The use of indocyanine green fluorescent angiography for real-time assessment in microvascular free flap anastomosis in Udonthani hospital

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Background and literature review

- Microvascular tissue transfer ->
  - Past: very complex, difficult, need specialist, low success rate, high donor site morbidity
  - Present: better planning, higher success rate (>90% in large center)
- Better pre-operative planning (CTA, U/S doppler, CADs/CAM) -> reduce complication/increase success rate
- Intra-operative assessment?
- ICG -> more than 50 years for hepatic function assessment, retinal vascularity and cardiac function evaluation
- **Safe** & no need to expose radiation (Fluoroscope/contrast)

Background and literature review

- Liu et al. (2011) -> Report using ICG angiography in free flap first time
- Wu et al. (2013) -> Clinical appraisal for ICGA in plastic surgery (preoperative planning for lymphatic surgery, post-op monitoring of flap)

Rationale

- Plastic surgeons require informations regarding flap perfusion after microvascular free tissue surgery intraoperatively to reduce post-operative complications and enhance the success rate of free flap surgery

Objective

- To review and demonstrate the promising and satisfied outcomes of the use of indocyanine green angiography for real-time assessment in microvascular free tissue transfer

Research methodology

- Retrospective design
  - Retrospective descriptive study
- Population and setting
  - All patients 18 years old to 65 years old who underwent free tissue transfer with ICG angiography at Udonthani hospital between August 2020 - August 2021

Exclusion criteria

- Iodine allergy
- Hyperthyroidism/neoplasm of thyroid gland
- Peripheral vascular disease

Research methodology

- All patients received ICG intravenous by anesthesiologist after microvascular free flap anastomosis
- The dye uptake and clearance were observed real-time on microscope screen
- The dye could be injected repeatedly every 5 mins for further investigation
- Clinical features and characteristics of the flap were also recorded (color, capillary refill, arterial pulsatile, venous tension, blood on flap edge, temperature)

Indocyanine green

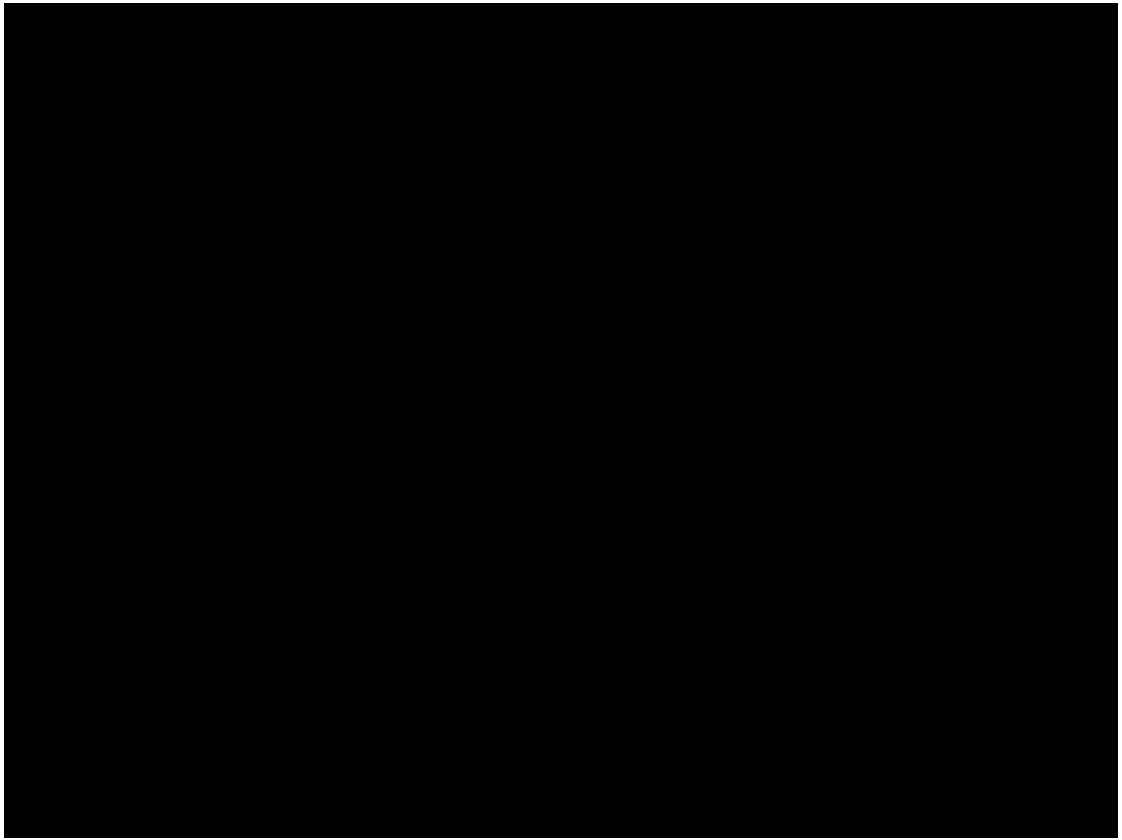
- 2 mg/kg of ICG or
- 12.5 mg intravenous bolus
- Repeat 3-5 minutes

Leica M530 OH6

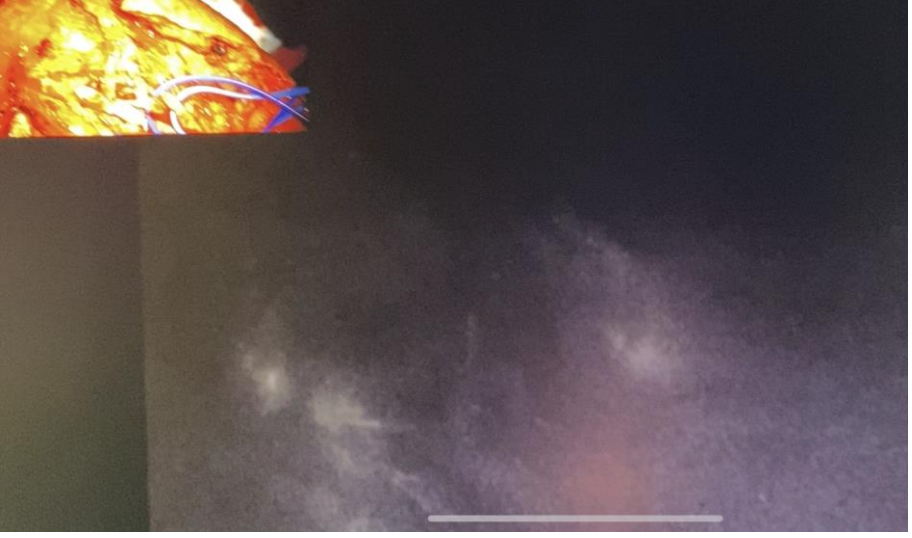
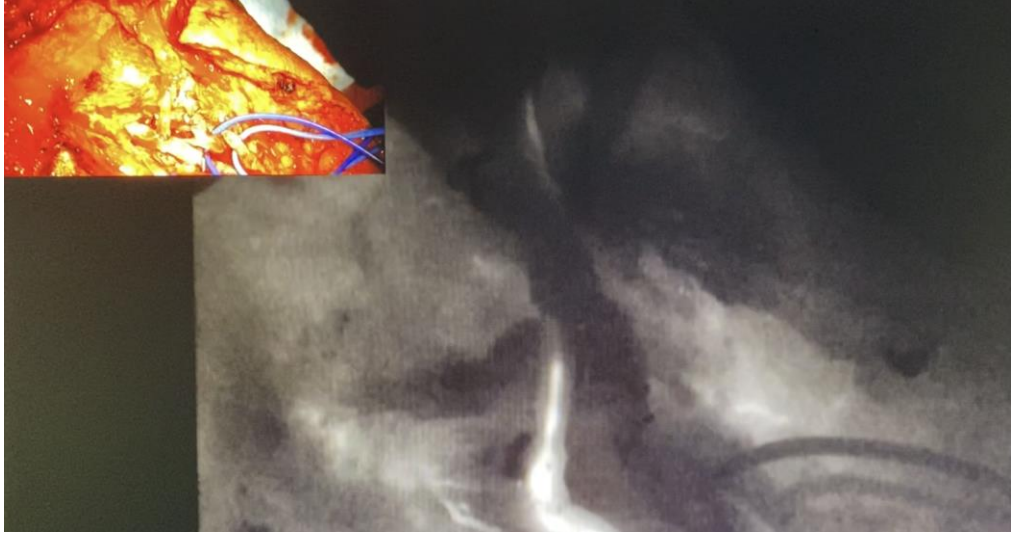
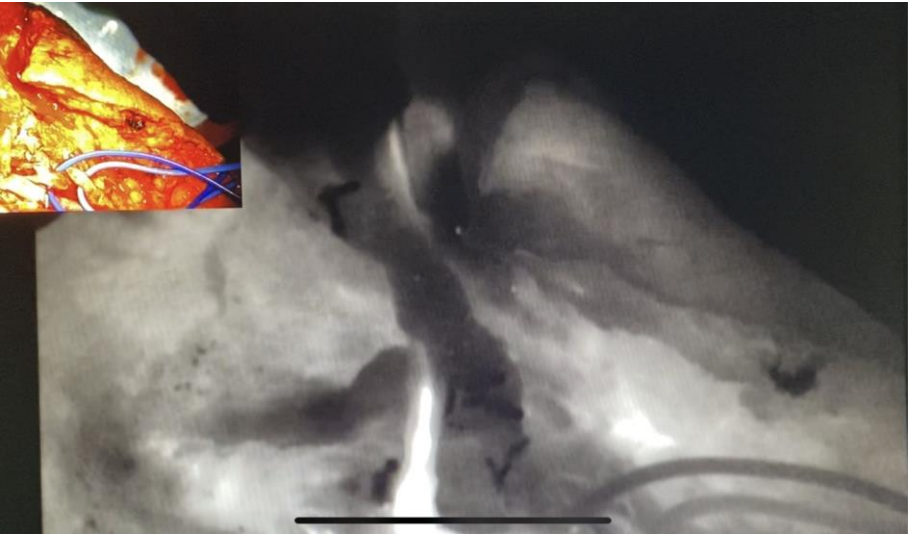
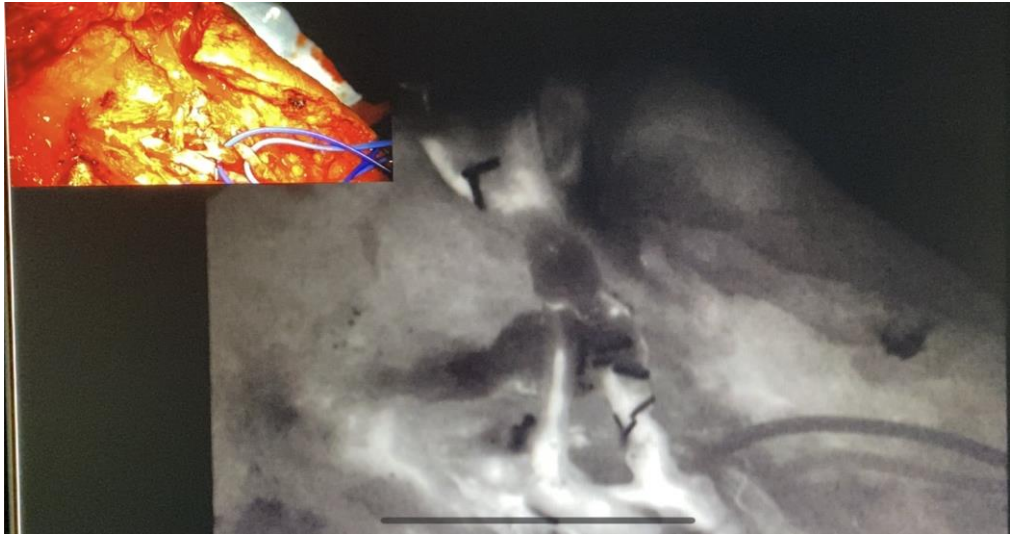
Reconstruction heel defect with contralateral medial plantar free flap

Case 1

Medial plantar free flap



Microvascular anastomosis

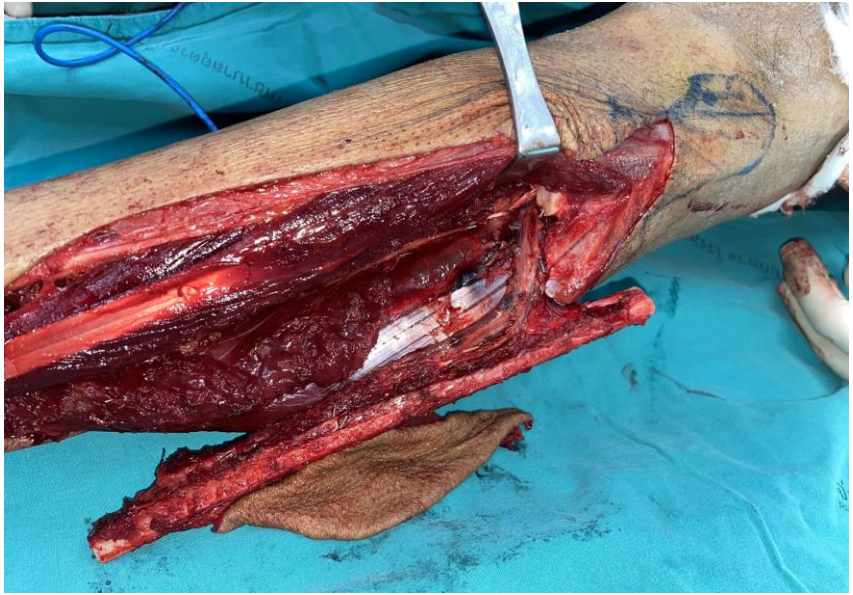





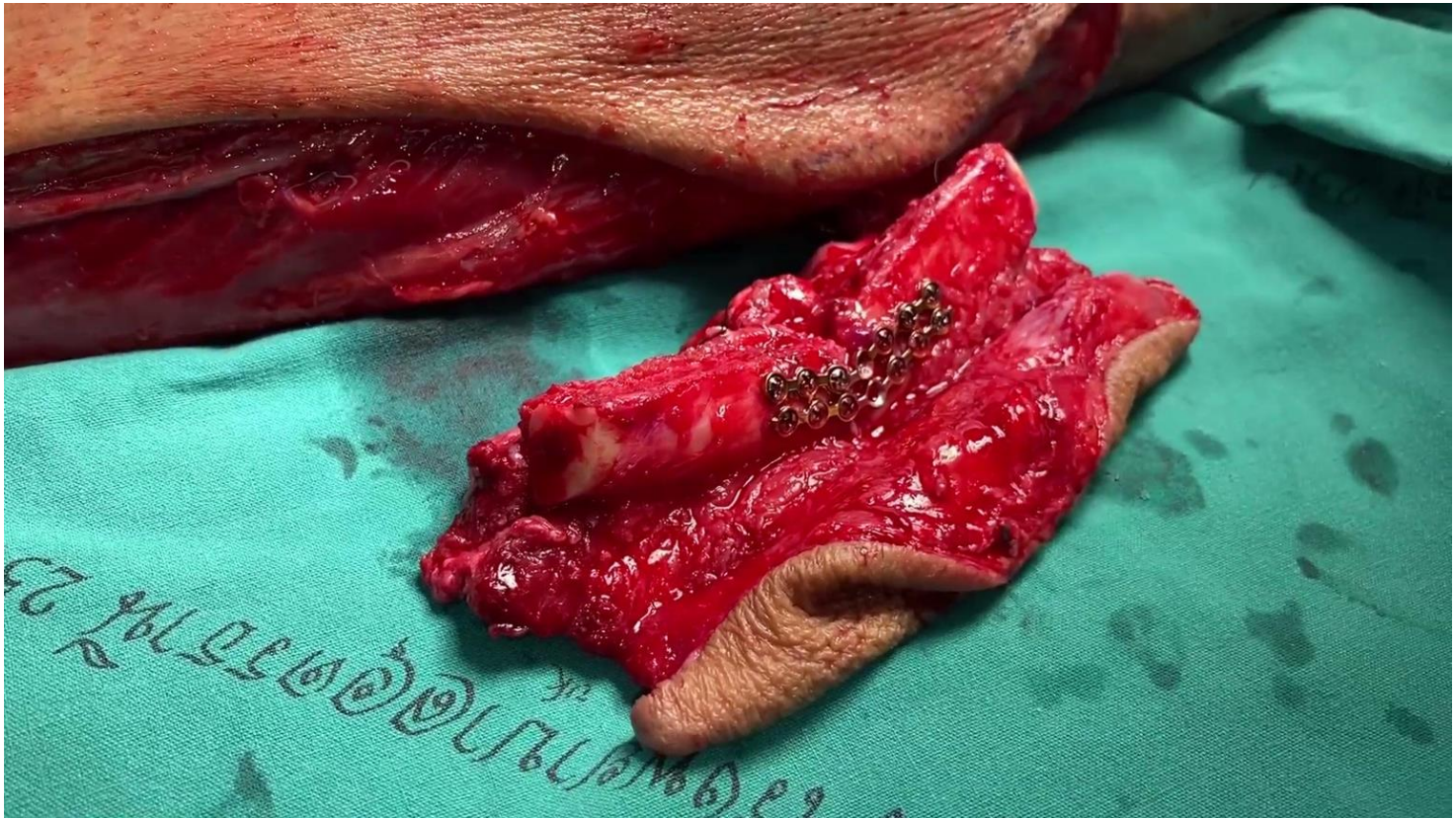
Video shows ICG angiography

3 months follow-up

Reconstruction of mandible & tongue defects with fibular osteocutaneous free flap

Case 2

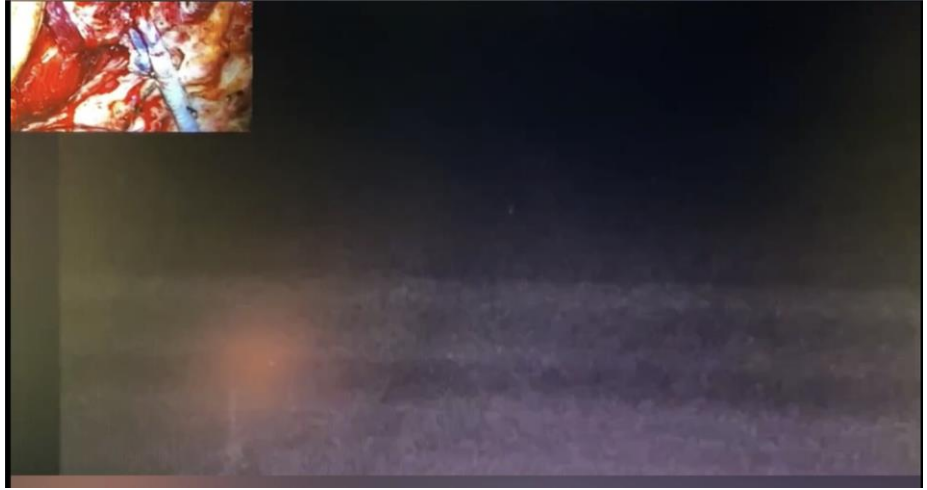


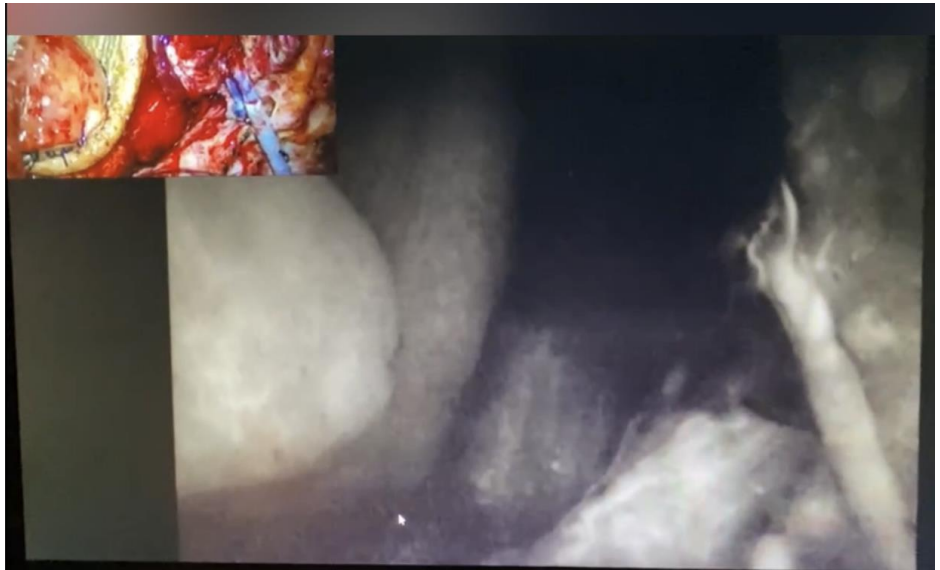


Clinical findings after osteotomy of fibular bone

Microvascular anastomosis (Nylon 9-0)

clinical findings after flap inset





Fibular osteocutaneous flap ICG angiography

After inserting the flap

1 month after surgery

Results

ราย	เพศ	อายุ	วินิจฉัย	ตำแหน่งรอยโรคหลังผ่าตัด	ชนิดของ flap	ICG angiography intra-op	คุณลักษณะทางคลีนิค	ผลลัพธ์
1	ชาย	58	Leiomyosarcoma left elbow	Left elbow defect	Anterolateral thigh flap	++	++	Flap survive 100%
2	หญิง	38	Osteoradionecrosis of forehead skull	Forehead defect with skull exposed	Radial forearm flap	++	++	Flap survive 100%
3	ชาย	21	Open fracture talus with extensive soft tissue loss	Right dorsal foot defect with bone exposed	Anterolateral thigh flap	++	++	Flap survive 100%
4	ชาย	19	Avulsion wound with calcaneus bone fracture	Left heel defect with calcaneus bone exposed	Contralateral medial plantar flap	++	++	Venous congestion : re-operative for venous anastomosis หลังทำมี partial flap necrosis
5	ชาย	36	Open fracture left 4th and 5th finger with hypothenar defect	Left hypothenar defect with bone exposed	Anterolateral thigh flap	++	++	Flap survive 100%, ทำหลัง failed PIA flap
6	ชาย	53	Avulsion flap on left dorsal hand s/p 3rd finger amputation	Left dorsal hand defect with tendon exposed	Medial sural artery flap	++	++	Flap survive 100%
7	ชาย	46	Locally advanced squamous cell carcinoma of right lower gum invaded mandible/tongue	Composite defects : right lateral mandible, half of tongue and floor of mouth	Osteocutaneous fibular flap	++	++	Flap survive 100%

Conclusion

- ICGA - standardized and reproducible real-time flap perfusion assessment intra-operatively
- high sensitivity in detecting well-perfused and non-perfused tissue in plastic surgery
- Potential to reduce flap related complications and enhance success rate in free flap surgery

Discussion

- This is the first study of indocyanine green angiography(ICGA) in free flap surgery in Thailand.
- ICGA has proved to be sensitive in detecting arterial inflow to the flap (easily to determine well-perfused vs non-perfused tissue)
- However ICGA isn’t sensitive to detect venous congestion after vascular anastomosis need more clinical experiences and studies
- Post-operative flap monitoring is still the key for early detection any sign of flap complications
- Despite ICGA, still no absolute or relative perfusion levels correlating with fluorescence intensity
- Lee et al. -> 20% - 30% intensity is ”safely perfused tissue”

Discussion

- Complex reconstruction in our series -> chimeric flap/fibular osteocutaneous flap, ICG is very helpful to determine flap perfusion
- Beckler et al. (2015) -> showed that ICGA reduced partial skin flap necrosis (8%) compared to clinical alone (33%) in head and neck reconstruction
- ICGA should be considered in any flap in which skin paddle viability is uncertain based on clinical findings or extends beyond angiosome
- Serial peri-operative ICGA need further investigation to prove benefit
- Anthony et al. (2021) -> mean perfusion of free flap during intra-operative and immediate post-op period are norminal.