

Submission ID #: 69392

Scriptwriter Name: Poornima G

Project Page Link: <https://review.jove.com/account/file-uploader?src=21164608>

Title: An Experimental Human DIEP Flap Model to Investigate Preservation Strategies for Vascularized Composite Allografts

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Author Questionnaire

- 1. Microscopy:** Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **NO**

- 2. Software:** Does the part of your protocol being filmed include step-by-step descriptions of software usage? **NO**

- 3. Filming location:** Will the filming need to take place in multiple locations? **no**

- 4. Testimonials (optional):** Would you be open to filming two short testimonial statements **live during your JoVE shoot**? These will **not appear in your JoVE video** but may be used in JoVE's promotional materials. **YES**

Current Protocol Length

Number of Steps: 21

Number of Shots: 37

Introduction

Videographer: Obtain headshots for all authors available at the filming location.

NOTE: The authors have added/recorded answers in French as well for the **INTRODUCTION** section, please ignore them in the introduction section only. French testimonials can be processed as usual.

INTRODUCTION:

- 1.1. **Elise Lupon:** Our study aims to improve preservation and survival of vascularized composite allografts and free flaps using human experimental flap models.
 - 1.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

~~Quel est le champ de votre recherche ? Quelles questions cherchez-vous à résoudre ?~~

~~**1.1. Elise Lupon :** Notre étude vise à améliorer la préservation et la survie des allogreffes composites vascularisées et des lambeaux libres en utilisant des modèles expérimentaux de lambeaux humains.~~

- 1.2. **Amina Oyuntogos:** Current research mainly relies on animal VCA and free-flap models, often using rodent or large-animal hindlimb osteomyocutaneous flaps.
 - 1.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

~~Quelles technologies sont actuellement utilisées pour faire avancer la recherche dans votre domaine ?~~

~~**1.2. Amina Oyuntogos :** Les recherches actuelles reposent principalement sur des modèles animaux. Elle utilise souvent des modèles de lambeaux osteomyocutanés de membre postérieur de rongeurs ou de gros animal.~~

CONCLUSION:

- 1.3. **Elise Lupon:** We lack human anatomical data for realistic VCA and free-flap studies, current models rely on animals and poorly reflect clinical surgery.

1.3.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

~~Quelle lacune scientifique votre protocole cherche-t-il à combler ?~~

~~**1.3. Elise Lupon :** Nous manquons de données anatomiques humaines pour des études réalistes en transplantation composite et en lambeaux libres ; les modèles actuels reposent sur l'animal et reflètent mal la chirurgie clinique.~~

- 1.4. **Amina Oyuntogos:** Our human perfusion model reduces animal sacrifice and offers anatomical and surgical realism that animal models cannot replicate for free flaps studies.

1.4.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

~~Quel avantage votre protocole présente-t-il par rapport aux autres techniques ?~~

~~**1.4. Amina Oyuntogos :** Notre modèle de perfusion humaine réduit l'utilisation et le sacrifice d'animaux et offre un réalisme anatomique et chirurgical que les modèles animaux ne peuvent pas reproduire pour l'étude des lambeaux libres.~~

- 1.5. **Amina Oyuntogos:** Our model enables per-operative testing of cytoprotective agents in human skin flaps to evaluate their protective effect against ischemic injury.

1.5.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

~~Quelles nouvelles questions scientifiques vos résultats permettent-ils désormais d'explorer ?~~

~~**1.5. Amina Oyuntogos :** Notre modèle permet le test per-opératoire d'agents cytoprotecteurs dans des lambeaux cutanés humains afin d'évaluer leur effet protecteur contre les lésions ischémiques.~~

Videographer: Obtain headshots for all authors available at the filming location.

Testimonial Questions (OPTIONAL):

Videographer: Please capture all testimonial shots in a wide-angle format with sufficient headspace, as the final videos will be rendered in a 1:1 aspect ratio. Testimonial statements will be presented live by the authors, sharing their spontaneous perspectives.

- Testimonial statements will **not appear in the video** but may be featured in the journal's promotional materials.
- **Provide the full name and position** (e.g., Director of [Institute Name], Senior Researcher [University Name], etc.) of the author delivering the testimonial.
- Please **answer the testimonial question live during the shoot**, speaking naturally and in your own words in **complete sentences**.

How do you think publishing with JoVE will enhance the visibility and impact of your research?

- 1.6. **Elise Lupon, Associate Professor, Plastic Surgery**: (authors will present their testimonial statements live)
 - 1.6.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 2.3.1*

Can you share a specific success story or benefit you've experienced—or expect to experience—after using or publishing with JoVE? (This could include increased collaborations, citations, funding opportunities, streamlined lab procedures, reduced training time, cost savings in the lab, or improved lab productivity.)

- 1.7. **Elise Lupon, Associate Professor, Plastic Surgery**: (authors will present their testimonial statements live)
 - 1.7.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 4.2.1*

Authors: Could you please also deliver the above statements in French?

Videographer: Please film the testimonials in both English and French

Ethics Title Card

This research has been approved by the Institutional Ethics Committee at the University
Côte d’Azur

Protocol

2. Preparation Steps of the Abdominoplasty

Demonstrators: Elise Lupon, Luc Chouquet

- 2.1. To begin, perform the preoperative dermolipectomy marking with the patient and identify the midline from the pubic symphysis to the xiphoid process [1]. Draw a transverse line approximately 7 cm above the vulvar commissure [2]. Extend this line laterally about 7 cm on each side, gently curving it upward to join just below the anterior superior iliac spines [3].

2.1.1. LAB MEDIA: IMG_0417.MOV 00:05–00:10

2.1.2. LAB MEDIA: IMG_0417.MOV 00:14–00:20

2.1.3. LAB MEDIA: IMG_0417.MOV 00:39–00:45

- 2.2. Identify the perforators around the umbilicus using a handheld acoustic Doppler probe with 8 to 10 Megahertz while the patient is in the supine position [1].

2.2.1. LAB MEDIA: IMG_0421.MOV 00:40–00:55

- 2.3. Using a dermatographic pen, outline a skin paddle in an elliptical shape of the desired dimensions, including the perforator along its medial border [1] and extending on both sides of the umbilicus [2].

2.3.1. LAB MEDIA: IMG_0422.MOV 00:10–00:20

2.3.2. LAB MEDIA: IMG_0422.MOV 00:35–00:40

- 2.4. Prepare and drape the surgical field from the xiphoid process to the upper third of the thighs [1], including the pubic region [2], using sterile surgical drapes as routinely performed in standard abdominal surgery [3].

2.4.1. LAB MEDIA: IMG_0428.MOV 00:00–00:10

2.4.2. LAB MEDIA: IMG_0428.MOV 01:50–02:00

- 2.5. Make a low transverse skin incision along the preoperative marking, approximately 7 cm above the vulvar commissure [1], gently curving toward the anterior superior iliac spines on each side, using a No. 15 or No. 21 scalpel blade [2].

2.5.1. LAB MEDIA: IMG_0434.MOV 00:04–00:20

2.5.2. LAB MEDIA: IMG_0434.MOV 00:21–00:45

2.6. Detach the umbilicus from the abdominal wall through a circumferential incision down to the hypodermis using a No. 15 scalpel blade [1].

2.6.1. LAB MEDIA: IMG_0435.MOV 00:14–00:30

2.7. Dissect the umbilicus vertically using Mayo scissors, from the superficial to the deep plane, until it is completely freed while preserving its umbilical pedicle [1].

2.7.1. LAB MEDIA: IMG_0435.MOV 01:50–01:55 and 02:39–02:45

2.8. Place a long, loose, non-absorbable suture on either side of the umbilical margin [1].

2.8.1. LAB MEDIA: IMG_0435.MOV 02:52–02:55 and 03:18–03:22

2.9. Raise the superior abdominoplasty flap in the subcutaneous plane, starting from the lower incision and progressing cranially toward the umbilicus [1]. Use a fine-tip monopolar electrocautery set to approximately 50 to 70 degrees Celsius and 80 watts in coagulation mode to separate the anterior rectus fascia from the overlying subcutaneous tissue and skin [2], while maintaining meticulous hemostasis throughout the dissection [3].

2.9.1. LAB MEDIA: IMG_0437.MOV 00:04–00:15

2.9.2. LAB MEDIA: IMG_0437.MOV 00:25–00:35

2.9.3. LAB MEDIA: IMG_0437.MOV 00:35–00:40

2.10. As the dissection approaches the previously isolated umbilical pedicle, continue with fine dissection using Metzenbaum scissors to avoid pedicle injury [1].

2.10.1. LAB MEDIA: IMG_0441.MOV 00:10–00:25

2.11. Identify and carefully isolate the two dominant paraumbilical perforators arising from the deep inferior epigastric system [1]. Dissect each perforator circumferentially under direct vision using Stevens or small Metzenbaum scissors, preserving their vascular pedicles [2-TXT].

2.11.1. LAB MEDIA: IMG_0449.MOV 01:01–01:12

2.11.2. LAB MEDIA: IMG_0451.MOV 00:00–00:12 **TXT: Do not extend above anterior rectus aponeurosis level**

2.12. Divide the adipocutaneous panniculus longitudinally along the midline, from the center of the lower pubic incision up to the umbilicus [1], using a No. 15 blade followed by monopolar electrocautery set at approximately 50 to 70 degrees Celsius [2].

2.12.1. LAB MEDIA: IMG_0452.MOV 00:00–00:15

2.12.2. LAB MEDIA: IMG_0453.MOV 00:04–00:10

2.13. Continue the dissection cranially up to the xiphoid region and along the lateral costal margins, keeping the flap pedicles intact and undivided [1].

2.13.1. LAB MEDIA: IMG_0454.MOV 00:30–00:50

2.14. Ligate the deep inferior epigastric artery perforator pedicle using resorbable 3-0 sutures or automatic clips [1] and transect the perforator above the fascia, with no subfascial dissection [2].

2.14.1. LAB MEDIA: IMG_0459.MOV 00:05–00:15

2.14.2. LAB MEDIA: IMG_0460.MOV 00:03–00:15

3. Flap Procurement and Preparation

Demonstrators: Elise Lupon, Amina Oyuntogos, Alexis Majchrzak

3.1. Advance the supraumbilical skin and subcutaneous fat downward [1] and secure the undermined abdominal flap to the inferior incision margin at the midline using a non-absorbable suture, leaving one end of the knot long [2].

3.1.1. LAB MEDIA: IMG_0464.MOV 00:03–00:10

3.1.2. LAB MEDIA: IMG_0464.MOV 00:20–00:40

3.2. Use the long end of the midline non-absorbable suture connecting the supraumbilical and pubic areas as a guide to draw the resection line on the excess adipocutaneous panniculus [1]. The DIEP flaps are located below this marked resection line [2].

3.2.1. LAB MEDIA: IMG_0464.MOV 01:38–01:53

3.2.2. LAB MEDIA: IMG_0465.MOV 00:00–00:08

3.3. Completely detach the perforator flap from the surrounding discarded tissue [1].

3.3.1. LAB MEDIA: IMG_0467.MOV 00:50–01:05

3.4. Excise the redundant dermo-adipose tissue corresponding to the excess skin and fat removed during the abdominoplasty [1].

3.4.1. LAB MEDIA: IMG_0474.MOV 00:07–00:20

3.5. Then, dissect the vascular pedicle under magnification using microsurgical instruments, and identify both the artery and the vein [1]. Gently open the arterial lumen with a microvascular dilator [2].

3.5.1. LAB MEDIA: IMG_0479.MOV 00:00–00:15

3.5.2. LAB MEDIA: IMG_0479.MOV 00:20–00:38

3.6. Catheterize the artery using an 18 to 24 Gauge cannula [1] and secure it in the lumen with 5-0 (5-oh) silk suture ligation [2].

3.6.1. LAB MEDIA: IMG_0485.MOV 00:07–00:15

3.6.2. LAB MEDIA: IMG_0485.MOV 00:50–01:03

3.7. Finally, inject contrast agent intra-arterially through the catheter into the perforator artery [1], and evaluate the flap under fluoroscopy [2].

3.7.1. LAB MEDIA: IMG_3309.MOV 00:00–00:17

3.7.2. LAB MEDIA: IMG_3312.MOV 00:15–00:30

Results

4. Results

4.1. The harvested flaps had an average weight of around 198.6 grams [1], a mean size of 10 centimeters by 6 centimeters [2], a pedicle length of around 3.85 centimeters [3], and an external vessel diameter of 1.2 millimeters [4].

4.1.1. LAB MEDIA: Table 1. *Video editor: Highlight the cell showing average flap weight “198.6 ± 24.4 g”*

4.1.2. LAB MEDIA: Table 1. *Video editor: Highlight the average flap dimensions in notes column showing “10 cm × 6 cm”*

4.1.3. LAB MEDIA: Table 1. *Video editor: Highlight the row with “pedicle length” reported as “3.85 ± 0.74 cm”*

4.1.4. LAB MEDIA: Table 1. *Video editor: Highlight the row with “external vessel diameter” listed as “1.2 ± 0.3 mm”*

4.2. Arteriography confirmed that all flaps had homogeneous and complete vascular filling, demonstrating good perfusion [1].

4.2.1. LAB MEDIA: Figure 8.

4.3. There was no significant difference in operative time between six patients undergoing standard abdominoplasty with flap harvest and six retrospective cases without flap harvest [1].

4.3.1. LAB MEDIA: Table 1. *Video editor: Highlight the ‘operative time’ row*

4.4. No postoperative abdominal wall deficits or infections were observed in any of the six patients during follow-up [1].

4.4.1. LAB MEDIA: Figure 9. : *Highlight the ‘post-operative follow up’ row’s ‘notes’ column*

4.5. After catheterization, the flaps were preserved at 4 degrees Celsius in vacuum-sealed bags and divided into treated and control groups based on perfusion with a cytoprotective agent or University of Wisconsin solution [1].

4.5.1. LAB MEDIA: Table 1. *Video editor: Highlight the group assignment of flaps into “control” and “treatment” with their respective preservation methods*

4.6. Histological sections from punch biopsies at different time points showed progressive ischemic changes from 0 to 48 hours after storage [1].

4.6.1. LAB MEDIA: Figure 9. *Video editor: Sequentially show the six biopsy panels labeled T0h to T48h*

- **Dermolipectomy**

Pronunciation link: <https://www.howtopronounce.com/dermolipectomy> [howtopronounce.com](https://www.howtopronounce.com)

IPA: /ˌdɜːrmoʊˈlɪpektəmi/

Phonetic Spelling: der-mo-lie-pec-toh-mee

- **Pubic**

Pronunciation link: <https://www.merriam-webster.com/dictionary/pubic> [merriam-webster.com](https://www.merriam-webster.com)+1

IPA: /ˈpjuːbɪk/

Phonetic Spelling: pyoo-bik

- **Symphysis** (as in “pubic symphysis”)

Pronunciation link: <https://www.merriam-webster.com/dictionary/symphysis> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /ˈsɪm fə sis/

Phonetic Spelling: sim-fə-sis

- **Xiphoid** (as in “xiphoid process”)

Pronunciation link: <https://www.merriam-webster.com/dictionary/xiphoid> [merriam-webster.com](https://www.merriam-webster.com)+1

IPA: /ˈzaɪfɔɪd/

Phonetic Spelling: zy-foyd

- **Vulvar** (from “vulvar commissure”)

Pronunciation link: <https://www.merriam-webster.com/dictionary/vulvar> [Scope Heal](https://www.merriam-webster.com)

IPA: /ˈvʌlvər/

Phonetic Spelling: vul-ver

- **Commissure**

Pronunciation link: <https://www.merriam-webster.com/dictionary/commissure> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /kəˈmɪʃ ə/

Phonetic Spelling: kuh-MISH-er

- **Iliac** (as in “anterior superior iliac spines”)

Pronunciation link: <https://www.merriam-webster.com/dictionary/iliac> [merriam-webster.com](https://www.merriam-webster.com)+1

IPA: /'ɪliæk/

Phonetic Spelling: IL-ee-ak

- **Perforator** (as in “perforators around the umbilicus”)

Pronunciation link: <https://www.merriam-webster.com/dictionary/perforator> [merriam-webster.com](https://www.merriam-webster.com)

(Note: “perforator” may not be in all dictionaries—this link shows entry for “perforate /-or”.)

IPA: /'pɜːfərəˌteɪtər/ or /'pɜːrfəˌreɪtər/

Phonetic Spelling: PER-fə-ray-tor

- **Doppler** (as in “Doppler probe”)

Pronunciation link: <https://www.merriam-webster.com/dictionary/Doppler> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /'dɒplər/ or /'dɑːplər/ (US)

Phonetic Spelling: DOP-ler

- **Subcutaneous**

Pronunciation link: <https://www.merriam-webster.com/dictionary/subcutaneous> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /ˌsʌbkjuːˈteɪniəs/

Phonetic Spelling: sub-kyoo-TAY-nee-us

- **Hypodermis**

Pronunciation link: <https://www.merriam-webster.com/dictionary/hypodermis> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /ˌhaɪpəˈdɜːrmɪs/

Phonetic Spelling: hy-puh-DER-mis

- **Electrocautery**

Pronunciation link: <https://www.merriam-webster.com/dictionary/electrocautery> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /ɪˌlektroʊˈkɔːtəri/

Phonetic Spelling: ee-lek-troh-COT-uh-ree

- **Metzenbaum** (as in “Metzenbaum scissors”)

Pronunciation link: No confirmed link found (proper name + specialized term)

IPA (approx): /'metsənˌbaʊm/

Phonetic Spelling: MET-sen-baum

- **Panniculus** (as in “adipocutaneous panniculus”)

Pronunciation link: <https://www.merriam-webster.com/dictionary/panniculus> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /pəˈnɪkjələs/

Phonetic Spelling: puh-NIK-u-lus

- **Pedicle** (as in “umbilical pedicle” / “vascular pedicle”)

Pronunciation link: <https://www.merriam-webster.com/dictionary/pedicle> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /'pɛdɪkəl/

Phonetic Spelling: PED-i-kul

- **Paraumbilical**

Pronunciation link: No confirmed link found (rare compound anatomical term)

IPA (approx): /,pærəʌm'bɪlɪkəl/

Phonetic Spelling: par-uh-um-BIL-i-kul

- **Epigastric**

Pronunciation link: <https://www.merriam-webster.com/dictionary/epigastric> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /,ɛprɪ'gæstrɪk/

Phonetic Spelling: ep-i-GAS-trik

- **Aponeurosis**

Pronunciation link: <https://www.merriam-webster.com/dictionary/aponeurosis> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /,æpə,nʊ'roʊsɪs/

Phonetic Spelling: ap-uh-noo-ROH-sis

- **Subfascial**

Pronunciation link: No confirmed link found (less common term)

IPA (approx): /,sʌb'fæʃɪəl/

Phonetic Spelling: sub-FASH-ee-uhl

- **Microsurgical**

Pronunciation link: <https://www.merriam-webster.com/dictionary/microsurgical> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /,maɪkroʊ'sɜːdʒɪkəl/

Phonetic Spelling: my-kroh-SUR-ji-kul

- **Cannula**

Pronunciation link: <https://www.merriam-webster.com/dictionary/cannula> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /'kæn.jə.lə/

Phonetic Spelling: KAN-yuh-luh

- **Cytoprotective**

Pronunciation link: No confirmed link found (less common compound)

IPA (approx): /,saɪtoʊprə'tɛktɪv/

Phonetic Spelling: sy-toh-pro-TEK-tiv

- **Histological**

Pronunciation link: <https://www.merriam-webster.com/dictionary/histological> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /ˈhɪstəˈlɒdʒɪkəl/

Phonetic Spelling: his-toh-LOJ-i-kul

- **Ischemic**

Pronunciation link: <https://www.merriam-webster.com/dictionary/ischemic> [merriam-webster.com](https://www.merriam-webster.com)

IPA: /ɪsˈki:mɪk/

Phonetic Spelling: is-KEE-mik