

Conflict of interest statement

None

Indocyanine Green Angiography in Oncoplastic surgery

Is it relevant?

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Breast Cancer - Facts

- Most common cancer in women
- Number one cause of deaths in women
- 2.2 million women worldwide in 2020
- ~ 4500 women/year in Denmark

- Screening
- Increasingly more effective treatment
- Increasing number of survivors
- More women seek breast reconstruction



Breast reconstruction – Overall complications 10 – 40%

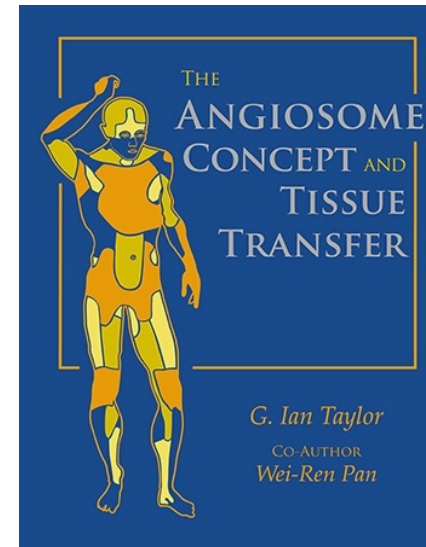
- Epidermolysis
- Necrosis
- Infection
- Hematoma
- Seroma
- Implant loss
- Flap loss



Reconstruction - It's all about the blood perfusion

- 1889 Marchot
- 1930 Salmon
- 1987 Taylor & Palmer

- Composite block of 3D tissue supplied by an artery

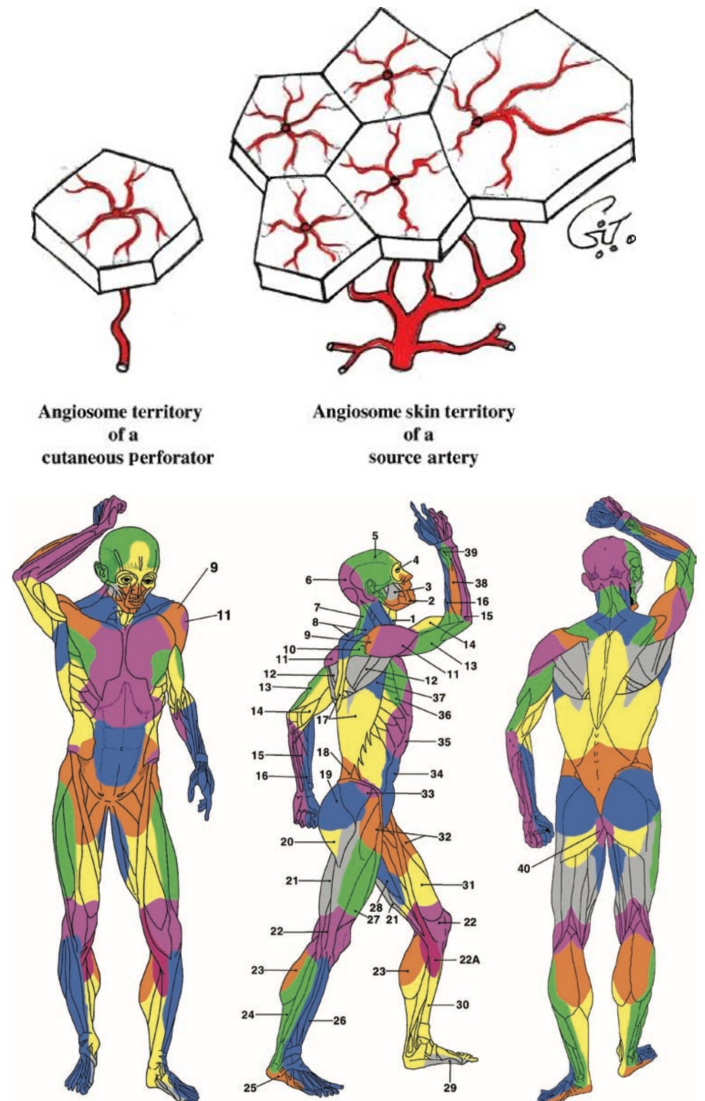


British Journal of Plastic Surgery (1987), **40**, 113-141
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The vascular territories (angiosomes) of the body: experimental study and clinical applications

G. I. TAYLOR and J. H. PALMER

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University of Melbourne*



Indocyanine Green (Verdye®)

- Water soluble molecule
- Injected per-operatively
- Half-life 3-5 min.
- Can be repeated during surgery
- Excreted via the liver to the bile



Indocyanine Green Angiography

- Intraoperative imaging modality
- Real-time tissue perfusion
- Aids the surgeon in decision making
- Fluorescent near-infrared camera
- Cut-off perfusion score 33%





Be aware of:

- Anaphylactic shock 1:42.000
- Side-effects 0.34%:
 - Nausea
 - Dizziness
 - Discomfort
 - Rash
 - Sweating
- Extravasation



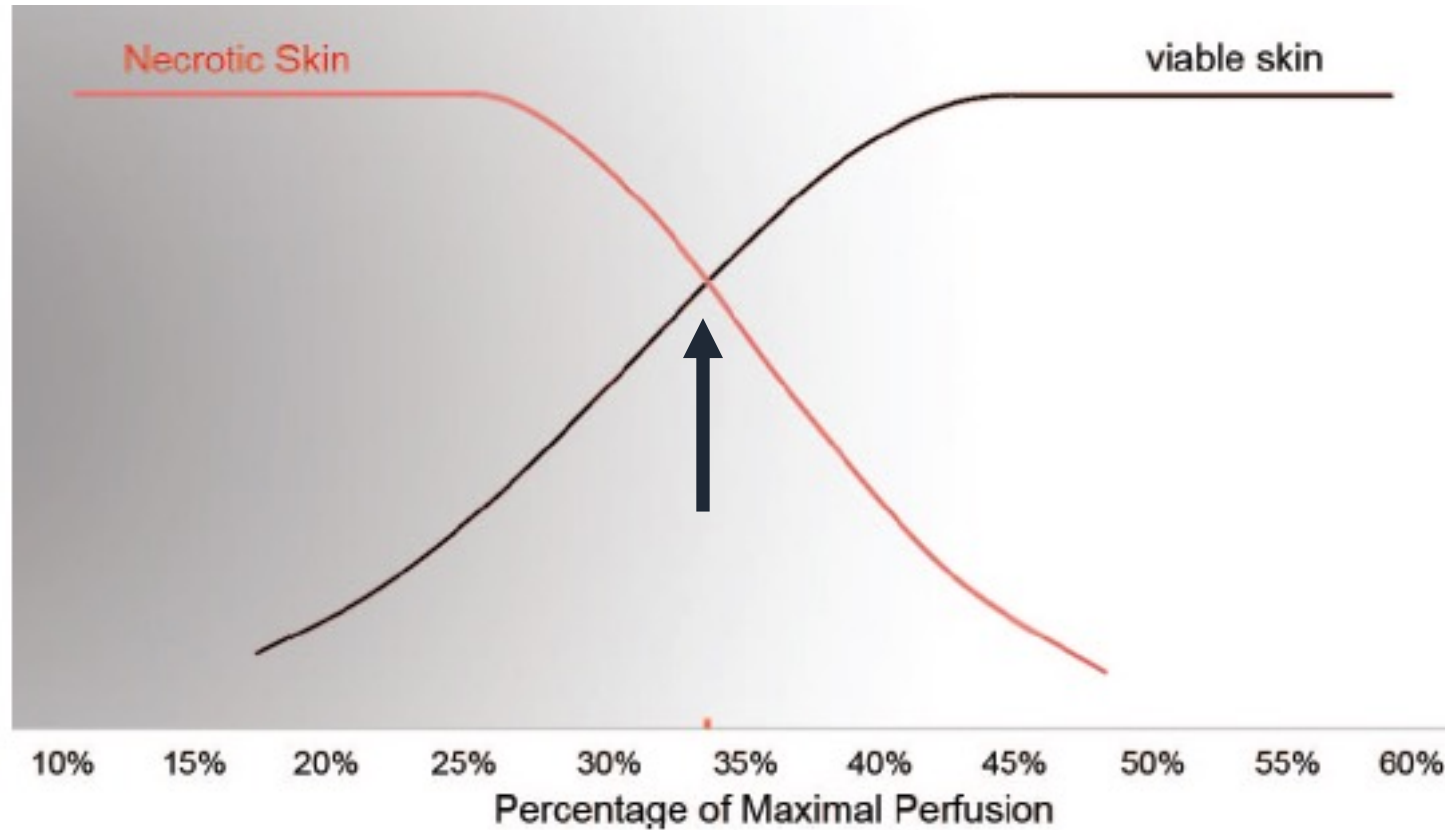
Review Article

Indocyanine green angiography in breast reconstruction: a narrative review

Elisabeth Lauritzen, Rikke Bredgaard, Christian Bonde, Lisa Toft Jensen, Tine Engberg Damsgaard

Predicting mastectomy skin flap necrosis with indocyanine green angiography: the gray area defined

Hunter R Moyer ¹, Albert Losken



107/70

245%

136%

Quantification of the per-operative perfusion

SPY-Elite® imaging system

- Camera fixed on arm
- Steady measurement
- 20 cm from tissue
- Built in laser for optimal distance



SPY-PHI QP system

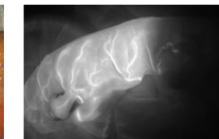
- Hand-held, lightweight camera
- 10-40 cm from tissue
- Large field of vision
- Independent of OR lighting
- Measurement not affected by contour of tissue



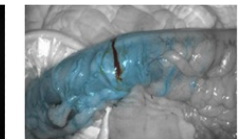
White Light



Overlay Mode



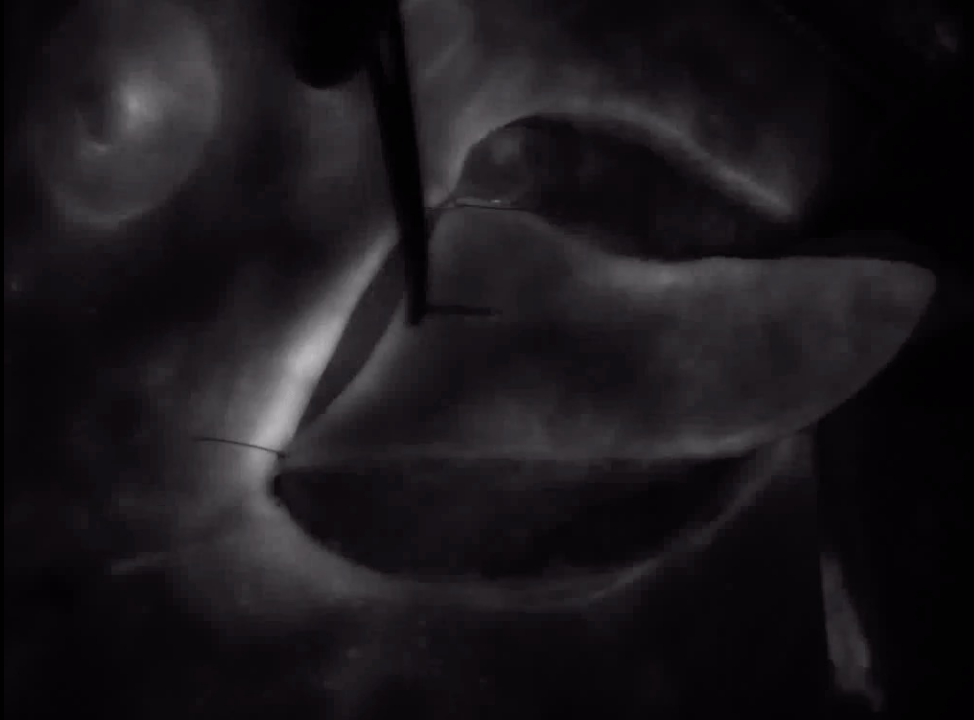
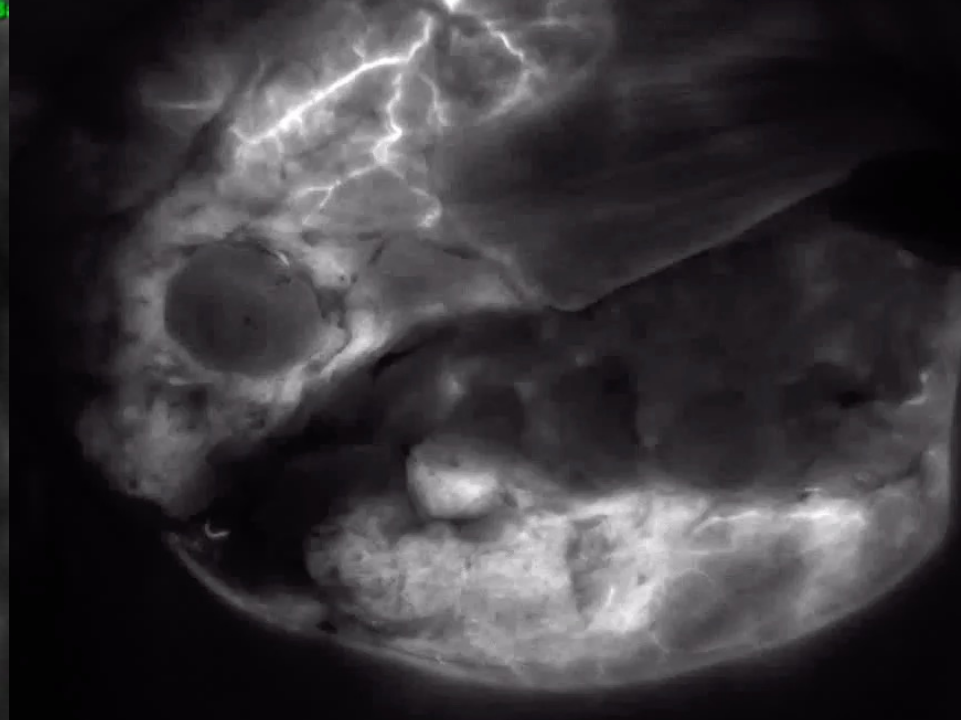
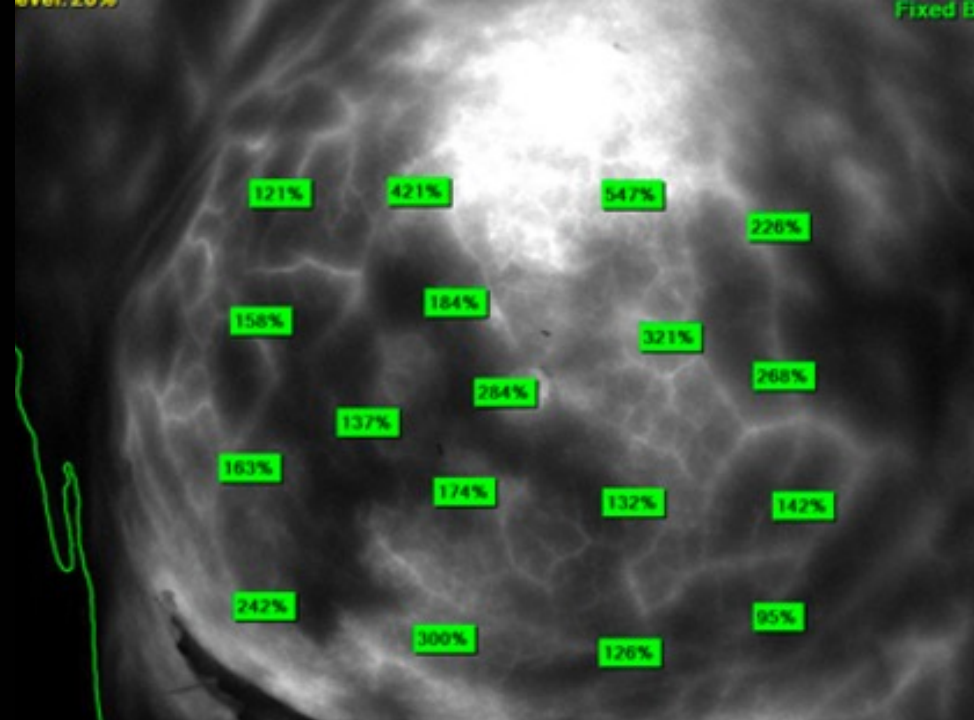
SPY Fluorescence Mode



Color Segmented
Fluorescence (CSF) Mode

06/07/2024

Fixed B



Use of peroperative ICG-A = lower risk of complications



A Systematic Review of the Utility of Indocyanine Angiography in Autologous Breast Reconstruction

Parmeshwar, Nisha MD²; Sultan, Steven M. MD³; Kim, Esther A. MD²; Piper, Merisa L. MD³

Author Information 

Annals of Plastic Surgery: May 2021 - Volume 86 - Issue 5 - p 601-606
doi: 10.1097/SAP.0000000000002576



Use of Indocyanine Green Angiography decreases the risk of complications in autologous- and implant-based breast reconstruction: A systematic review and meta-analysis

Elisabeth Lauritzen*, Tine Engberg Damsgaard

Department of Plastic Surgery and Burns Treatment, Copenhagen University Hospital, Denmark



BREAST: ORIGINAL ARTICLES

Outcomes of DIEP Flap and Fluorescent Angiography: A Randomized Controlled Clinical Trial

Varela, Ramon M.D.; Casado-Sanchez, Cesar M.D., Ph.D.; Zarbakhsh, Shirin M.D.; Diez, Jesus M.D., Ph.D.; Hernandez-Godoy, Juan M.D.; Landin, Luis M.D., Ph.D.

Cochrane Database Syst Rev. 2020 Apr; 2020(4): CD013280. PMID: PMC7175780

Published online 2020 Apr 22.

PMID: [32320056](https://pubmed.ncbi.nlm.nih.gov/32320056/)

doi: [10.1002/14651858.CD013280.pub2](https://doi.org/10.1002/14651858.CD013280.pub2)

Indocyanine green angiography for preventing postoperative mastectomy skin flap necrosis in immediate breast reconstruction

Monitoring Editor: [Tim Pruijboom](#), [Rutger M Schols](#), [Sander MJ Van Kuijk](#),

ICG-A - level of evidence

Review

Use of Indocyanine Green Angiography decreases the risk of complications in autologous- and implant-based breast reconstruction: A systematic review and meta-analysis

Elisabeth Lauritzen*, Tine Engberg Damsgaard

Department of Plastic Surgery and Burns Treatment, Copenhagen University Hospital, Denmark

> [Plast Reconstr Surg.](#) 2012 May;129(5):1043-1048. doi: 10.1097/PRS.0b013e31824a2b

Predicting mastectomy skin flap necrosis with indocyanine green angiography: the gray area defined

Hunter R Moyer¹, Albert Losken

Affiliations + expand

PMID: 22544087 DOI: 10.1097/PRS.0b013e31824a2b02

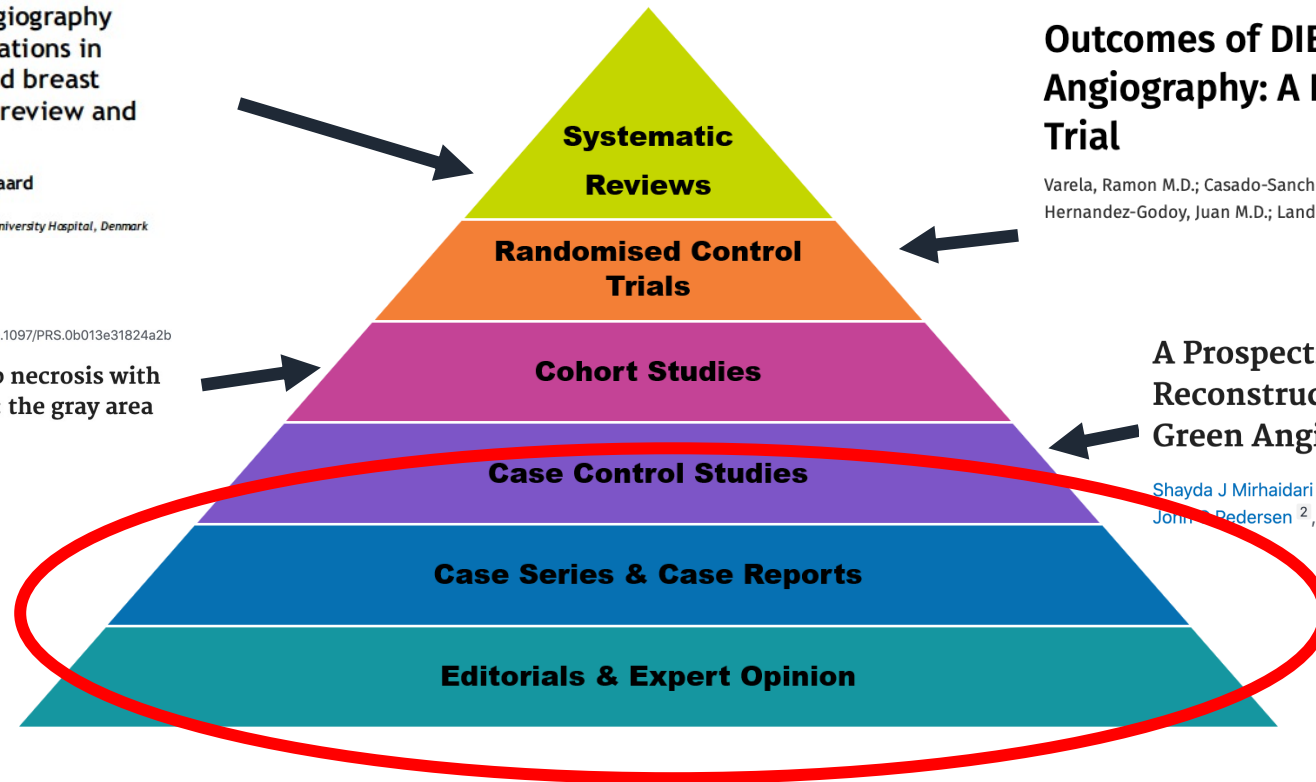
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A Prospective Study of Immediate Breast Reconstruction with Laser-Assisted Indocyanine Green Angiography

Shayda J Mirhaidari¹, Gregory M Beddell¹, Marc V Orlando¹, Michael G Parker¹, John C Pedersen², Douglas S Wagner¹



Majority

OBCS & ICG-A – what do we know?

Kijima et al. 2014

- Case-series
- Vol. replacement

Lauritzen et al. 2021

- Narrative review
- Vol. displacement + replacement

Lauritzen et al. 2022

- Pilot-study





Further studies needed

Oncoplastic breast conserving surgery (OBCS)

First described late 1970'ies

- 💡 Benelli
- 💡 Clough
- 💡 Galimberti

Comparative Study > Cancer. 1978 Oct;42(4):2045-53.

doi: 10.1002/1097-0142(197810)42:4<2045::aid-cnrcr2820420455>3.0.co;2-8.

Conservative management of operable breast cancer: ten years experience at the Foundation Curie

R Calle, J P Pilleron, P Schlienger, J R Vilcoq

PMID: 101299 DOI: 10.1002/1097-0142(197810)42:4<2045::aid-cnrcr2820420455>3.0.co;2-8

BCS vs. OBCS:

- ✅ Oncologic safety
- ✅ Surgical complications
- ✅ Aesthetic outcome
- ✅ Specialized breast centres

Review > Surg Oncol. 2022 Jun;42:101779. doi: 10.1016/j.suronc.2022.101779.

Epub 2022 May 10.

Comparison of surgical and oncological outcomes between oncoplastic breast-conserving surgery versus conventional breast-conserving surgery for treatment of breast cancer: A systematic review and meta-analysis of 31 studies

Ali Yasen Y Mohamedahmed ¹, Shafquat Zaman ², Shaista Zafar ², Ishita Laroia ²,
Javeria Iqbal ², Melissa Ley Hui Tan ², Geeta Shetty ²

Why use OBCS techniques?

Breast conserving surgery (BCS):

- Removing only enough tissue to secure free margins
- **Up to 50% experience breast deformities!**
- **OBCS introduced to overcome this**



Ann Surg Oncol (2010) 17:1375–1391
DOI 10.1245/s10434-009-0792-y

Annals of
SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY

ORIGINAL ARTICLE – BREAST ONCOLOGY

Improving Breast Cancer Surgery: A Classification and Quadrant per Quadrant Atlas for Oncoplastic Surgery

Krishna B. Clough, MD, Gabriel J. Kaufman, MD, Claude Nos, MD, Ines Buccimazza, MD,
and Isabelle M. Sarfati, MD

Department of Surgery, The Paris Breast Center (L'Institut du Sein), Paris, France

Oncoplastic breast conserving surgery (OBCS)

Volumen displacement

- Recruiting and transposing local dermoglandular flaps into the resection site

- Eg.:
 - Breast-flap advancement
 - Mammoplasty (sup- / inf. pedicle)
 - Centralization of NAC-complex
 - +/-contralat. surgery (reduction mammoplasty)



Figure 3 Volume displacement. Superior pedicle approach to reconstruct defect in inferior pole.



Figure 4 Volume displacement. Inferior pedicle approach to reconstruct central defect.



Figure 5 Volume displacement. Round block approach to reconstruct peripheral defect.

Oncoplastic breast conserving surgery (OBCS)

Volumen replacement

- Importing volume from elsewhere to replace the amount of tissue resected

- Eg.:
 - LICAP-flap
 - LD-flap



Figure 1 Volume replacement. Latissimus dorsi myocutaneous miniflap used for reconstruction of lower pole defect.



Figure 2 Volume replacement. Latissimus dorsi myosubcutaneous miniflap used for reconstruction of upper pole defect.

ICG-A for OBCS - a prospective observational study

Hypothesis:

- Use of ICG-A will optimize perfusion
- Reduce rates of postoperative infection and skin necrosis



ICG-A for OBCS - a prospective observational study

Primary endpoints:

- Feasibility of ICG-A for OBCS
- Localize perforators and determine tissue supplied by the perforator
- Complications
 - ICG-A vs. post op. complications

Secondary endpoints:

- Satisfaction with scars
- QoL
- Risk of developing lymphedema

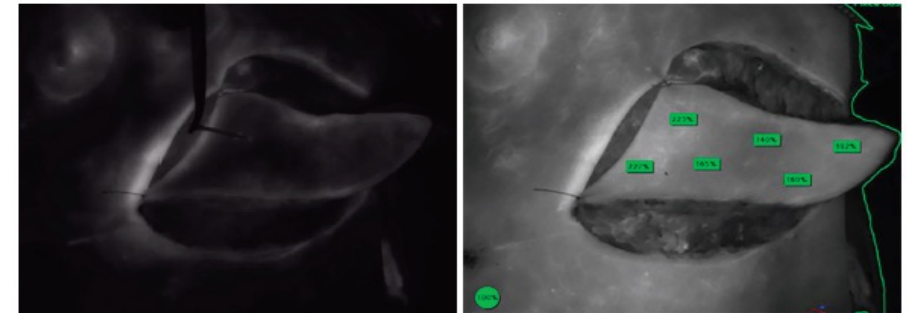
Methods

Study design:

- Prospective observational

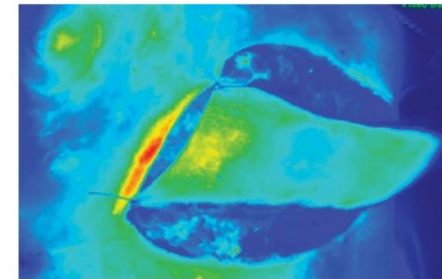
15 patients:

- Volume displacement- and replacement OBCS
- February 2020 to June 2021
- Dep. Plastic Surgery and Burns Treatment, Copenhagen University Hospital & Dep. Breast Surgery, Herlev Gentofte Hospital
- 1 year follow-up



A. ICG-A after raising the LICAP-flap before transposition, visualizes perforators (Video 4)

B. Quantification and scoring of perfusion. Perfusion is generally >33%



C. ICG-A color mode



D. Per-operative clinical photo of LICAP-flap before de-epithelialization

[Review Article](#)

Indocyanine green angiography in breast reconstruction: a narrative review

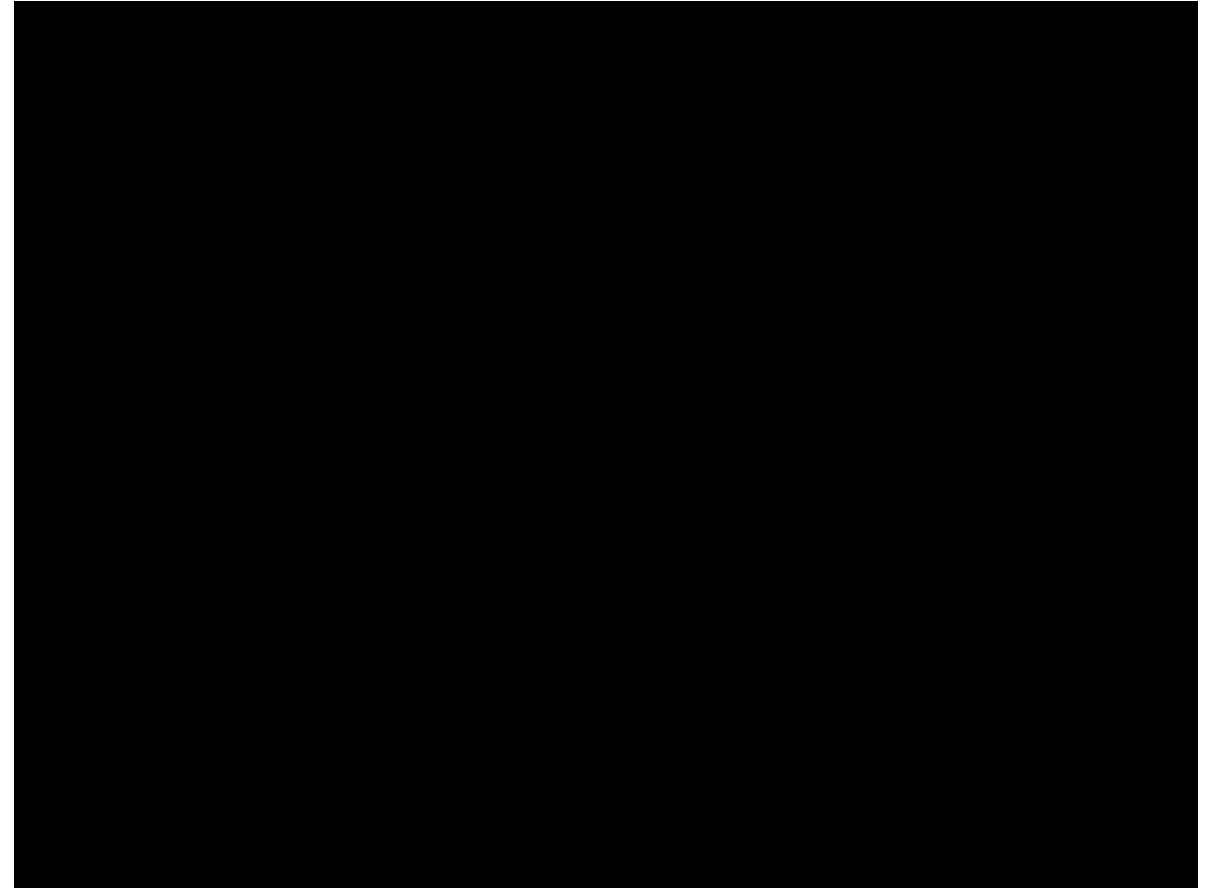
Elisabeth Lauritzen, Rikke Bredgaard, Christian Bonde, Lisa Toft Jensen, Tine Engberg Damsgaard

Methods

Peroperative ICG-A:

- Bolus 2.5 ml/mg Verdye® + 10 ml saline
- Perfusion values quantified after 45 sec.
- Relative perfusion cut-off score 33%

- **3 preset timepoints:**
 1. After lumpectomy
 2. Upon dissection of perforators
 3. After wound closure



Follow-up

- Clinical evaluation:
 - Pre-op., 4 weeks, 4-6 months and 12 months postop.
 - Patient well-being
 - Clinical examination of surgical field
 - POSAS
 - BREAST-Q
 - Lymphedema measurements
 - Timing of adjuvant therapy



Results

- 11 patients included
- Mean age 59.2
- Mean BMI 25.9
- 7 volumen displacement OBCS
- 4 volumen replacement OBCS:
 - 3 LICAP
 - 1 msLD

Results

- Peroperative ICG-A:
 - Sufficient in 100%
 - **No cases of necrosis or loss of OBCS**
- Complications:
 - Major: none
 - **Minor: 9% (1 ptt.)**
- Lymphedema: 0 ptt.
- **Breast edema: 36.4% (4 ptt.)**
- **Delay in adjuvant treatment: 1 ptt.**
 - Due to COVID-19
- Scar assessment (POSAS)
 - 4-weeks and 4-6 months
 - 1 year: **No difference**
- QoL (BREAST-Q)
 - 4-weeks – 12 months
 - 1 year: **No difference in pre- and postop. score**

Breast edema – an underrepresented complication?

- 1 patient
 - Diagnosed at 4-6 months visit
- 3 patients
 - Diagnosed at 12 months

Table 2. Case specifics, outcomes and adjuvant treatment

Patient no.	Age	BMI	Meno. Status	Diagnosis	SNB /ALD	Type of OBCS	Perop. ICG-A	Eventful healing	Adj. treatment	Adj. treatment on time? Y/N	Breast edema postop. Time of diagnosis.
1	53	31.6	Pre	Intraductal carcinoma	SN dxt.	Volume displacement	OK	-	Radiation therapy	On time? N	-
2	71	27.3	Post	Intraductal carcinoma	SN dxt.	Volume displacement	OK	-	None (patients' decision)	On time? Y	-
3	62	25.4	Post	Intraductal carcinoma	SN dxt.	Volume displacement	OK	-	NACT, radiation therapy, antihormone	On time? Y	4-6- and 12 months postop.: Breast edema. Compression+deep oscillation treat.
4	47	24.6	Pre	DCIS	-	Volume replacement (LICAP flap)	OK	-	Radiation therapy	On time? Y	-
5	63	25.8	Post	DCIS	SN dxt.	Volume replacement (msLD-flap)	OK	-	Radiation therapy, antihormone	On time? Y	12 months postop.: Breast edema. Compression+deep oscillation treat.
6	68	26.2	Post	Intraductal carcinoma	SN dxt.	Volume displacement (bilat.)	OK	-	Radiation therapy, antihormone	On time? Y	-
7	59	24.5	Post	Intraductal carcinoma	SN dxt.	Volume displacement (bilat.)	OK	-	Radiation therapy, antihormone	On time? Y	-
8	49	19.7	Pre	Intraductal carcinoma	SN + ALD dxt.	Volume replacement (LICAP flap)	OK	-	NACT, radiation therapy	On time? Y	12 months postop.: Breast edema. No treat.
9	57	24.2	Post	DCIS	SN dxt.	Volume replacement (LICAP flap)	OK	-	Radiation therapy	On time? Y	-
10	69	26	Post	Intraductal carcinoma	SN dxt.	Volume displacement (bilat.)	OK	-	Chemo- and radiation therapy, antihormone	On time? Y	12 months postop.: Breast edema. Compression+manual drainage
11	53	29.6	Pre	DCIS	SN sin.	Volume displacement (bilat.)	OK	Infection, seroma. Cons. treat.	Radiation therapy	On time? Y	-

Breast edema – **an underrepresented complication?**

- 4 of 11 patients → **36.4%**
- On the OBCS treated side
- All treated with postop. radiation therapy

• Incidence reported: 28.2 – 32.7%

Independent risk factors:

- Radiation therapy
- OBCS
- Axillary lymph node dissection
- Large tumor size

! Increasing demand for OBCS

! Small sample size

! Observational study

! Further studies are needed

