubercle from the prior cadavers, we were able to rapidly dissect from lateral to medial until dye was visualized. At this point, we switched to blunt dissection to avoid transecting the nerve. Once the nerve was identified, it could be tracked proximally to the femoral nerve takeoff, if desired, for a long graft, or a cadaveric nerve graft could be utilized for coaptation.

The typical TUG dissection would proceed up to the level of the femoral neurovascular bundle. This sensory nerve that we describe is a branch of this bundle that descends in a medial trajectory, towards the typical dissection of the medial thigh flap.[1-3] Inclusion of this nerve in medial thigh flap dissections can also be postulated based on studies demonstrating medial thigh sensory disturbances in up

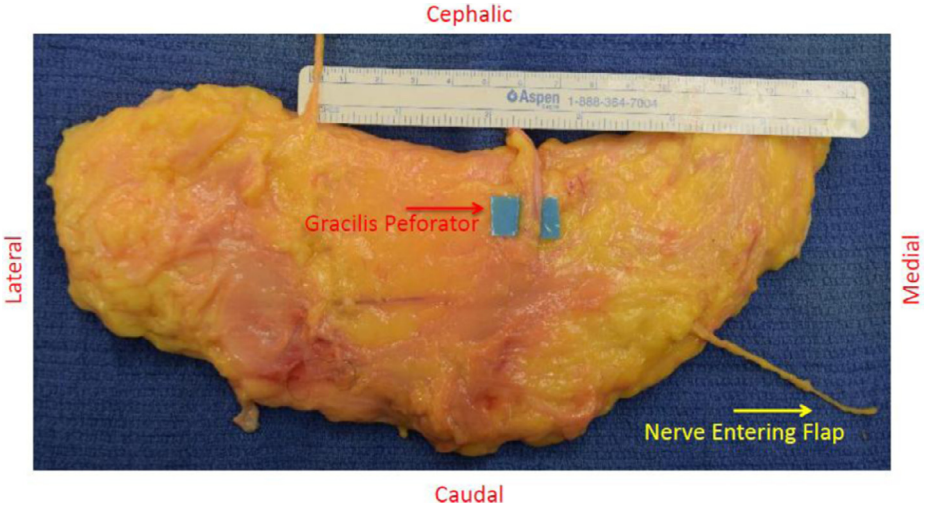

Figure 2 TUG cadaver flap completely dissected demonstrating relationship between gracilis perforator and nerve entering the flap medially.

to 25% of patients who this reconstruction.[1] Therefore, with slight modifications in the flap design and with understanding of the location and course of the nerve as described, a surgeon could easily allow for inclusion of the nerve.

In conclusion, this is the first study to report on the consistent location of a sensory nerve to the medial thigh flap. We hope this report will enable surgeons to expand their options of donor tissue for patients who desire sensate breast reconstruction.

Conflict of Interest

None of the authors have any funding or conflicts of interests to report.

Disclosures

The authors have no disclosures.

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A quantitative analysis of factors influencing lower lid retraction and involutional ectropion☆

Dear Sir,

Laxity of the eyelid can be evaluated by a subjective assessment during manipulation and distraction, using procedures such as the “pinch test” and “snap back test”.[1] To our knowledge, no study has objectively measured the force exerted to induce eyelid malposition during such testing. We conducted a quantitative analysis to record the minimum force that can induce lower eyelid ectropion and displacement in four different demographic groups (age, gender, race, and orbital vectors).

An adhesive patch in conjunction with a force gauge was used to measure the force exerted to induce lower eyelid ectropion or retraction (Figure 1A). Measurements were taken with the adhesive patch placed in the center of the left lower eyelid, directly below the lash line and 2 cm below the lash line (Figure 1B). There are four outcomes [(1) ectropion 2 cm below lash line, (2) ectropion just below lash line, (3) displacement 2 cm below lash line, (4) displacement just below lash line] analyzed among the four different demographic groups. A p value < 0.05 was considered statistically significant.

There was a significantly strong negative correlation between age and the 4 force measurements for malposition. There was no significant difference in the mean of each measurement when assessed by gender. The mean force to induce ectropion and displacement below lash line was minimum in Caucasians. The force needed to cause ectropion and eyelid displacement was minimum in neutral orbital vector group.

Involutional ectropion and lower eyelid retraction are the results of laxity in the eyelid support system. Mitchell et al. showed that ectropion was strongly age-related and there was a marked age-related increase in prevalence noted in their study,[2] which was consistent with our results.

From previous literatures, involutional ectropion was more common in males.[2] However, our study showed there is no significant difference in the susceptibility to ectropion and lower eyelid retraction between females and males. In previous studies, the study population generally included elderly people with ectropion; in comparison, the population in our study ranged from 20 to 80+ years and was comprised of individuals without eyelid malposition. The disparity between our results and previous studies may be explained by these differences in population and age group.

Damasceno et al. reported that involutional ectropion was more prevalent in whites, followed by browns and blacks.[3] In our study, the Caucasian group appeared more

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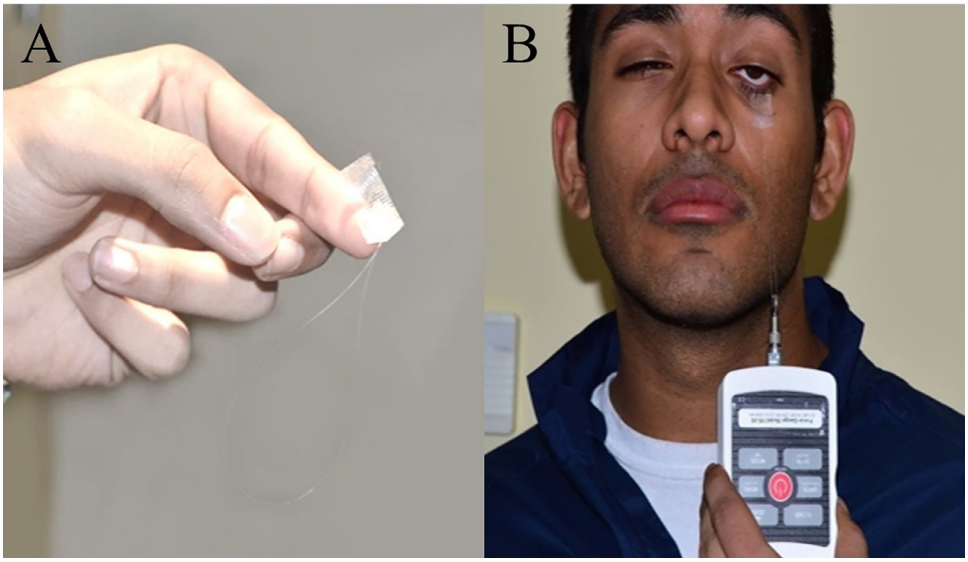

Figure 1 Device design and measurement. A) - The adhesive patches with nylon loops. B) - The loop is attached to a hook-ended force gauge, which was slowly pulled in a downward direction until ectropion or 2 mm eyelid displacement was achieved.

susceptible to involutional ectropion and lower eyelid retraction, which is consistent with previous reports.[3] The Hispanic group was the least susceptible to involutional ectropion and South Asians the least susceptible to lower eyelid retraction. The highest percentage (66.7%) of positive orbital vector was noted among Hispanics, which may explain why Hispanic people are the most resistant to ectropion. However, the lowest percentage (38.8%) of positive orbital vector was recorded among South Asians, but they are the most resistant to lower eyelid retraction. We can speculate that South Asians may have stronger periorbital fibrous and elastic tissues.

A study by Rajabi et al. in 2017 showed that negative orbital vectors were associated with involutional ectropion and proposed that the orbital vector is a reliable factor to predict the type of potential involutional eyelid malposition.[4] Jelks and Jelks observed that a negative orbital vector was a cause of lower eyelid retraction.[5] However, our results show that the neutral orbital vector group was more susceptible to ectropion and lower eyelid retraction, followed by the negative and positive orbital vector groups, in that order. The study population comprised subjects without eyelid malposition. Patients with negative orbital vector but without eyelid malposition may have stronger periorbital fibrous and elastic tissues to maintain their eyelid in a normal position. This may be the reason why the force need to cause ectropion and eyelid displacement was greater in the negative orbital vector group than in neutral group.

Both involutional ectropion and lower eyelid retraction have a strong positive correlation with age. Our results show that the old Caucasian people with neutral orbital vector group were the most susceptible to ectropion and lower eyelid retraction, young Hispanic people with positive orbital vector were the least susceptible to involutional ectropion and young South Asians with positive orbital vector the least susceptible to lower eyelid retraction.

For high risk patient group who need cosmetic lower blepharoplasty surgery, we use transconjunctival approach with minimal (<5 mm) or no lower lid skin excision to avoid orbicularis oculi muscle injury. Lower lid skin laxity can be improved by further carbon dioxide (CO_2) or erbium laser resurfacing. We also suggest prophylactic lateral canthoplasty for patients with severe lower lid laxity.

Conflict of interest

None.

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When should we use the terms “aponeurotic blepharoptosis” and “reinsertion of the levator aponeurosis”?

Dear Sir,

It is generally considered that involutional (or senile) blepharoptosis is caused by disinsertion of the levator aponeurosis.[1] This type of acquired blepharoptosis is therefore also referred to as “aponeurotic blepharoptosis”, by reference to its presumed etiology. However, the levator aponeurosis is rarely found to be disinserted peroperatively[2] (at most a dehiscence is found) and it has been suggested that in some cases this disinsertion could be iatrogenic and caused by the surgical procedure itself.[3] Also, in an experimental study on monkeys, there was no blepharoptosis two weeks after the disinsertion of the levator aponeurosis (nor if mullerectomy was performed). On the contrary, this same study found that permanent blepharoptosis resulted if both levator aponeurosis and Muller’s muscle were excised, which suggests that both structures contribute to eyelid elevation in monkeys.[4] It is therefore possible that, similarly to monkeys, a sole disinsertion of the aponeurosis may not be sufficient to cause permanent blepharoptosis in humans.

In humans, an anatomical study of the levator aponeurosis showed that its force is mostly exerted on the anterior lamella, causing an eversion of the upper eyelid margin rather than pulling the eyelid superiorly.[5] Thus, the traction on the posterior lamella may be attributed to Muller’s muscle which inserts on the superior surface of the tarsus and could be the main transmitter of levator muscle action.[5] The “primum movens” of involutional ptosis would therefore be a degeneration of Muller’s muscle rather than a disinsertion of the levator aponeurosis. Indeed, it has been shown that with aging Muller’s muscle can become thinner, more elongated and infiltrated with fat,[4] probably reducing the levator muscle’s ability to keep the eyelid appropriately raised in primary position. In case of a degenerated and elongated Muller’s muscle, the levator muscle’s action would switch to its aponeurosis which also inserts on the tarsus. When the aponeurosis is in traction, in addition to eyelid elevation also appears a rise of the skin crease (since the crease is formed by the attachment of aponeurosis fibers to the overlying orbicularis muscle[4]). This accounts for the elevated skin crease which is a common sign of involutional ptosis. Although uncommonly found during surgery, levator aponeurosis dehiscence (or even disinsertion) could occur as a consequence of prolonged excessive traction of the levator muscle over its aponeurosis in the presence of a degenerated Muller’s muscle.

We therefore consider that the term “aponeurotic blepharoptosis” should only be reserved for the cases where levator aponeurosis disinsertion is found during surgery or if preoperative imaging showed the disinsertion. “Involutional (or senile) ptosis” is a more appropriate and general terminology. Regarding levator aponeurosis surgery, the expression “reinsertion of the aponeurosis” should be reserved for cases where a true disinsertion is found peroperatively. Hence, more general expressions like “advancement of the levator aponeurosis” should be used in most cases to describe this type of surgical repair for blepharoptosis.

Conflict of interest

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Table 1 Select survey answers

	Percentage of total (%)
Experience ($n = 401$)	
<5 years	1.8
6–10 years	14.0
11–15 years	18.2
16–20 years	19.2
>20 years	46.9
Practice area ($n = 402$)	
Private	61.4
Academic	26.1
No. surgeons in practice ($n = 401$)	
Solo	23.4
Partner (2)	22.4
Group (3+)	32.9
Partnership type ($n = 388$)	
Formal	40.7
Informal	9.3
Attorney help ($n = 388$)	
Yes	35.8
No	64.2
Medical malpractice ($n = 401$)	
Claims-made coverage	42.9
Occurrence coverage	23.2
Tail coverage	17.2

The plastic surgeon as employee: Survey of the American Society of Plastic Surgeons☆

Dear Sir,

The path toward becoming a plastic surgeon is long, and after years of medical school, residency, and fellowship, many are poorly equipped to negotiate their first employment contracts due to a lack of formal business background.[1] Although management services exist at the national level, as is the case with the American Society of Plastic Surgeons (ASPS), there could be a greater attempt to integrate such applications during training.[2] It is not until recently that there has been an emphasis to track job satisfaction of practicing plastic surgeons that have entered into initial contracts.[3]

By requesting information from board-certified plastic surgeons, we scrutinized components that are commonly related to surgical specialty employment contracts. A 16-question survey was sent to ASPS members using the online platform SurveyMonkey®. To examine a potential correlation between base salary and satisfaction with one's contract, salaries were adjusted for inflation according to the Consumer Price Index. All statistical analyses were performed with JASP version 0.8.6 (Amsterdam, Netherlands).

Table 1 summarizes the findings. Sorting respondents by geographic region, distribution ranged from 37.6% in the South to 11.1% in the West, with the Midwest at 26.8% and Northeast at 24.5%. The greatest percentage of respondents, 46.9%, had been in practice for more than 20 years, while the least percentage, 1.8%, had been in practice for up to 5 years. 61.4% started in private practice, whereas 26.1% began in academia.

Practice size was mixed, with 32.9% having worked in a group of three or more, 23.4% in solo practice, and 22.4% in some form of partnership. Of those in partnerships, 40.7% made formal legal agreements (e.g. Limited Liability Company) and 9.3% were in an informal arrangement. Strikingly, attorney review was sought among 35.8% of respondents.

Regarding malpractice insurance, 42.9% had claims-made coverage, 23.2% had occurrence coverage, and 17.2% had tail coverage. Of particular interest, 65.9% of these individuals had coverage secured by their employers. Regarding other options, the most common inclusions were expense reimbursements at 46.1%, bonus structure at 39.3%, and moving/relocation costs at 29.0%.

Data on expected salary were as follows: 7% reported annual income of $100,000–149,999; 24% reported $150,000–199,999; 23% reported $200,000–249,999; 20% reported $250,000–299,999; 9% reported $300,000–349,999; 6% re-

☆ Presented at the Practice Management and Research Abstracts Sessions of the 2016 Annual Meeting of the American Society of Plastic Surgeons, Los Angeles, CA, on September 24, 2016.

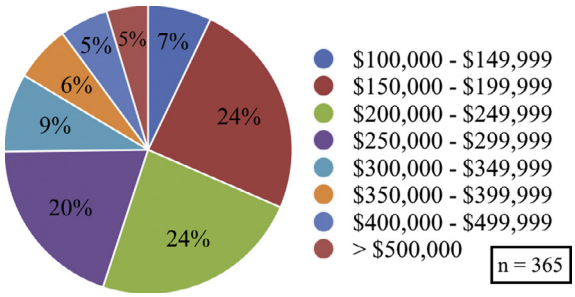

Figure 1 Inflation-adjusted salaries reported by ASPS members as agreed upon in their first employment contracts.

ported $350,000–399,999; 5% reported $400,000–499,999; and 5% reported more than $500,000 (Figure 1). Utilizing a 5-point Likert scale to gauge satisfaction, 10% were "extremely dissatisfied," or a score of 1; 13% gave a score of 2; 28% gave a score of 3; 25% gave a score of 4; and 24% gave a score of 5, indicating that they were "perfectly happy." The Spearman rank correlation coefficient for these two variables was calculated to be 0.217 ($p < 0.001$), indicating a statistically significant positive, monotonic relationship between salary and satisfaction, and that greater compensation might be tied to greater satisfaction.

Qualitative feedback was also provided to help ameliorate the paucity of current knowledge. The most popular response (21.2%) recommended seeking legal counsel. Other frequent suggestions included moving to where you want to live, going into solo practice, having a definitive long-term plan, and advance planning for a second contract.

Given the disproportionately high number of residency spots for plastic surgery in California, and accordingly high number of practicing plastic surgeons in the state,[4] one might expect that the West region of the United States would account for the highest percentage. However, we found the opposite. This can be explained by our previously conducted pilot survey of the constituency of the California Society of Plastic Surgeons,[4] for which there are overlapping memberships. Almost half of the respondents had the highest tiered level of experience, which could point to a desire of older surgeons to mentor those in training, in addition to seeing the results presented at their own state or regional meetings. The selection biases found with both location and experience can be considered inherent weaknesses of the study.

More respondents stated that they worked in private practice as opposed to academia, raising implications whether plastic surgery training or the employment market incentivizes physicians toward the private sector, or whether academia drives newly trained surgeons away from itself. Although such an evaluation remains difficult and beyond our scope, research suggests that academic medicine places a burden on delivery of patient care because of time demands, academic requirements, and bureaucratic challenges.[5]

The approximate two-thirds of respondents who did not solicit an attorney is concerning. Financial repercussions and employment risk associated with breach of contract, intended or not, can be consequential. Nevertheless, we are encouraged in noting an increasing affirmation over time for those acquiring malpractice insurance and disability coverage. Future directions will address fellowship predilection for academia as well as non-compete clauses.

Disclosures

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