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Title: Surgical Approach to Full Soft Tissue Face Allograft Procurement for Vascularized Composite Allotransplantation

Authors and Affiliations:
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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.

No

Current Protocol Length
Number of Steps: 25
Number of Shots: 57

Introduction

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

Authors: The questions will not appear in the final video

INTRODUCTION:

~~What is the scope of your research? What questions are you trying to answer?~~

1.1. **Elise Lupon:** Our research focuses on standardizing full facial allograft procurement and identifying key anatomical landmarks to optimize safety, reproducibility, and training.

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

~~What are the current experimental challenges~~?

1.2. **Tanguy Perraudin:** Current challenges include minimizing ischemia time while achieving reproducible, safe dissections that preserve vascular and neural pedicle length.

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

CONCLUSION:

~~What research gap are you addressing with your protocol~~?

1.3. **Elise Lupon:** This protocol fills a gap by providing a visual, step-by-step reference, often more effective than extensive text for complex surgical procedures.

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

~~What advantage does your protocol offer compared to other techniques?~~

1.4. **Tanguy Perraudin:** Our protocol provides a standardized, visually guided approach that improves reproducibility, anatomical understanding, and safety compared to narrative descriptions alone.

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

~~What questions will future research focus on?~~

1.5. **Elise Lupon:** Our future research will focus on dynamic perfused models like SimLife to evaluate graft viability, perfusion, and surgical training realism.

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

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

Ethics Title Card

This research has been approved by the French National Ethics Committee

Protocol

2. Cervical and Facial Nerve Dissection

Demonstrators: Elise Lupon, Tanguy Perraudin

2.1. To begin the cervical dissection, use a number 15 scalpel blade to make a cervical incision extending from the superior border of the clavicle to the earlobe **[1]**.

2.1.1. WIDE: Talent making a cervical skin incision with a number 15 scalpel blade from the clavicle toward the earlobe.

2.2. Using strabismus scissors, dissect the neck area to identify the sternocleidomastoid muscle **[1]**. Perform a circumferential dissection of the external jugular vein **[2]**. Ligate the external jugular vein and divide it using strabismus scissors **[3]**.

2.2.1. Talent carefully dissecting cervical tissues with strabismus scissors to expose the sternocleidomastoid muscle.

2.2.2. Talent dissecting circumferentially around the external jugular vein. **Videographer's NOTE:** 2 2 2 and 2 2 3 in the same shoot as 2.2.1

2.2.3. Talent placing ligatures around the external jugular vein and dividing the ligated external jugular vein with strabismus scissors.

2.3. Next, with a Farabeuf retractor, retract the sternocleidomastoid muscle laterally to gain access to the vascular pedicles **[1-TXT]**.

2.3.1. Talent placing a Farabeuf retractor and retracting the sternocleidomastoid muscle laterally. **TXT: Free the muscle laterally to expose the vessels**

2.4. Using strabismus scissors, dissect carefully to expose the internal jugular vein to reveal the thyro-linguofacial trunk and identify and preserve the facial vein **[1]**. Dissect carefully to expose the common carotid artery to reveal the carotid bifurcation **[2]**.

2.4.1. Talent dissecting to expose the internal jugular vein, extending the dissection to visualize the thyro-linguofacial trunk. **Videographer's NOTE**: DSC_3743 and DSC_3744-both are for the 2.4.1. I stoped the camera because they had to Clean the corpse. DSC_3746 is the same thing that 2 4 1 but on the other side

2.4.2. Talent dissecting along the common carotid artery and exposing the carotid bifurcation.

2.5. Using strabismus scissors, dissect the external carotid artery cranially and identify the arterial branches **[1]**. Ligate and divide the superior thyroid artery, ascending pharyngeal artery, and occipital artery **[2]**.

2.5.1. Talent dissecting the external carotid artery in a cranial direction and identifying branches of the external carotid artery. **Videographer's NOTE**: DSC_3748 is the 2 5 1 and the 2 5 2 on the left side. DSC_3749 is the same thing but on the other side

2.5.2. Talent ligating and dividing the superior thyroid artery, ascending pharyngeal artery, and the occipital artery.

2.6. Continue the dissection to ligate and divide the lingual artery. Identify and preserve the facial branch of the external carotid artery **[1]**. Now, identify the posterior belly of the digastric muscle and identify the stylohyoid muscle **[2]**.

2.6.1. Talent ligating and dividing the lingual artery and preserving the facial branch.

2.6.2. Talent pointing out the posterior belly of the digastric muscle and the stylohyoid muscle.

2.7. Using a fine-tip monopolar electrocautery set to approximately 30 degrees Celsius in coagulation mode, transect the posterior belly of the digastric muscle near its insertion **[1]**. Then, transect the stylohyoid muscle near its insertion to enhance surgical exposure **[2]**.

2.7.1. Talent transecting the posterior belly of the digastric muscle with monopolar electrocautery.

2.7.2. Talent transecting the stylohyoid muscle with monopolar electrocautery.

2.8. Locate the hypoglossal nerve and section it proximally to obtain maximal length for potential nerve grafting **[1]**. Next, ligate and divide the submandibular gland, duct, and vessels, excluding the submandibular gland from the allograft **[2-TXT]**.

2.8.1. Talent sectioning the hypoglossal nerve proximally.

2.8.2. Talent identifying the submandibular duct and associated vessels.

2.8.3. Talent ligating and dividing the submandibular duct, and vessels. **TXT: Repeat the cervical dissection on the opposite side**

2.9. For facial nerve dissection, use a number 15 scalpel blade to perform the pretragal incision **[1]**. Using strabismus scissors, dissect a preauricular skin flap in the sub-superficial musculoaponeurotic system plane **[2]**.

2.9.1. Talent making a pretragal skin incision with a number 15 scalpel blade.

2.9.2. Talent dissecting the preauricular skin flap with strabismus scissors in the sub-superficial musculoaponeurotic system plane.

2.10. Transect the external auditory canal and expose the facial nerve at its origin **[1]**. Then, using strabismus scissors, liberate all anterior soft tissues en bloc **[2]**. Isolate the facial nerve with a vessel loop and dissect the facial nerve with strabismus scissors to obtain maximal length **[3-TXT]**.

2.10.1. Talent transecting the external auditory canal and exposing the facial nerve at its point of origin.

2.10.2. Talent dissecting and mobilizing the anterior soft tissues as a single unit.

2.10.3. Talent placing a vessel loop around the facial nerve and carefully dissecting the facial nerve to maximize its length. **TXT: Repeat the pretragal and facial nerve dissection on the contralateral side**

3. Coronal Approach for Scalp Dissection and Periorbital Management

3.1. To begin the coronal approach, using a number 15 scalpel blade, make a coronal incision **[1]**. Elevate the scalp flap in a sub-periosteal plane from posterior to anterior until the supraorbital nerve is encountered **[2]**.

3.1.1. Talent making a coronal scalp incision with a number 15 scalpel blade.

3.1.2. Talent elevating the scalp flap in a subperiosteal plane and exposing the supraorbital nerve.

3.2. Using strabismus scissors, ligate the supraorbital neurovascular contents close to the bony foramen **[1]**. Divide the supraorbital contents, then Ligate and divide the supratrochlear neurovascular contents close to the bony foramen **[2]**.

3.2.1. Talent ligating the supraorbital neurovascular bundle near the foramen.

3.2.2. Talent dividing the supraorbital neurovascular contents, ligating and dividing the supratrochlear neurovascular contents.

3.3. With the globe in situ, locate the levator palpebrae superioris muscle and place a marking suture using Ethilon on it **[1]**. Next, proceed with periorbital dissection in the sub-periosteal plane and divide the upper eyelid horizontally to preserve the orbicularis

oculi within the graft **[2]**.

3.3.1. Talent placing a marking suture on the levator palpebrae superioris muscle.

3.3.2. Talent dissecting the periorbital tissues and dividing the upper eyelid horizontally.

3.4. Using a number 15 scalpel blade, perform circumferential transconjunctival incisions **[1-TXT]**. Now, with an osteotome, elevate the lateral canthus with a small segment of the lateral orbital rim to ensure proper canthal support within the graft **[2]**.

3.4.1. Talent making circumferential transconjunctival incisions with a number 15 scalpel blade. **TXT: Preserve: Superior and inferior tarsal plates; Orbital septum; Levator palpebrae superioris; Müller muscle**

3.4.2. Talent using an osteotome to elevate the lateral canthus with a segment of the orbital rim.

3.5. Excise the lower eyelid while preserving the conjunctiva. Using strabismus scissors, dissect through the inferior fornix just inside the orbital rim **[1-TXT]**. After identifying the infraorbital nerve, transect the infraorbital nerve near its foramen to ensure maximal nerve length for future neurorrhaphy **[2]**.

3.5.1. Talent dissecting through the inferior fornix with strabismus scissors and excising the lower eyelid. **TXT: Preserve: Orbital septum; Orbital fat; Lower eyelid retractors**

3.5.2. Talent transecting the infraorbital nerve close to the foramen.

3.6. Employing a strabismus scissors, section the facial nerve at its exit from the stylomastoid foramen **[1]** and shave the masseter muscle to expose the mandibular surface **[2]**.

3.6.1. Talent identifying and sectioning the facial nerve at the stylomastoid foramen with strabismus scissors.

3.6.2. Talent shaving the masseter muscle to expose the mandibular surface.

3.7. Raise the flap anteriorly on top of the masseter muscle **[1]**. Identify the buccal fat pad at its anterior border and continue the anterior dissection along the buccal fat pad while leaving it in situ **[2]**. After harvesting the buccal mucosa in full, extend the dissection superiorly to the orbit and continue the dissection laterally to include the zygoma **[3]**.

3.7.1. Talent elevating the flap anteriorly over the masseter muscle.

3.7.2. Talent dissecting anteriorly along the buccal fat pad without removing it.

3.7.3. Talent extending the dissection toward the orbital region and extending the dissection to expose the zygoma.

4. Midface Osteotomies, Intraoral Dissection and Flap Liberation

4.1. To begin the midface osteotomies, employ strabismus scissors to perform a sub-periosteal dissection lateral to the nose **[1-TXT]**. Using a reciprocating saw, perform a low-to-low lateral nasal osteotomy and then extend the osteotomy inferiorly to the hard palate with a curved osteotome **[2]**.

4.1.1. Talent performing subperiosteal dissection lateral to the nose with strabismus scissors. **TXT: Preserve the medial canthal tendon attachments**

4.1.2. Talent creating a lateral nasal osteotomy and extending the osteotomy to the hard palate with a curved osteotome.

4.2. Next, extend the osteotomy laterally to include the zygomatic buttress **[1-TXT]**. Using strabismus scissors, divide the nasal septum longitudinally **[2]**. Harvest the nose together with the skin and cartilage, including alar, triangular, and most of the septum, nasal bones, and nasal mucosa **[3]**.

4.2.1. Talent extending the osteotomy laterally through the zygomatic buttress. **TXT: Follow the zygomaticofrontal suture and the sphenozygomatic suture of the maxilla and zygoma**

4.2.2. Talent dividing the nasal septum longitudinally with strabismus scissors.

4.2.3. Talent harvesting the nose together with the skin, cartilage, triangular, septum, nasal bones, and mucosa.

4.3. For Intraoral dissection, pick up a number 10 or number 15 scalpel blade to make a circumferential intraoral incision along the gingivobuccal mucosal junction **[1]**. Then, incise the superior gingival mucosa following the maxillary dental arcade and the inferior gingival mucosa following the mandibular dental arcade **[2]**. Now, incise the gingival mucosa along the mandibular line using the scalpel **[3]**.

4.3.1. Talent picking up the scalpel blade and making a circumferential intraoral incision along the gingivobuccal mucosal junction.

4.3.2. Talent incising the maxillary gingival mucosa and mandibular gingival mucosa

precisely.

4.3.3. Talent incising the gingival mucosa along the mandibular line.

4.4. After identifying the mental nerve near its mental foramen, divide it close to the foramen while preserving maximal length for potential neurorrhaphy **[1-TXT]**. ~~Using the scalpel, cut the mucosa at the gingiva on the dental part of the maxilla **[1]**. Continue cutting the mucosa at the gingiva on the dental part of the mandible **[2]**~~.

4.4.1. Talent identifying and dividing the mental nerve close to the foramen with strabismus scissors. **TXT: Use strabismus scissors**

~~4.4.2. Talent cutting the gingival mucosa on the maxillary dental surface.~~

~~4.4.3. Talent cutting the gingival mucosa on the mandibular dental surface.~~ **NOTE**: Not filmed

4.5. Now, using strabismus scissors, divide the mental nerve close to its foramen on the contralateral side **[1]**.

4.5.1. Talent dividing the contralateral mental nerve near the mental foramen.

4.6. Mobilize the cervical soft tissue planes medially **[1]** and direct the tissues toward the oral cavity **[2]**. Dissect in the plane above the sternohyoid and superior omohyoid muscles **[3]**, with or without inclusion of the anterior jugular vein **[4]**.

4.6.1. Talent mobilizing cervical soft tissue planes medially

4.6.2. Talent directing the mobilized tissues toward the oral cavity.

4.6.3. Talent dissecting above the sternohyoid and superior omohyoid muscles.

4.6.4. Talent pointing to the anterior jugular vein during dissection.

4.7. Then, elevate the graft en bloc **[1]** and liberate the allograft from all remaining soft tissue attachments while preserving the bilateral vascular pedicles **[2]**.

4.7.1. Talent elevating the composite graft as a single unit.

4.7.2. Talent freeing remaining soft tissue attachments while preserving vascular pedicles.

4.8. Using absorbable monofilament, ligate the internal jugular veins as distally as possible **[1]**. Ligate the carotid arteries as distally as possible **[2]**. Finally, detach the entire face **[3]**.

4.8.1. Talent ligating the internal jugular veins distally.

~~4.8.2. Talent ligating the external jugular veins.~~ **NOTE**: Not filmed

4.8.3. Talent ligating the carotid arteries distally.

4.8.4. Talent completing detachment of the facial allograft.

Results

5. Results

5.1. The donor face dissected for this study was a male measuring 1.72 meters in height with a malnourished body morphology **[1]**.

5.1.1. LAB MEDIA: Figure 6

5.2. The facial nerve was marked with a blue suture on each side of the graft **[1]**.

5.2.1. LAB MEDIA: Figure 6A. *Video editor: Zoom in on both left and right sides of the graft in Panel A to show the blue sutures marking the facial nerve*.

5.3. The internal view of the graft showed the orbital septum **[1]**, superior gingival mucosa **[2]**, and inferior gingival mucosa **[3]**.

5.3.1. LAB MEDIA: Figure 6A. *Video editor: In Panel A, point to the white arrow indicating the orbital septum*.

5.3.2. LAB MEDIA: Figure 6A. *Video editor: In Panel A, point to the black arrow indicating the superior gingival mucosa*.

5.3.3. LAB MEDIA: Figure 6A. *Video editor: In Panel A, point to the green arrow indicating the inferior gingival mucosa*.

5.4. The diameters of the harvested arteries and veins, including the facial artery, superficial temporal artery, facial vein and internal jugular vein, were generally consistent with or within the range **[1]** of published literature values **[2]**.

5.4.1. LAB MEDIA: Figure 7. *Video editor: Highlight 'CADAVER' bars for "Facial artery", "Superficial temporal artery", "Facial vein", "Internal jugular vein" and "External*

5.4.2. LAB MEDIA: Figure 7. *Video editor: Highlight 'LITERATURE' bars for "Facial artery", "Superficial temporal artery", "Facial vein", "Internal jugular vein" and "External*

5.5. The measured nerve diameters, including the facial nerve trunk and infraorbital nerve, were slightly smaller **[1]** than published averages **[2]**.

5.5.1. LAB MEDIA: Figure 7. *Video editor: Highlight the "cadaver" bars for "Facial*

nerve" and "Infraorbital nerve"

5.5.2. LAB MEDIA: Figure 7. *Video editor: Highlight the "literature" bars for "Facial nerve" and "Infraorbital nerve*"

1. Cervical
   Pronunciation link: https://www.merriam-webster.com/dictionary/cervical
   IPA: /ˈsɝːvɪkəl/
   Phonetic Spelling: sur·vi·kuhl
2. Clavicle
   Pronunciation link: https://www.merriam-webster.com/dictionary/clavicle
   IPA: /ˈklævɪkəl/
   Phonetic Spelling: kla·vi·kuhl
3. Strabismus
   Pronunciation link: https://www.merriam-webster.com/dictionary/strabismus
   IPA: /strəˈbɪzməs/
   Phonetic Spelling: struh·biz·muhs
4. Sternocleidomastoid
   Pronunciation link: https://www.merriam-webster.com/dictionary/sternocleidomastoid
   IPA: /ˌstɝːnoʊˌklaɪdoʊˈmæsˌtɔɪd/
   Phonetic Spelling: stur·noh·kly·doh·mas·toyd
5. Circumferential
   Pronunciation link: https://www.merriam-webster.com/dictionary/circumferential
   IPA: /ˌsɝːkəmfəˈrɛnʃəl/
   Phonetic Spelling: sur·kuhm·fuh·ren·shuhl
6. Jugular
   Pronunciation link: https://www.merriam-webster.com/dictionary/jugular
   IPA: /ˈdʒʌgjələr/
   Phonetic Spelling: juh·gyuh·ler
7. Ligate
   Pronunciation link: https://www.merriam-webster.com/dictionary/ligate
   IPA: /ˈlaɪˌgeɪt/
   Phonetic Spelling: ly·gayt
8. Farabeuf
   Pronunciation link: https://www.merriam-webster.com/dictionary/Farabeuf
   IPA: /ˈfærəˌbʌf/
   Phonetic Spelling: fa·ruh·buf
9. Pedicles
   Pronunciation link: https://www.merriam-webster.com/dictionary/pedicle
   IPA: /ˈpɛdɪkəl/
   Phonetic Spelling: peh·di·kuhl
10. Thyro-linguofacial
    Pronunciation link: No confirmed link found

IPA: /ˌθaɪroʊˌlɪŋgwoʊˈfeɪʃəl/
Phonetic Spelling: thy·roh·ling·gwoh·fay·shuhl

11. Carotid
Pronunciation link: https://www.merriam-webster.com/dictionary/carotid
IPA: /kəˈrɑːtɪd/
Phonetic Spelling: kuh·rah·tid
12. Bifurcation
Pronunciation link: https://www.merriam-webster.com/dictionary/bifurcation
IPA: /ˌbaɪfɚˈkeɪʃən/
Phonetic Spelling: by·fur·kay·shuhn
13. Pharyngeal
Pronunciation link: https://www.merriam-webster.com/dictionary/pharyngeal
IPA: /ˌfærənˈdʒiːəl/
Phonetic Spelling: fa·ruhn·jee·uhl
14. Occipital
Pronunciation link: https://www.merriam-webster.com/dictionary/occipital
IPA: /ɑkˈsɪpɪtəl/
Phonetic Spelling: ok·sip·i·tuhl
15. Digastric
Pronunciation link: https://www.merriam-webster.com/dictionary/digastric
IPA: /daɪˈgæstrɪk/
Phonetic Spelling: dy·gas·trik
16. Stylohyoid
Pronunciation link: https://www.merriam-webster.com/dictionary/stylohyoid
IPA: /ˌstaɪloʊˈhaɪɔɪd/
Phonetic Spelling: sty·loh·hy·oyd
17. Monopolar
Pronunciation link: https://www.merriam-webster.com/dictionary/monopolar
IPA: /ˌmɑːnoʊˈpoʊlər/
Phonetic Spelling: mon·oh·poh·ler
18. Electrocautery
Pronunciation link: https://www.merriam-webster.com/dictionary/electrocautery
IPA: /ɪˌlɛktroʊˈkɔːtəri/
Phonetic Spelling: ih·lek·troh·kaw·tuh·ree
19. Hypoglossal
Pronunciation link: https://www.merriam-webster.com/dictionary/hypoglossal
IPA: /ˌhaɪpoʊˈglɑːsəl/
Phonetic Spelling: hy·poh·gloh·suhl
20. Submandibular
Pronunciation link: https://www.merriam-webster.com/dictionary/submandibular
IPA: /ˌsʌbmænˈdɪbjələr/
Phonetic Spelling: sub·man·dib·yuh·ler
21. Pretragal
Pronunciation link: No confirmed link found

IPA: /priˈtreɪgəl/
Phonetic Spelling: pree·tray·guhl

22. Musculoaponeurotic
Pronunciation link: https://www.merriam-webster.com/dictionary/musculoaponeurotic
IPA: /ˌmʌskjəloʊˌæpənjʊˈrɑːtɪk/
Phonetic Spelling: mus·kyuh·loh·ap·uh·nyuh·rah·tik
23. Stylomastoid
Pronunciation link: https://www.merriam-webster.com/dictionary/stylomastoid
IPA: /ˌstaɪloʊˈmæstɔɪd/
Phonetic Spelling: sty·loh·mas·toyd
24. Periosteal
Pronunciation link: https://www.merriam-webster.com/dictionary/periosteal
IPA: /ˌpɛriˈɑːstiəl/
Phonetic Spelling: peh·ree·os·tee·uhl
25. Supraorbital
Pronunciation link: https://www.merriam-webster.com/dictionary/supraorbital
IPA: /ˌsuːprəˈɔːrbɪtəl/
Phonetic Spelling: soo·pruh·or·bi·tuhl
26. Supratrochlear
Pronunciation link: https://www.merriam-webster.com/dictionary/supratrochlear
IPA: /ˌsuːprəˈtrɑːkliər/
Phonetic Spelling: soo·pruh·trok·lee·er
27. Levator palpebrae superioris
Pronunciation link: https://www.merriam-webster.com/dictionary/levator%20palpebrae%20superioris
IPA: /lɪˈveɪtər ˈpælpɪˌbriː suːˌpɪriˈɔːrɪs/
Phonetic Spelling: luh·vay·ter pal·puh·bree soo·peer·ee·or·iss
28. Transconjunctival
Pronunciation link: https://www.merriam-webster.com/dictionary/transconjunctival
IPA: /ˌtrænzkənˈdʒʌŋktɪvəl/
Phonetic Spelling: tranz·kuhn·jungk·ti·vuhl
29. Infraorbital
Pronunciation link: https://www.merriam-webster.com/dictionary/infraorbital
IPA: /ˌɪnfrəˈɔːrbɪtəl/
Phonetic Spelling: in·fruh·or·bi·tuhl
30. Neurorrhaphy
Pronunciation link: https://www.merriam-webster.com/dictionary/neurorrhaphy
IPA: /ˌnʊrˈɔːrəfi/
Phonetic Spelling: nyur·or·uh·fee
31. Zygoma
Pronunciation link: https://www.merriam-webster.com/dictionary/zygoma
IPA: /zaɪˈgoʊmə/
Phonetic Spelling: zy·goh·muh
32. Osteotome
Pronunciation link: https://www.merriam-webster.com/dictionary/osteotome

IPA: /ˈɑːstiəˌtoʊm/
Phonetic Spelling: os·tee·uh·tohm

33. Gingivobuccal
Pronunciation link: https://www.merriam-webster.com/dictionary/gingivobuccal
IPA: /ˌdʒɪndʒɪvoʊˈbʌkəl/
Phonetic Spelling: jin·ji·voh·buk·uhl
34. Neurorrhaphy
Pronunciation link: https://www.merriam-webster.com/dictionary/neurorrhaphy
IPA: /ˌnʊrˈɔːrəfi/
Phonetic Spelling: nyur·or·uh·fee
35. Allograft
Pronunciation link: https://www.merriam-webster.com/dictionary/allograft
IPA: /ˈæləˌgræft/
Phonetic Spelling: a·luh·graft