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Evaluation of Face Lift Skin Perfusion and Epinephrine Effect Using Laser Fluorescence Imaging

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Background: Face lift dissections are believed to compromise skin flap circulation, possibly leading to wound healing complications. To reduce blood loss, plastic surgeons commonly inject a solution of local anesthetic that contains epinephrine. However, the effect of surgery on skin perfusion and the degree of vasoconstriction caused by the epinephrine have not been quantitated. Little information is available to guide the selection of epinephrine concentration.
Methods: Nine consecutive patients undergoing a deep-plane face lift were asked to participate in this prospective study. All patients consented (inclusion rate, 100%). The SPY Elite Intraoperative Perfusion System was used to quantitate perfusion. Measurements were made at 5 sites on both sides of the face and the neck. A nondissected temple site served as a reference. Three patients received no epinephrine in their local anesthetic solution, 3 patients received 1:800,000 epinephrine, and 3 patients were injected with 1:300,000 epinephrine.
Results: All 9 patients were female nonsmokers. There was no reduction in skin perfusion measurements after surgery. In patients treated with 1:800,000 and 1:300,000 epinephrine, 4 sites showed significantly ($P < 0.05$) decreased perfusion compared with the no-epinephrine group. Combined perfusion data were almost 50% reduced, but the difference was nonsignificant, likely because of the small sample sizes. One patient developed a hematoma. Two of the 3 patients who received no epinephrine developed extensive bruising.
Conclusions: A deep-plane face lift dissection does not impair skin flap perfusion. Both 1:300,000 epinephrine and 1:800,000 epinephrine concentrations are effective in producing intraoperative vasoconstriction. *(Plast Reconstr Surg Glob Open 2015;3:e484; doi: 10.1097/GOX.0000000000000469; Published online 19 August 2015.)*

Face lift dissections are believed to compromise skin flap circulation, leading to wound healing complications in some cases. A local anesthetic agent with epinephrine may be injected to reduce bleeding. Limited information is available regarding the appropriate dose and efficacy. Hematomas have been attributed to rebound bleeding.

Laser fluorescence imaging is the most advanced method available to evaluate skin perfusion. This method has been used to quantitate blood supply during free-tissue transfers,[1] breast reconstruction,[2–5]

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and abdominoplasty.[6–8] To the author's knowledge, this technology has not been applied to face lifts.

This study was undertaken to evaluate (1) the degree of vascular compromise associated with a face lift dissection, if any, and (2) the effect of 2 concentrations of epinephrine on vascularity.

PATIENTS AND METHODS

Patients

Nine consecutive patients undergoing face lifts performed by the author were asked to participate in the study. The only inclusion criteria were face lift surgery and patient consent. There were no exclusion criteria. All patients consented (inclusion rate, 100%). Institutional review board approval was obtained from Chesapeake Institutional Review Board Services, accredited by the Association for the Accreditation of Human Research Protection Programs.

Local Anesthesia and Epinephrine Doses

The author's usual face lift local anesthetic solution combines 50 mL of 0.5% bupivacaine with 1:200,000 epinephrine, 50 mL of 1% lidocaine with 1:100,000 epinephrine, and 100 mL of normal saline (total volume, 200 mL) for a final epinephrine concentration of 1:300,000.[9] For study purposes, another solution was prepared, containing the same local anesthetic concentrations but an epinephrine concentration of 1:800,000 (Fig. 1) and a third solution containing no epinephrine. These epinephrine concentrations were chosen based on existing clinical[10] and experimental data[11] documenting efficacy in concentrations as dilute as 1:800,000. The first patient in the series received the 1:300,000 concentration of epinephrine. The second patient received the more dilute 1:800,000 concentration (**See Video, Supplemental Digital Content 1**, which demonstrates the local anesthetic injections, ***http://links.lww.com/PRSGO/A123***), and the third patient received no epinephrine. The sequence was repeated chronologically by the date of surgery. The mean volume of local anesthetic solution was 74 mL per side (range, 60–85 mL), with no significant difference in volumes among the 3 patient groups.

Surgery

All procedures were performed at a state-licensed ambulatory surgery center under total intravenous anesthesia using a laryngeal mask airway. No inhalational agent was given. No intraoperative hypotension or routine preoperative antihypertensive agent was administered, apart from any blood pressure medication taken regularly by the patient. All patients were treated with sequential compression devices. No patient received chemoprophylaxis. All patients underwent Doppler ultrasound scans of the lower extremities before surgery, the day after surgery, and approximately 1 week after surgery.[12] Surgical drains were removed the day after surgery. Head dressings were not used.

Three patients underwent simultaneous procedures on the breasts or body. In 8 patients, a submental lipectomy was performed (1 patient had a previous submental lipectomy). Eight patients underwent adjunctive facial procedures, including fat injection ($n = 7$), endoscopic forehead lift ($n = 6$), laser skin resurfacing ($n = 5$), upper blepharoplasties ($n = 3$), rhinoplasty ($n = 3$), chin augmentation ($n = 1$), and setback otoplasties ($n = 1$). Adjunc-

Fig. 1. The local anesthetic solution combines one 50-mL bottle of 0.5% bupivacaine with 1:200,000 epinephrine and one 50-mL bottle of 1% lidocaine without epinephrine with equal parts of saline. The final concentration of epinephrine is 1:800,000. In patients receiving no epinephrine, a bottle of 0.25% bupivacaine without epinephrine is used instead. In patients receiving the full 1:300,000 concentration of epinephrine, a bottle of 1% lidocaine with 1:100,000 epinephrine is substituted.

Video Graphic 1. See video, which demonstrates a local anesthetic injection. This video is available in the "Related Videos" section of the full-text article at http://www.PRSGO.com or available at ***http://links.lww.com/PRSGO/A123***.

Video Graphic 2. See video, which demonstrates a face lift dissection. This video is available in the "Related Videos" section of the full-text article at http://www.PRSGO.com or available at ***http://links.lww.com/PRSGO/A124***.

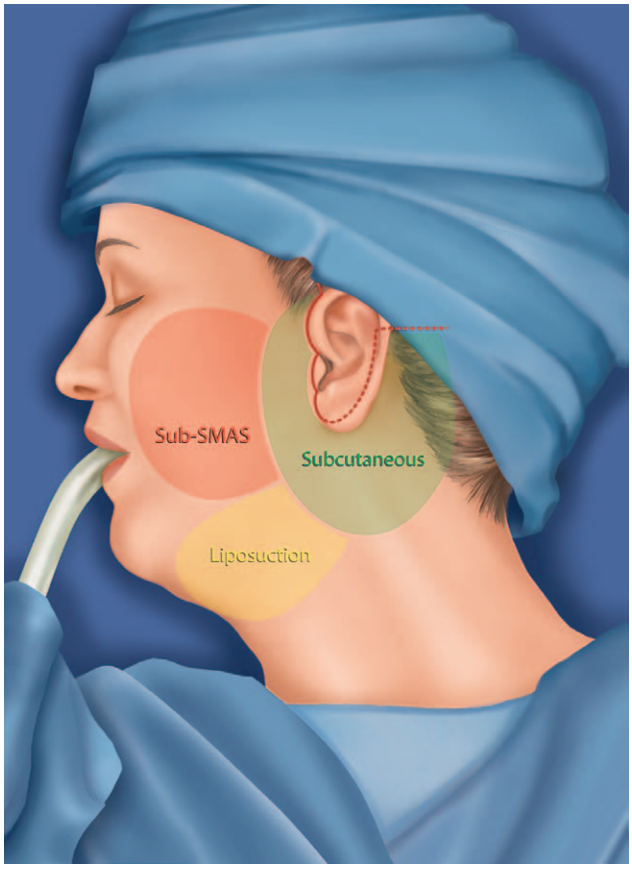


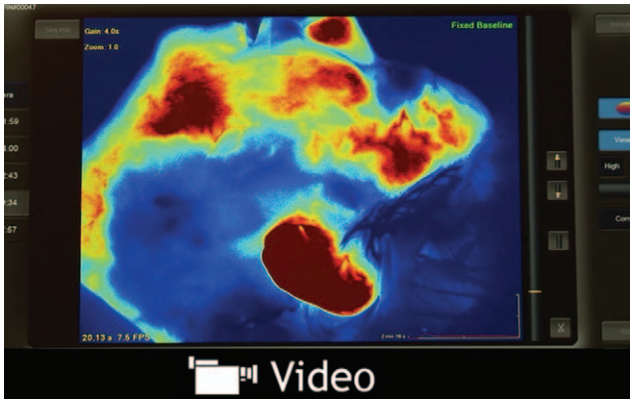
Fig. 2. The face lift incision is marked. This incision "hugs" the tragus in front of the ear and courses on the back of the ear just above the postauricular crease (dotted line). The incision turns at a right angle and continues horizontally into the hairline. Liposuction is performed over the lateral neck (yellow). Liposuction preserves the filamentous connections between the muscle (platysma) and the skin, allowing the skin to move in unison with the muscle. The superficial musculoaponeurotic system (SMAS) and skin are elevated as one layer in the cheek (magenta). Skin undermining is minimized (green).

tive facial procedures (with the exception of upper blepharoplasties and otoplasties) were performed after the final imaging video so as not to interfere with perfusion measurements.

All patients were treated using the same face lift technique (**See Video, Supplemental Digital Content 2**, which demonstrates a face lift dissection. This video is available in the "Related Videos" section of the full-text article at http://www.PRSGO.com or available at ***http://links.lww.com/PRSGO/A124***). The author uses no temporal incision, allowing skin redundancy to settle spontaneously and avoiding a temple scar. A subcutaneous dissection is used in the lateral neck (Fig. 2), with conservative liposuction over the lateral neck and sternocleidomastoid muscle. The author typically uses a "triple-vector platysmaplasty." A deep-plane dissection is used to elevate the superficial musculoaponeurotic system (SMAS) and platysma (vertical, vector 1), with release of the retaining ligaments. The platysma is plicated laterally (oblique, vector 2). A submental incision is used to access the neck for anterior liposuction, interplatysmal fat resection, and a medial platysmaplasty (medial, vector 3).

Perfusion Measurements

The SPY Elite Intraoperative Perfusion System (Novadaq, Bonita Springs, Fla.) was used to image each side of the face and neck at least 20 minutes after injection of the local anesthetic solution on that side and before the face lift dissection. Immediately after completion of the face lift on each side, the patient was reimaged. Each patient was imaged 4 times. A video was recorded immediately after the contrast agent, indocyanine green, was injected intravenously (2.5 mL, 6.25 mg) and flushed with 10 mL of normal saline. (**See Video, Supplemental Digital Content 3**, which demonstrates



Video Graphic 3. See video, which demonstrates SPY laser fluorescence imaging videos before and after face lift. This video is available in the "Related Videos" section of the full-text article at http://www.PRSGO.com or available at ***http://links.lww.com/PRSGO/A125***.

Table 1. Patient Data

	%
N	9
Age, y	
Mean	58.9
SD	10.4
Range	43.8–78.7
Sex	
Female	9 (100)
Male	0 (0)
Follow-up time, days	
Mean	62.3
SD	39.4
Range	4–146
Body mass index, kg/m^2	
Mean	23.1
SD	3.9
Range	17.6–27.9
Smoking status	
Nonsmoker	9 (100)
Smoker	0 (0)
Secondary face lift	
Yes	2 (22)
No	7 (78)
Right face lift local anesthetic volume, mL	
Mean	73.9
SD	6.0
Range	60–80
Left face lift local anesthetic volume, mL	
Mean	74.4
SD	6.8
Range	60–85
Operating time, face lift only, min	
Mean	172.7
SD	31.7
Range	122–221
Complications	
No	7 (78)
Yes	2 (22)
Hematoma	
No	8 (89)
Yes	1 (11)
Neuropraxia	
No	8 (89)
Yes	1 (11)

SPY laser fluorescence imaging videos before and after face lift. This video is available in the "Related Videos" section of the full-text article at http://www.PRSGO.com or available at ***http://links.lww.com/PRSGO/A125***). Measurements were made at the same time, 120 seconds after the start of the video recording. The temple was selected as the reference site. This site was used because it was just outside the injected area, not dissected, and it was within the field of view. Relative values were tabulated using this reference point.

Statistics

Statistical analyses were performed using IBM SPSS for Macintosh version 22.0 (SPSS, IBM, Armonk, N.Y.). Paired *t* tests were used to compare measurements before and after the face lift. One-way analyses of variance were computed to compare the preoperative mean perfusion values across the 3 treatment groups. A P value < 0.05 was considered significant. A Pearson correlation was computed to determine the linear relation between epinephrine concentration and hematoma rate.

RESULTS

Patient data are provided in Table 1. Subjectively, the 3 patients who did not receive epinephrine appeared to have greater bleeding during the face lift dissection. Two of these women had extensive postoperative bruising (Fig. 3). Table 2 provides perfusion data, including both absolute and relative measurements. Individual and combined comparisons before and after the face lift showed no decrease in perfusion. Two of the individual site comparisons and the combined right face and neck measurements showed significantly ($P < 0.05$) greater absolute perfusion values after the dissection. An example of a patient who was not treated with epinephrine and her left face lift perfusion studies are provided in Figures 4–6.

Table 3 compares pre-face lift perfusion data for the 3 groups with different concentrations of epinephrine. For patients who did not receive epinephrine, the mean values for the combined right and left facial measurements were 103.4% and 100.8%, using the reference value of 100% assigned to the temple. For patients treated with 1:800,000 epinephrine (Figs. 7, 8), these combined values were 50.8% and 59.6%. For patients injected with an epinephrine concentration of 1:300,000 (Figs. 9, 10), the mean relative perfusion values were 52.3% and 51.6%. The differences in combined perfusion measurements did not reach statistical significance because of the small sample sizes. However, 4 of the individual site comparisons (2 absolute values and 2 relative values) were significant at $P < 0.05$, and one comparison of absolute values, the right submandibular site, was significant at $P < 0.01$.

Complications

There were 2 complications. One patient who received epinephrine 1:800,000 developed a hematoma of the right neck several hours after discharge requiring surgical evacuation. Another patient experienced weakness in the left buccal branch distribution that fully resolved within 1 month. There were no systemic complications. All ultrasound scans were negative.

DISCUSSION

Blood Flow after a Face Lift Dissection

The author expected a diminution in blood flow caused by the face lift dissection. However, the data did not support this hypothesis. All 4 combined

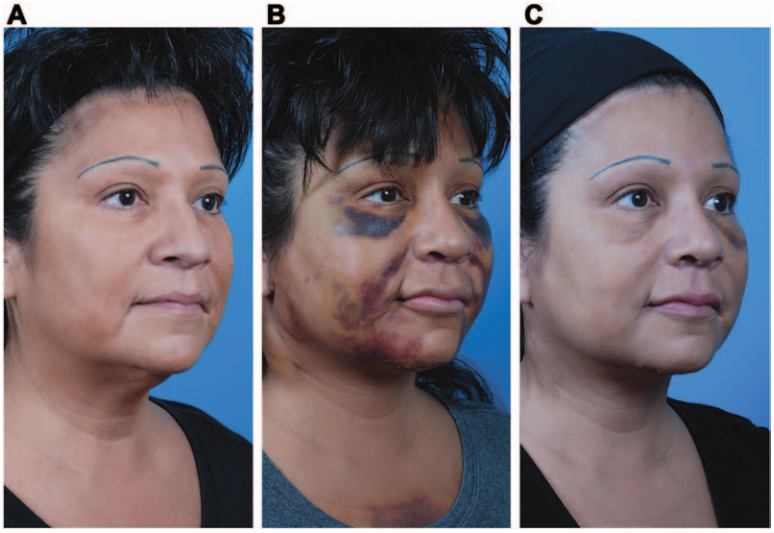


Fig. 3. This 54-year-old woman (A) underwent a deep-plane face lift, submental lipectomy, endoscopic forehead lift, rhinoplasty, and fat injection of the lips, cheeks, nasolabial creases, and glabella (total fat volume, 27 mL). Her anesthetic solution contained no epinephrine. She had extensive bruising of the face, neck, and chest 10 days after surgery (B). One month after surgery (C), bruising of the face and neck has cleared, but she still has bruising of the orbital rims. She had previous blepharoplasties performed by the author 9 years previously and had no unusual bruising after the previous surgery. The patient is wearing no makeup, except for permanent tattooing of her eyebrows that was present preoperatively.

absolute and relative postoperative perfusion measurements (right, 67.3% vs 60.5%; left, 74.7% vs 70.7%) were higher after surgery than before surgery, although not significantly (Table 2). There are several possible explanations. First, the dissection was subcutaneous over the lateral neck, but largely sub-SMAS in the face (Fig. 2). Second, the author uses hydrodissection[13] in creating the subcutaneous tissue plane, which may be less traumatic to the skin flap.[14] Third, lidocaine[10,15–17] and bupivacaine[18] produce local vasodilation, thought to be caused by a local chemical sympathectomy effect,[17] which would not be balanced by the vasoconstrictive effect of epinephrine in the 3 patients who did not receive epinephrine. This vasodilation is overcome by epinephrine, producing net vasoconstriction,[10,15–18] caused by the α-adrenergic effect of epinephrine on the smooth muscle of arterioles.[15,19] The finding of excellent post-face lift flap perfusion is consistent with the author's clinical experience of few cases of marginal skin loss.[20]

Epinephrine

In an effort to control for any possible confounders (eg, room temperature, ambient lighting, and neurohormonal factors), the perfusion of the temple was used for reference. The mean measurements representing the combined data relative to the temple showed perfusion levels decreased by almost half (Table 3). The combined perfusion measurements for the 2 epinephrine concentrations were surprisingly similar, attesting to the efficacy of the more dilute epinephrine concentration. Similarly, Dunlevy et al,[10] in their study using a laser Doppler flowmeter, found that a 1:800,000 concentration of epinephrine reduced cutaneous blood flow approximately 50% in patients undergoing head and neck surgery. These investigators[10] also found that a 1:400,000 concentration decreased blood flow about 60%, with no significant difference in blood flow comparing epinephrine concentrations of 1:200,000 and 1:400,000. In their study of albino rabbits, Siegel and Vistnes[11] found no significant difference in hemostatic effect comparing epinephrine concentrations of 1:100,000, 1:400,000, and 1:800,000; a concentration of 1:1,600,000 was significantly less effective. Previous studies show that the reduction in blood flow reaches a plateau between 5 and 10 minutes after epinephrine injection,[10,15,16,18,19] although the maximum effect requires 25 minutes.[17]

Today, plastic surgeons use a variety of epinephrine concentrations, from 1:160,000 to 1:4,000,000[14,20–41] (Fig. 11). Because epinephrine can produce toxic local (eg, skin necrosis)[10,16,18,19] and systemic side effects (eg, tachycardia, arrhythmias, and hypertension)[10,15,18] from stimulation of α- and β-adrenergic receptors,[10,19] the prudent surgeon will choose the most dilute solution that provides

Table 2. SPY Laser Fluorescence Measurements and Absolute and Relative Values*

Anatomic Site	Before Face Lift	After Face Lift	*P*
N	9	9	
Absolute values			
Right temple			
Mean	30.1	36.7	
SD	13.8	23.5	NS
Range	13–48	16–91	
Right lateral cheek			
Mean	23.6	33.1	
SD	10.8	14.1	0.05
Range	12–38	17–55	
Right angle of mandible			
Mean	15.7	23.9	
SD	6.8	11.4	NS
Range	6–28	11–48	
Right submandibular			
Mean	10.9	18.4	
SD	4.8	9.7	0.011
Range	3–18	4–36	
Right lateral neck			
Mean	12.2	16.4	
SD	4.0	6.5	NS
Range	6–19	6–30	
Right mastoid			
Mean	15.7	19.9	
SD	8.6	14.0	NS
Range	2–30	3–49	
Left temple			
Mean	27.7	25.1	
SD	14.1	10.0	NS
Range	12–58	8–39	
Left lateral cheek			
Mean	22.8	25.1	
SD	11.0	12.2	NS
Range	8–44	6–37	
Left angle of mandible			
Mean	18.3	21.1	
SD	11.8	12.6	NS
Range	3–39	3–37	
Left submandibular			
Mean	16.0	19.7	
SD	10.3	9.8	NS
Range	4–36	5–34	
Left lateral neck			
Mean	19.7	16.3	
SD	11.5	9.9	NS
Range	7–36	3–31	
Left mastoid			
Mean	21.0	17.1	
SD	12.2	13.0	NS
Range	8–45	1–39	
Mean, all right face and neck measurements			
Mean	15.6	22.4	
SD	5.7	10.6	0.033
Range	7.0–23.2	10.2–43.6	
Mean, all left face and neck measurements			
Mean	19.6	19.9	
SD	10.9	10.0	NS
Range	7.0–40.0	3.8–30.0	
Percentages			
Right temple			
Mean	100	100	
SD	0	0	—
Range	100–100	100–100	
Right lateral cheek			
Mean	85.1	97.1	
SD	23.6	25.1	NS
Range	38–115	61–145	
Right angle of mandible			
Mean	66.1	71.8	
SD	38.1	26.9	NS
Range	20–113	38–114	
Right submandibular			
Mean	44.7	56.7	
SD	27.1	28.5	NS
Range	17–87	12–100	
Right lateral neck			
Mean	51.7	54.3	
SD	28.4	29.0	NS
Range	22–93	18–100	
Right mastoid			
Mean	55.1	56.6	
SD	24.1	31.8	NS
Range	20–93	16–100	
Left temple			
Mean	100	100	
SD	0	0	—
Range	100–100	100–100	
Left lateral cheek			
Mean	83.4	97.9	
SD	28.4	32.7	NS
Range	42–132	19–131	
Left angle of mandible			
Mean	63.2	80.2	
SD	29.9	45.3	NS
Range	14–105	28–142	
Left submandibular			
Mean	57.6	75.6	
SD	32.6	30.4	NS
Range	24–121	32–121	
Left lateral neck			
Mean	73.7	61.2	
SD	45.8	29.9	NS
Range	32–179	19–100	
Left mastoid			
Mean	75.4	58.4	
SD	30.8	32.5	NS
Range	42–137	12–118	
Mean, all right face and neck measurements			
Mean	60.5	67.3	
SD	24.0	26.6	NS
Range	31.2–97.2	31.4–106.0	
Mean, all left face and neck measurements			
Mean	70.7	74.7	
SD	31.1	27.0	NS
Range	42.2–134.8	28.8–104.4	

*Paired *t* tests were computed to compare mean differences between the parameters before and after the face lift.
NS, not significant.

adequate vasoconstriction. The measurements in this study suggest that 1:300,000 and 1:800,000 epinephrine concentrations are both effective.

Blood Loss

Limited information is available regarding blood loss associated with a face lift. A surprisingly heavy blood loss is calculated from hematocrits when a face lift (including endoscopic forehead lifts) is

Fig. 4. This 60-year-old woman underwent a deep-plane face lift, submental lipectomy, carbon dioxide laser skin resurfacing, fat injection of the cheeks, nasolabial creases, lips, and earlobes (total fat volume, 45 mL), setback otoplasties, and a left forehead scar revision. She is seen before (A) and 3.5 months after (B) surgery, with no makeup. This patient's SPY images before and after her left face lift are provided in Figures 5 and 6.

performed at the time of body contouring surgery, approximately 500 mL.[9] This nontrivial blood loss attests to the highly vascular nature of the face and the scalp. Hence, the need to minimize surgical blood loss and the role for vasoconstriction.

Hematomas

To gauge the frequency of hematomas, the author reviewed 40 face lift studies published in the plastic surgical literature in the last 15 years,[14,20–58] including fluid collections treated with needle aspiration when they were reported. The mean hematoma rate was 3.8%. This rate is more than twice the frequency of this complication in a recent review[59] that did not include hematomas treated with needle aspiration or seromas when these fluid collections were reported separately. The mean frequency of hematomas reported in the 6 prospective studies[20,28,31,47,48,56] was 6.7%.

Rebound Bleeding

Approximately 86% of hematomas develop within 24 hours of surgery.[27,60] Some

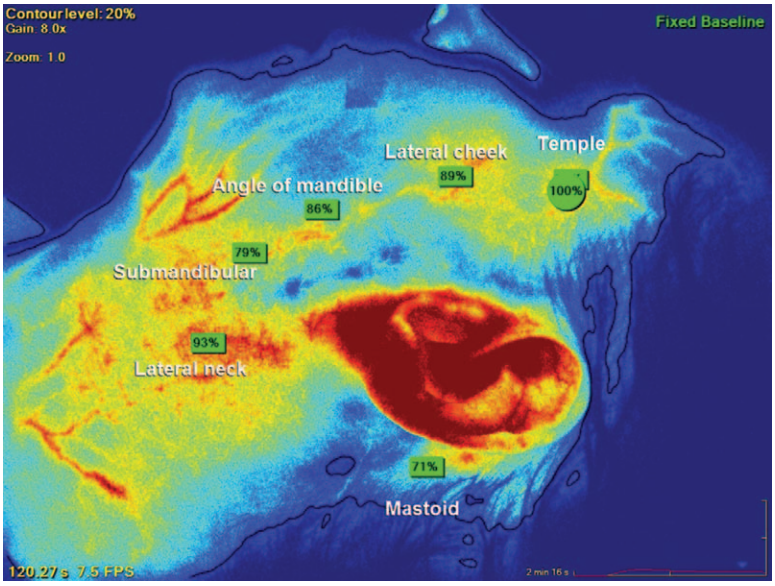


Fig. 5. SPY laser fluorescence imaging of the patient seen in Figure 4 before the left face lift. This patient received no epinephrine in her local anesthetic solution. The measurement sites are labeled. The temple is used for reference. Areas of greater perfusion appear red.

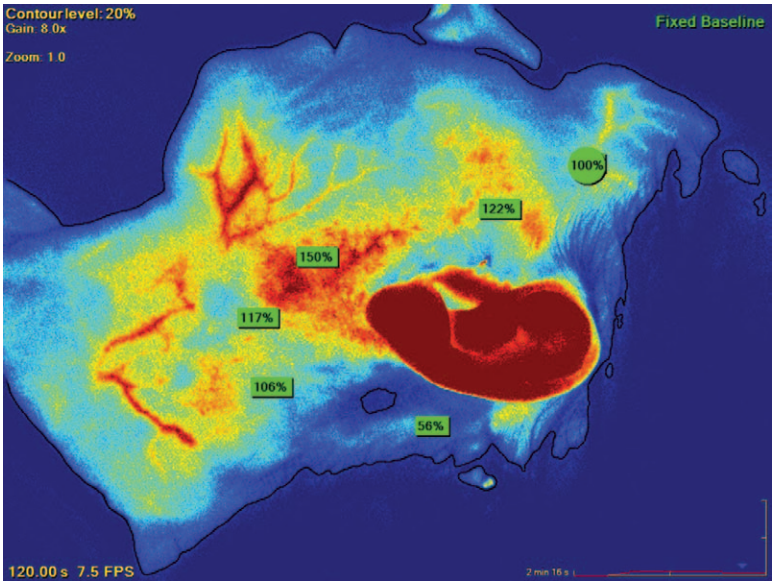


Fig. 6. SPY laser fluorescence imaging of the patient seen in Figure 4 immediately after the left face lift. There is no significant change in her perfusion measurements.

plastic surgeons recommend against using epinephrine.[25,32] The theory is that bleeding is suppressed during surgery but occurs postoperatively after the vasoconstrictive effect of the epinephrine wears off. However, there is no significant correlation between epinephrine concentration and reported hematoma rates (Fig. 11). Most surgeons take a "second look"[61] for hemostasis after the face lift repair and before skin closure. Nevertheless, hematomas occur even in patients treated by experienced plastic surgeons paying meticulous attention to hemostasis.[13]

Perhaps unfairly, patients may judge the extent of bruising as an indication of the degree of surgical trauma. Without epinephrine, the local vasodilatory effect of lidocaine is unopposed,[10,15–18] increasing bruising and delaying patient recovery (Fig. 3). Epinephrine also serves to reduce the rate of systemic

Table 3. SPY Laser Fluorescence Measurements Pre-face Lift, Epinephrine Effect, and Absolute and Relative Values*

Anatomic Site	1:300,000 Epinephrine	1:800,000 Epinephrine	None	*P*
N	3	3	3	
Absolute values				
Right temple				
Mean	26.0	38.3	26.0	
SD	16.8	10.0	14.9	NS
Range	13–45	28–48	15–43	
Right lateral cheek				
Mean	21.7	24.3	24.7	
SD	14.2	12.1	10.6	NS
Range	12–38	15–38	15–36	
Right angle of mandible				
Mean	8.7	19.3	19.0	
SD	2.3	8.1	2.0	NS
Range	6–10	12–28	17–21	
Right submandibular				
Mean	6.0	10.7	16.0	
SD	3.0	0.6	2.6	0.006†
Range	3–9	10–11	13–18	
Right lateral neck				
Mean	8.7	13.3	14.7	
SD	2.5	4.9	2.1	NS
Range	6–11	10–19	13–17	
Right mastoid				
Mean	8.7	19.3	19.0	
SD	7.0	9.3	7.0	NS
Range	2–16	13–30	14–27	
Left temple				
Mean	18.3	39.7	25.0	
SD	5.5	19.0	7.0	NS
Range	12–22	20–58	20–33	
Left lateral cheek				
Mean	13.0	29.0	26.3	
SD	7.0	14.5	2.3	NS
Range	8–21	15–44	25–29	
Left angle of mandible				
Mean	5.3	26.7	23.0	
SD	2.1	12.5	2.6	0.027†
Range	3–7	14–39	20–25	
Left submandibular				
Mean	7.0	20.3	20.7	
SD	3.0	15.0	3.2	NS
Range	4–10	6–36	17–23	
Left lateral neck				
Mean	8.7	21.7	28.7	
SD	1.5	14.0	4.6	NS
Range	7–10	8–36	26–34	
Left mastoid				
Mean	10.0	26.7	26.3	
SD	3.5	16.5	6.5	NS
Range	8–14	13–45	20–33	
Mean, all right face and neck measurements				
Mean	10.7	17.4	18.7	
SD	5.3	5.5	3.9	NS
Range	7.0–16.8	12.2–23.2	14.6–22.4	
Mean, all left face and neck measurements				
Mean	8.8	24.9	25.0	
SD	2.3	14.5	1.4	NS
Range	7.0–11.4	11.2–40.0	23.4–26.0	
Percentages				
Right temple				
Mean	100	100	100	
SD	0	0	0	—
Range	100–100	100–100	100–100	
Right lateral cheek				
Mean	98.3	69.3	126.7	
SD	45.1	28.3	56.9	NS
Range	67–150	38–93	88–192	
Right angle of mandible				
Mean	51.0	61.0	111.3	
SD	42.9	41.2	64.5	NS
Range	20–100	31–108	46–175	
Right submandibular				
Mean	31.7	31.0	92.7	
SD	24.5	6.1	54.7	NS
Range	17–60	27–38	41–150	
Right lateral neck				
Mean	48.3	38.0	89.0	
SD	36.5	10.6	55.1	NS
Range	22–90	26–46	32–142	
Right mastoid				
Mean	32.3	54.7	97.3	
SD	12.0	20.2	33.7	0.032†
Range	20–44	33–73	66–133	
Left temple				
Mean	100	100	100	
SD	0	0	0	—
Range	100–100	100–100	100–100	
Left lateral cheek				
Mean	75.0	70.7	104.7	
SD	29.8	23.9	27.0	NS
Range	42–100	54–98	78–132	
Left angle of mandible				
Mean	33.7	65.0	91.0	
SD	18.2	19.2	20.1	0.029†
Range	14–50	52–87	68–105	
Left submandibular				
Mean	39.3	47.0	86.3	
SD	7.8	29.3	37.8	NS
Range	33–48	24–80	46–121	
Left lateral neck				
Mean	51.3	50.7	119.0	
SD	7.6	25.7	55.3	NS
Range	43–58	32–80	70–179	
Left mastoid				
Mean	58.7	64.7	103.0	
SD	14.4	31.0	29.6	NS
Range	42–67	42–100	83–137	
Mean, all right face and neck measurements				
Mean	52.3	50.8	103.4	
SD	27.5	17.4	52.2	NS
Range	34.2–84.0	31.2–64.6	54.6–158.4	
Mean, all left face and neck measurements				
Mean	51.6	59.6	100.8	
SD	8.4	25.5	32.4	NS
Range	42.2–58.2	44.8–89.0	70.2–134.8	

*One-way analyses of variance were computed to compare the mean differences across groups.

†Scheffé post hoc comparisons were computed for the 4 significant analyses of variance to determine which specific groups were significantly different from each other. The mean right preoperative absolute submandibular value for the group that received 1:300,000 epinephrine was significantly smaller than the mean value for the group that did not receive epinephrine ($P = 0.006$). The mean left preoperative absolute angle of mandible value for the group that received 1:300,000 epinephrine was significantly smaller than the mean value for the group that received 1:800,000 epinephrine ($P = 0.036$). The mean right preoperative percent mastoid value for the group that received 1:300,000 epinephrine was significantly smaller than the mean value for the group that did not receive epinephrine ($P = 0.032$). The mean left preoperative percent angle of mandible value for the group that received 1:300,000 epinephrine was significantly smaller than the mean value for the group that did not receive epinephrine ($P = 0.029$). No other comparisons were significant at $P < 0.05$.

NS, not significant.

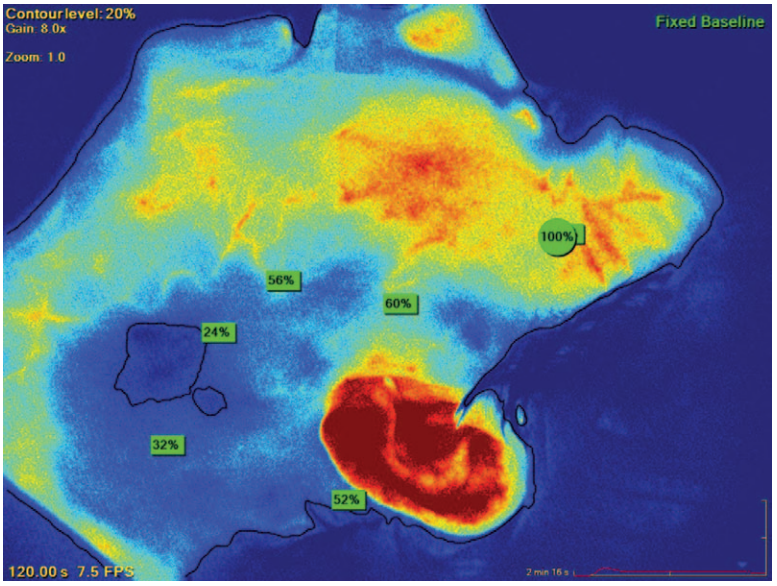


Fig. 7. SPY laser fluorescence imaging of a 78-year-old woman before her left face lift. This patient received an injection of 1:800,000 epinephrine > 20 minutes before the image was recorded. This patient was also the subject of the supplemental file videos. Despite the dilute epinephrine concentration, its vasoconstrictive effect is visible.

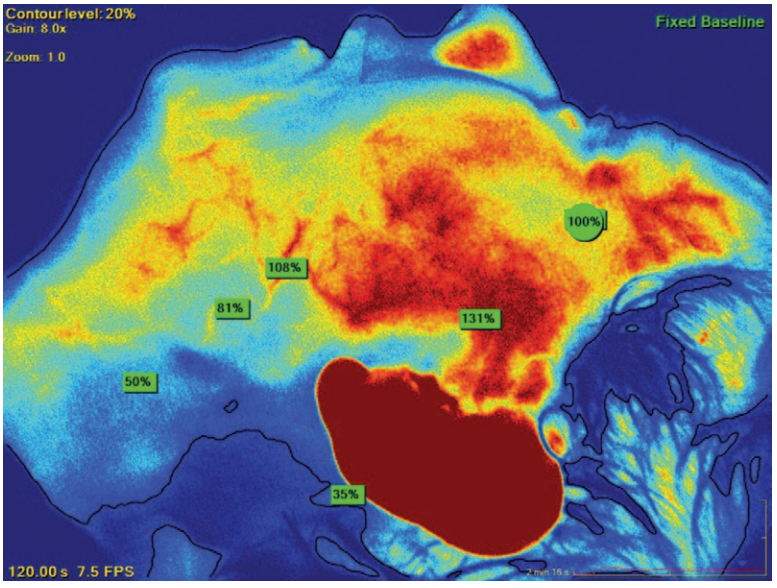


Fig. 8. SPY laser fluorescence imaging of the same patient depicted in Figure 7 immediately after completion of her left face lift.

absorption of local anesthetic agents, reducing the risk of systemic toxicity.[9]

Many plastic surgeons advocate close control of blood pressure during surgery and postoperatively, including the use of clonidine.[14,25,27,34,38,58,62] Although avoidance of hypertension is always advisable,[59] the value of intraoperative hypotension is less clear.[53,60] Local vasoconstriction is preferred to systemic hypotension to reduce blood loss. Moreover, intraoperative hypotension might be expected to increase the risk of rebound bleeding after surgery. Feldman[41] takes the opposite approach, administering intravenous ephedrine to elevate the patient's blood pressure during surgery, "so that the final look for hemostasis is a reliable one." However, vasoactive medications can interfere with the reliability of pulse, blood pressure, and respiratory rate when titrating propofol and fentanyl doses. To ensure the validity of these important

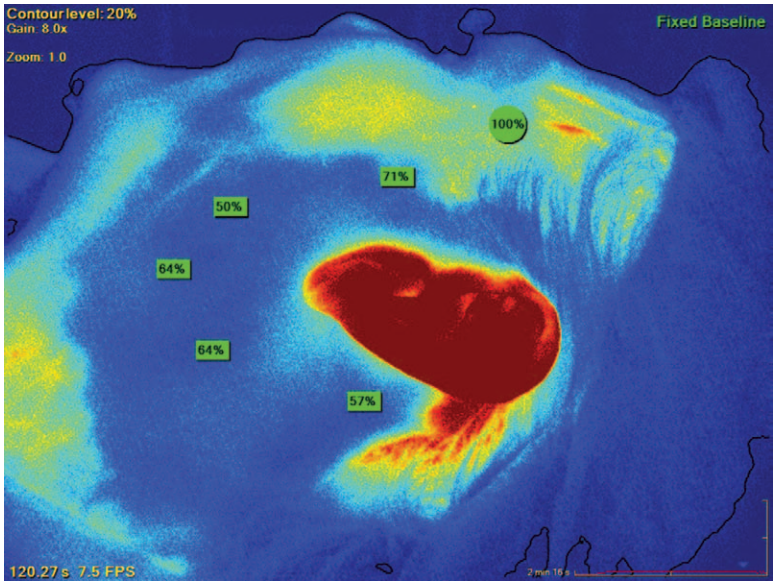


Fig. 9. SPY laser fluorescence imaging of a 59-year-old woman before her left face lift. This patient received an injection of 1:300,000 epinephrine > 20 minutes before the image was recorded. The dark blue area of the lateral cheek, jawline, lateral neck, and mastoid area demonstrates the vasoconstrictive effect of the epinephrine.

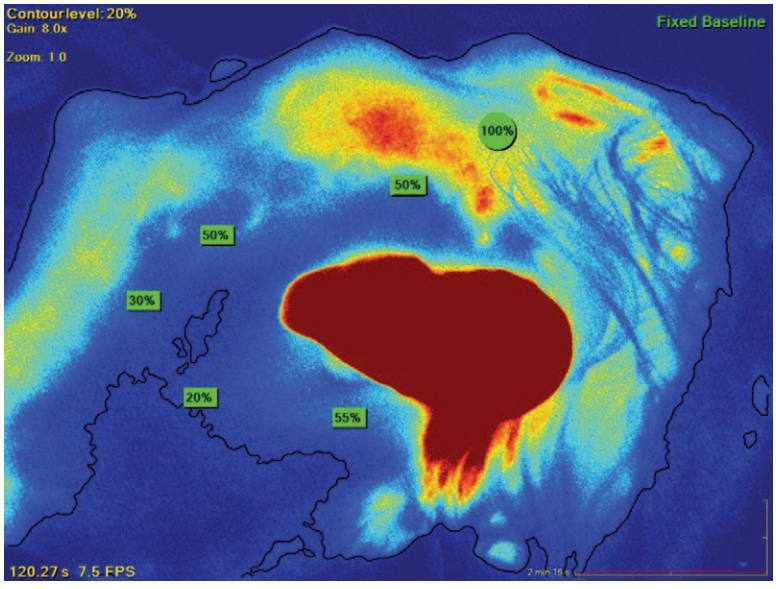


Fig. 10. SPY laser fluorescence imaging of the same patient depicted in Figure 9 after completion of her left face lift.

clinical indicators, the author prefers normotensive anesthesia. When pain and a full bladder are ruled out as causes of intra- or postoperative hypertension, antihypertensives may occasionally be administered (eg, labetalol, esmolol, and hydralazine). The incidence of postoperative nausea and vomiting, which can raise the blood pressure, may be reduced by using a propofol infusion rather than anesthetic gas[9,27] and by routinely administering antiemetics.[9,34,58,59]

Choice of Local Anesthesia

Most plastic surgeons use lidocaine for local anesthesia, usually in a concentration of 0.5% (range, 0.25–1%).[14,20–24,26,27,30,31,33,36,38–40,60] Other investigators use bupivacaine either on its own[29,35,63,64] or with lidocaine.[14,20,25,28,31,62] Bupivacaine has a greater potency and duration of action than lidocaine.[9] Its safety has been documented when administered into the subcutaneous tissue in dilute concentrations and when

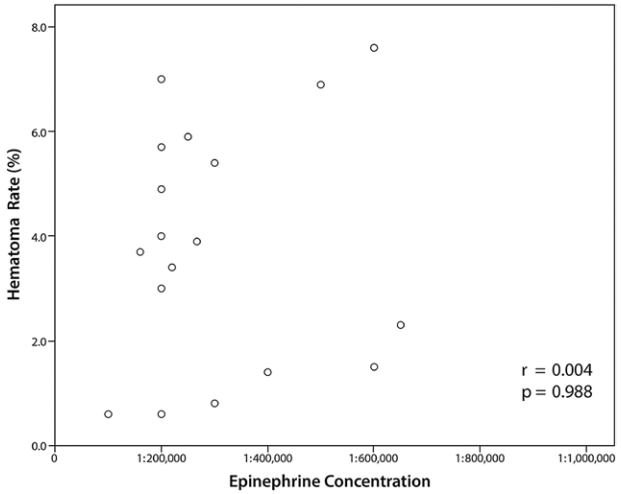


Fig. 11. Illustration of hematoma rates and epinephrine concentrations in 20 recent face lift publications. Two studies with concentrations less than 1:1,000,000 (one was 1:2,000,000[30] and the other was 1:4,000,000[41]) lie outside the graph parameters but are included in the calculations. There is no significant correlation between the epinephrine concentration and hematoma rate.

combined with lidocaine.[9] Postoperative analgesia is helpful in reducing the need for analgesic medication in the immediate postoperative period. Narcotic analgesics are a common cause of nausea and vomiting; their use should be minimized.[21] The longer duration of action of bupivacaine makes it frequently possible to evacuate a hematoma several hours after surgery without the need for a general anesthetic or additional local anesthesia. Hematomas are less onerous when they can be treated without a return trip to the operating room and without the need for another general anesthetic.

Limitations of the Study

The sample size was small, comprising only 9 patients. It is not feasible to study a large number of patients because this sophisticated imaging technology is expensive and there is no third-party payer. The cost of each study was $1300, representing the cost of each dye kit, borne by the author. Nevertheless, in view of the higher (not lower) perfusion values after surgery, it is doubtful that a significant decrease in tissue perfusion would be detected if the sample sizes were larger. There is subjectivity in assigning measurement sites and variability of perfusion measurements, although this problem is largely mitigated by combining measurements. This study provides no information on smokers, male patients, other face lift techniques, or the duration of vasoconstriction.

Strengths of the Study

A novel imaging method provides data that were previously unavailable. Eighteen before-and-after perfusion studies were possible because the procedure is bilateral. Importantly, patients served as their own controls, avoiding confounders that can affect comparisons in different patients. The same surgeon used the same technique in this prospective study of consecutive patients with a 100% inclusion rate, avoiding selection bias and adding to the reliability of the conclusions.

Video Graphic 4. See video, which demonstrates a comprehensive video showing patient interviews before and 24 hours after surgery, local anesthetic injection, face lift dissection, and SPY laser fluorescence imaging videos. This video is available in the "Related Videos" section of the Full-Text article at http://www.PRSGO.com or available at ***http://links.lww.com/PRSGO/A126***.

CONCLUSIONS

A deep-plane face lift dissection does not decrease skin flap perfusion (**See Video, Supplemental Digital Content 4**, which demonstrates a comprehensive video showing patient interviews before and 24 hours after surgery, local anesthetic injection, face lift dissection, and SPY laser fluorescence imaging videos. This video is available in the "Related Videos" section of the full-text article at http://www.PRSGO.com or available at ***http://links.lww.com/PRSGO/A126***). Both 1:300,000 epinephrine and 1:800,000 epinephrine concentrations are effective in producing intraoperative vasoconstriction.

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