

Supplementary Table 5: Parathyroid identification

Ref. No.	Author	Country	Journal	Year	Study design	Patient selection		Imaging techniques				Endpoint measures				Learning curve	Cost analysis	Other comments	Ref. detail			
						Subject	N (cases)	Fluorogenic agent	Dose	Route	Timing	Imaging system	Quantitative measurement	Main endpoints	Imaging accuracy/success rate					Clinical impact, changes in intraoperative decision-making and outcomes	Clinical impact, advantages in postoperative outcomes	Adverse effects
1	Paras	US	J Biomed Opt	2011	Prospective	Endocrine surgery	21	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	NA	Fiber optic spectrometer (S2000-FL, Ocean Optics)	Fluorescence intensity	Fluorescence intensity of the parathyroid gland and surrounding tissues	The fluorescence intensity of the parathyroid gland was found to be consistently greater than that of the thyroid and all other tissues in the neck of all patients. In particular, parathyroid fluorescence was two to eleven times higher than that of the thyroid tissues with peak fluorescence occurrence at 470 to 475 nm	NA	NA	None	NA	NA	Paras C, Keller M, White L, Pflug J, Mahadevan-Jansen A, Broome JT. <i>Optic</i> . 2011 Jun;16(6):0670-2.	
2	McWade	US	Surgery	2013	Not stated	Parathyroidectomy and thyroidectomy	45	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After identifying the parathyroid tissue	Ocean Optics spectrometer	NA	Detect the parathyroid glands to avoid inadvertent removal	100%	NA	NA	None	NA	NA	McWade MA, Paras C, White LM, Pflug JE, Mahadevan-Jansen A, Broome JT. <i>Surgery</i> . 2013 Dec;154(6):1371-7.	
3	McWade	US	J Clin Endocrinol Metab	2014	Case series	Parathyroidectomy and thyroidectomy	6	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After identifying the parathyroid tissue	Ocean Optics spectrometer	NA	Localize the parathyroid glands	100%	NA	NA	None	NA	NA	Solorzano CC, Broome JT, et al. <i>J Clin Endocrinol Metab</i> . 2014 Dec;091(9):4574-80.	
4	Tunmes	The Netherlands	Surgery	2015	Prospective	Parathyroidectomy	13	Methylene blue	0.5 mg/kg	IV	After start of anesthesia	mini FLARE	NA	Detect parathyroid adenomas	69% (n of 9 of the 13 patients, fluorescence differentiated between healthy and diseased glands)	NA	NA	None	NA	NA	Tunmes OR, Schepers A, Hamming JF, Kooij J, Frangioni JV, van de Velde CJ, et al. <i>Surg</i> . 2015 Nov;158(5):1233-30.	
5	Chakelis	US	BMJ Case Rep	2015	Case report	Parathyroidectomy (reoperative)	1	ICG	2.5 mg/ml, and 3 ml.	IV	After exposure of the neck tissues	PINPOINT	NA	Localize the parathyroid glands	100%	NA	Improvement in symptoms within 1 day; no adverse events	None	NA	NA	Chakelis JM, Moore C, Brumand KT, Boonet M. <i>BMJ Case Rep</i> . 2015 Sep;2015 Sep;2015(9):e201521177.	
6	McWade	US	Surgery	2016	Prospective	Parathyroidectomy and thyroidectomy	137	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After exposure of the neck tissues	Ocean Optics spectrometer	NA	Detect the parathyroid glands to avoid inadvertent removal	97% (256 of 264 glands were identified correctly)	NA	NA	None	NA	NA	McWade MA, Simeone ME, Broome JT, Solórzano CC, Mahadevan-Jansen A. <i>Surgery</i> . 2016 Jan;159(1):193-202.	
7	Vidal Fortuny	Switzerland	Br J Surg	2016	Prospective	Total thyroidectomy	36	ICG	3.5 mL for a maximum of 5 mg/kg as necessary	IV	After thyroid resection	PINPOINT	NA	Predict normal parathyroid function after surgery by visualizing vascularization	83% (successful in 30 of 36 patients)	NA	Transient hypoparathyroidism was observed in 2 patients	None	NA	NA	Vidal Fortuny J, Bellóni V, Sadowski SM, Karcenovic W, Grunig S, Triponez F. <i>Br J Surg</i> . 2016 Apr;103(4):e57-61.	
8	Zaidi	US	J Surg Oncol	2016	Prospective	Parathyroidectomy	33	ICG	5 mg	IV	After exposing the central neck compartment, an additional dose was given later to assess perfusion in remnant tissue	PINPOINT	NA	Localize the parathyroid glands and assess perfusion	92.9% (104 of 112 glands were identified correctly)	NA	No postoperative hypoparathyroidism in any patient	None	NA	NA	Zaidi N, Bucak E, Okob A, Yazici P, Yigitbas H, Boerber E. <i>J Surg Oncol</i> . 2016 Jun;113(7):771-4.	
9	Zaidi	US	J Surg Oncol	2016	Prospective	Total thyroidectomy	27	ICG	5 mg	IV	After exposing the central neck compartment, an additional dose was given after thyroidectomy to assess perfusion in remnant tissue	PINPOINT	NA	Localize the parathyroid glands and assess perfusion	84% (71 of 85 parathyroid glands could be identified by ICG)	NA	1 patient exhibited hypocalcemia	None	NA	NA	Zaidi N, Bucak E, Yazici P, Soudamranjan S, Okob A, Yigitbas H, et al. <i>J Surg Oncol</i> . 2016 Jun;113(7):775-8.	
10	Falco	Argentina	J Am Coll Surg	2016	Not stated	Thyroid and parathyroid surgery	28	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After exposing the thyroid and parathyroid glands	Flobeam (Fluoptics)	NA	Identify the parathyroid glands to avoid accidental resection	100%	NA	No postoperative hypocalcemia or other complications	None	NA	NA	Falco J, Dip F, Quadri P, de la Fuente M, Rosenthal R. <i>J Am Coll Surg</i> . 2016 Apr;122(4):e72-80.	
11	Vidal Fortuny	Switzerland	J Am Coll Surg	2016	Not stated	Subtotal parathyroidectomy	13	ICG	3.5 mL for a maximum of 5 mg/kg as necessary	IV	Before resection of the parathyroid gland	PINPOINT	NA	Evaluate vascularization to select the target parathyroid remnant	100%	ICG angiography determined which parathyroid remnant to preserve (the best perfused)	No postoperative complications; two patients required intravenous calcium infusions	None	NA	NA	Vidal Fortuny J, Sadowski SM, Bellóni V, Karcenovic W, Grunig S, Triponez F. <i>J Am Coll Surg</i> . 2016 Nov;123(5):e1-6.	
12	De Leeuw	France	World J Surg	2016	Prospective	Total or partial thyroidectomy or parathyroidectomy	35 (81 parathyroid glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After exposing the thyroid and parathyroid glands	Flobeam (Fluoptics)	NA	Identify the parathyroid glands to avoid accidental resection	100%	NA	None	NA	NA	NA	De Leeuw F, Broznik I, Abbasi M, Cavaragli C, Mirghani H, Bon Laidier A, et al. <i>World J Surg</i> . 2016 Sep;40(9):1114-8.	
13	Kim	South Korea	J Clin Endocrinol Metab	2016	Case series	Total thyroidectomy and hemithyroidectomy	8 (16 glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After dissection of the parathyroid gland	EOS Rebel, Canon	NA	Localize the parathyroid glands	100%	NA	No postoperative hypoparathyroidism in any patient	None	NA	NA	Kim SW, Song SH, Lee HK, Noh WJ, Gwak C, Ahn YC, et al. <i>J Clin Endocrinol Metab</i> . 2016 Dec;101(12):4646-4651.	
14	Vidal Fortuny	Switzerland	World J Surg	2016	Not stated	Subtotal parathyroidectomy	Not stated	ICG	0.3 mg/kg for a maximum total of 5 mg/kg	IV	Prior to resection of the parathyroid glands	PINPOINT	NA	Confirm the vascular status of the parathyroid glands	NA	NA	None	NA	NA	NA	Vidal Fortuny J, Triponez F, Sadowski SM. <i>World J Surg</i> . 2016 Oct;40(10):1278-81.	
15	Lang	China	Surgery	2017	Not stated	Total thyroidectomy	70	ICG	2.5 mg	IV	After removal of the entire thyroid gland	SPY Elite	Fluorescence intensity	Assess parathyroid gland perfusion and function after total thyroidectomy	Fluorescence intensity varied greatly between patients	NA	Postoperative hypocalcemia was only observed in patients whose ICG fluorescence was weak; 9 patients experienced postoperative hypocalcemia that lasted a few days to a few weeks	None	Estimated at \$253 per patient at the authors' institution	NA	NA	Lang BH, Wang CK, Hung HF, Wong KP, Mak KL, Au KB. <i>Surg</i> . 2017 Jun;161(1):87-85.
16	Ladurner	Germany	Surg Endosc	2017	Prospective	Minimally invasive and open parathyroid and thyroid surgery	25 (35 parathyroid glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After identifying the parathyroid tissue	Karl Storz	NA	Identify the parathyroid glands to avoid accidental resection	77% (27 of 35 glands were identified correctly; the other 8 were embedded in adipose tissue)	NA	NA	None	NA	NA	Ladurner R, Sommerer S, Arabi NA, Hallfeldt KK, Stepp H, Galwas R. <i>Surg Endosc</i> . 2017 Aug;31(8):3140-14.	
17	Yu	South Korea	Surg Endosc	2017	Prospective	Bilateral axillo-breast approach robotic total thyroidectomy or thyroid lobectomy	22 (+44 control)	ICG	10 mg	IV	After dissecting the strap muscle from the thyroid	da Vinci Si	NA	Identify the parathyroid glands to avoid accidental resection	100%	ICG angiography lowered the rate of incidental parathyroidectomy	Some cases of transient or permanent hypoparathyroidism	None	NA	NA	Yu HW, Chung JW, Yi JW, Song BY, Lee JH, Kwon H, et al. <i>Surg Endosc</i> . 2017 Jul;31(7):1676-1677.	
18	Falco	Argentina	Surg Endosc	2017	Retrospective	Thyroid and parathyroid surgery (various pathologies)	74	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After retracting the strap muscle and recording the number of glands observed under white light	Not stated	NA	Identify the parathyroid glands to avoid accidental resection	80% (Visualizing all 4 glands was possible in 64 patients by autofluorescence but only in 9 patients under white light)	NA	No permanent hypocalcemia	None	NA	NA	In 1 patient, ICG angiography was used to confirm vascularization	Falco J, Dip F, Quadri P, de la Fuente M, Rosenthal R. <i>Surg Endosc</i> . 2017 Sep;31(9):3737-3742.

Author	Country	Journal	Year	Study Design	Intervention	Control	Outcome	Notes	Reference												
19 Cui	China	Sci Rep	2017	Prospective	Total parathyroidectomy for secondary hyperparathyroidism	20 (+9 control)	ICG	0.5 mg/kg	IV	Before the start of anesthesia	AISERY	NA	Localize the parathyroid glands	There were 5 false positives and 2 false negatives. 90% (37 of 41 glands) were identified correctly (authors are unable to specify the reason for failing to identify the last 4 glands from 7 patients)	The resection rate was higher in the group that received ICG angiography	4 patients experienced persistent hypoparathyroidism (2 in the ICG group and 2 in the non-ICG group)	None	NA	NA	Cui L, Gao Y, Yu H, Li M, Wang B, Zhou T, et al. <i>Sci Rep</i> . 2017 Aug 15;7:11193.	
20 Ladurner	Germany	Ann R Coll Surg Engl	2018	Prospective	Thyroidectomy with or without central lymph node dissection	20 (41 glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After identifying the parathyroid tissue	Karl Storz	NA	Identify the parathyroid glands to avoid accidental resection	Autofluorescence helped to determine the course of the surgery in 2 cases	NA	None	None	NA	NA	Ladurner R, Al Anabi N, Grendeliger U, Haffner R, Stepp H, Galwas J. <i>Ann R Coll Surg Engl</i> . 2019 Jun;100(1):133-36.	
21 Beamloud	France	Surgery	2018	Prospective	Total thyroidectomy	93 (+420 control)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	During exposure of the thyroid lobe	Floobeam (Flooptics)	NA	Determine whether autofluorescence imaging reduces the risk of postoperative hypocalcaemia	76.3%	Fluorescence imaging avoided some cases of parathyroid autotransplantation	Autofluorescence imaging decreased postoperative hypocalcaemia rates (5.2% versus 20.9%); permanent hypocalcaemia developed in 2 patients who received fluorescence imaging	None	None	NA	NA	Beamloud F, Fournier G, Bannier M, Davinet A, Serrero Kim SW, Lee JH, Ahn YC, Park CW, Jeon SW, Kim CH, et al. <i>J Am Coll Surg</i> . 2018 Feb;126(2):166-172.
22 Kim	South Korea	J Am Coll Surg	2018	Prospective	Thyroidectomy	38 (70 glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before identifying the gland under white light	EOS Rebel, Canon	NA	Localize the parathyroid glands	Sensitivity, specificity, and accuracy were all 100%; 1 gland could not be identified by autofluorescence	NA	1 patient experienced temporary hypocalcaemia	None	None	NA	NA	Kim CH, et al. <i>J Am Coll Surg</i> . 2018 Feb;126(2):166-172.
23 DeLong	US	Surgery	2018	Retrospective	Parathyroidectomy for primary hyperparathyroidism	60	ICG	3 mL of 2.5 mg/mL	IV	After identifying the suspected lesions	PINPOINT	NA	Localize the parathyroid glands	93%	NA	"There were no patients with a documented failure of treatment, and there were no cases of recurrent hypoparathyroidism"	None	None	NA	NA	DeLong R, Ward EP, Lavin TM, Brumand KT, Kelly KJ, Hoque S, et al. <i>Surgery</i> . 2018 Feb;163(2):388-397.
24 Hillary	UK	Langenbecks Arch Surg	2018	Prospective	Thyroid and parathyroid surgery	41	Methylene blue	Between 0.05 and 0.5 mg/kg (optimum dose was determined to be 0.4 mg/kg)	IV	After exposure of the thyroid and parathyroid glands	Floobeam (Flooptics)	NA	Identify the parathyroid glands to avoid accidental resection	Unclear but appears to be fairly successful	NA	NA	None	None	NA	NA	Hillary S, Guillemer S, Brown NI, Balanabrammuni SP, Langenbecks Arch Surg. 2018 Feb;303(1):111-118.
25 Vidal Fortuny	Switzerland	Br J Surg	2018	RCT	Total thyroidectomy or completion thyroidectomy	196	ICG	2.5 mg/mL	IV	After removing the thyroid	PINPOINT	NA	Determine whether well-perfused parathyroid glands are a predictor of postoperative hypoparathyroidism	In 50 patients, ICG did not demonstrate at least 1 well-perfused thyroid gland; these patients were excluded from the remainder of the study	None	None of the patients with at least one well-perfused gland presented with hypoparathyroidism, including those who did not receive calcium supplementation.	None	None	NA	NA	Vidal Fortuny J, Sadownik SM, Bitteloni V, Guigard S, Ponce A, Rio F, et al. <i>Br J Surg</i> . 2018 Mar;105(4):350-357.
26 Kahramangil	US, France, and Argentina	Ann Surg Oncol	2018	Retrospective	Thyroidectomy and parathyroidectomy	210	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After exposure of the tissues	Floobeam (Flooptics)	NA	Determine whether autofluorescence imaging facilitates identification of parathyroid glands	On logistic regression, smaller ICGs were more likely to be missed visually, but localized by AF on NBI (odds ratio with increasing size, 0.91; $p = 0.07$ )	Upon initial exploration, 46% of PIGs were not visible to the naked eye due to coverage by soft tissue, but AF from these glands could be detected by NBI without any further dissection.	NA	None	None	NA	NA	Kahramangil B, Dp F, Berniolini F, Falcó J, de La Fuente M, Verna S, et al. <i>Ann Surg Oncol</i> . 2018 Apr;25(4):957-962.
27 Alstina	Germany	Langenbecks Arch Surg	2018	Case series	Video-assisted neck surgery	5	Autofluorescence	2.5 mg/mL for the ICG; repeated when needed	IV for the ICG after dissection (to visualize vascularization)	After exposure of the tissues, ICG after dissection (to visualize vascularization)	Karl Storz	NA	Localize the parathyroid glands	69% for autofluorescence 75% for ICG	NA	No postoperative complications	None	None	NA	NA	Alstina PF, Meier B, Hirschi J, Melamed W, Walz MK, Langenbecks Arch Surg. 2018 May;403(5):585-401.
28 Thomas	US	Thyroid	2018	Not stated	Thyroidectomy and/or parathyroidectomy	35	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Unclear	In-house prototype (PType)	NA	Identify the parathyroid glands to avoid accidental resection	92.5% accuracy in guiding parathyroid identification	NA	NA	None	None	NA	NA	Thomas G, McWade MA, Paris C, Mamoh EA, Sanders ME, Ware EM, et al. <i>Thyroid</i> . 2018 Nov;28(11):1517-1521.
29 Jin	China	Adv Ther	2018	Not stated	Total thyroidectomy	26	ICG	5 mg up to 5 mg/kg	IV	After resecting one lobe of the thyroid	Digital Precision Medical Technology	NA	Localize the parathyroid glands and predict postoperative hypoparathyroidism	85% (ICG was unclear in 4 of the 26 patients, and 4 of them developed temporary hypocalcaemia/hypovitaminosis)	In 2 patients, parathyroid glands were accidentally resected despite fluorescing strongly with ICG	2 cases of temporary hypoparathyroidism	None	None	NA	NA	Jin H, Deng Q, He Z, Fan J, Liao K, Cui M. <i>Adv Ther</i> . 2018 Dec;35(12):167-2175.
30 Sound	US	Surg Innov	2019	Case series	Reoperative surgery for hyperparathyroidism	3	ICG	5 mg (repeated later in the operation)	IV	After dividing the platysma or dissecting the tissues around the sternum	PINPOINT	NA	Localize the parathyroid glands	100%	NA	No adverse postoperative events	None	None	NA	NA	Sound S, Okoh A, Vignabas H, Yarrici P, Herber E. <i>Surg Innov</i> . 2019 Dec;26(6):774-779.
31 Kose	US	Surgery	2019	Prospective	Bilateral neck exploration for primary parathyroidism	50 (199 glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After dissection of the strap muscles but before explorative dissection	Floobeam (Flooptics)	Fluorescence intensity	Compare autofluorescence from healthy and diseased parathyroid glands	96%	Hypofunctioning glands had lower autofluorescence; early detection possibly shortened the length of the procedure	NA	None	None	NA	NA	Kose E, Kahramangil B, Aydin H, Baumert M, Herber E. <i>Surgery</i> . 2019 Feb;165(2):431-437.
32 Jin	China	Am J Otolaryngol	2019	Case series	Total thyroidectomy	3	ICG	5 mg up to 5 mg/kg	IV	Unclear - after exposure of the tissues but unknown whether before or after resecting the thyroid	Digital Precision Medical Technology	NA	Localize the parathyroid glands	100%	NA	No adverse outcomes	None	None	NA	NA	Jin H, Fan J, Yang J, Liao K, He Z, Cui M. <i>Am J Otolaryngol</i> . 2019 Mar; Apr;40(2):323-330.
33 Thomas	US	Surgery	2019	Prospective	Thyroidectomy or parathyroidectomy	20	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After visual inspection of the exposed tissues	In-house prototype (PType)	NA	Identify the parathyroid glands to avoid accidental resection	98% (54 of 55 glands)	NA	NA	None	None	NA	NA	Thomas G, McWade MA, Nguyen JQ, Sanders ME, Broome JT, Hargrave N, et al. <i>Surgery</i> . 2019 Jun;165(1):134-139.
34 van den Bos	The Netherlands	Head Neck	2019	Prospective	Elective thyroidectomy	26 (30 surgeries)	ICG	7.5 mg	IV	Before thyroid resection and again after thyroid resection	Karl Storz	NA	Localize the parathyroid glands before resection and assess perfusion after resection	88% (In 3 of the patients, there was no ICG fluorescence to identify the parathyroid glands; the authors suspect that the glands had accidentally been resected before the imaging or that damage had occurred to blood vessels on the same)	ICG imaging was useful to the surgery course in 17 of the 30 procedures; in 2 of the 17 patients, ICG was the only identifier of parathyroid location (not evident visually)	1 case of arterial bleeding requiring reoperation; 1 wound infection that required antibiotics	None	None	NA	NA	van den Bos J, van Kooren L, Engelen SME, Labbers T, Stansen LPS, Bouvy ND. <i>Head Neck</i> . 2019 Feb;41(2):348-348.
35 Galvez-Pastor	Spain	Am J Surg	2019	Prospective	Total thyroidectomy	39	ICG	3 to 6 mL of 25 mg/10 mL	IV	After thyroidectomy	PINPOINT	NA	Predict hypocalcaemia	82% (all 4 glands were identified successfully in 32 of 39 patients)	The ICG score adequately predicted postoperative hypocalcaemia and postoperative parathyroid function; 6 patients developed hypocalcaemia	None	None	NA	NA	NA	Galvez-Pastor S, Torregrosa NM, Ros A, Fehrens B, Gonzalez-Costa R, Garcia-Lopez MA, et al. <i>Am J Surg</i> . 2019 Nov;178(5):601-606.
36 Jin	China	Clin Endocrinol (Oxf)	2019	Prospective	Total thyroidectomy	26	ICG	5 mg	IV	After thyroidectomy	Digital Precision Medical Technology	NA	Assess vascularization after resection and predict postoperative hypoparathyroidism	85% (in 4 of the 26 patients, the area fluoresced under ICG but not clearly enough to assess that vascularization was adequate)	NA	2 patients with low ICG vascularization score developed transient hypoparathyroidism	None	None	NA	NA	Jin H, Deng Q, He Z, Fan J, Liao K, Cui M. <i>Clin Endocrinol (Oxf)</i> . 2019 Mar;90(3):487-493.
37 Squires	US	Ann Surg Oncol	2019	Prospective	Parathyroidectomy	59 (69 glands to resect)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After mobilizing the thyroid	PDE Hamamatsu	Fluorescence intensity	Identify the parathyroid glands to avoid accidental resection	NA	Imaging increased intraoperative confidence of parathyroid identification and was helpful in 21 of the 59 patients	NA	None	None	NA	NA	Squires MH, Larin R, Shirley LA, Phay JE. <i>Ann Surg Oncol</i> . 2019 Apr;26(4):1142-1148.

38	Dp	Argentina	J Am Coll Surg	2019	RCT	Total thyroidectomy	85 (+85 control)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before thyroid dissection	Floobeam (Fhoiptics)	NA	Identify the parathyroid glands to avoid accidental resection and predict postoperative hypocalcaemia	The mean number of parathyroid glands identified pre-dissection with NIRi was the same identified post-dissection with WL (3.5 vs 3.6). In the experimental group, converting from WL to NIRi increased the number of glands detected from 2.6 to 3.5 (p < 0.001), and revealed at least 1 previously missed gland in 67.1% of	Imaging revealed at least 1 previously missed gland in 67.1% of patients	Calcium levels equal or lower than 7.5 mg/dL were one-third as common in the NIRi group (p = 0.005). The adjusted odds of hypocalcaemia developing increased by 15% for every 5-g increase in thyroid gland weight (odds ratio 1.15; 95% CI 1.06 to 1.25).	None	NA	NA	Dip F, Falco J, Verma S, Prud'homme M, Luciani M, Quadri P, et al. J Am Coll Surg 2019 May;228(5):530-543 Wolff HW, Grambsch B, Runkel N. Updates Surg 2019 Sep;71(3):579-585	
39	McWade	US	J Am Coll Surg	2019	Prospective	Thyroidectomy or parathyroidectomy	30	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before dissection	In-house overlay tissue imaging system	NA	Identify the parathyroid glands	97%	NA	None	None	NA	NA	McWade MA, Thomas G, Nguyen JQ, Sanders ME, Solórzano CC, Mahadevan-Jansen A. J Am Coll Surg 2019 Mar;228(3):330-343 Wolff HW, Grambsch B, Runkel N. Updates Surg 2019 Sep;71(3):579-585	
40	Wolf	Germany	Updates Surg	2019	Retrospective	Bilateral neck exploration, parathyroidectomy, and thyroidectomy	39 (66 glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before dissection	Karl Storz	NA	Identify the parathyroid glands	86% (57 of 66 glands autofluoresced)	NA	NA	None	NA	NA	Radin AV, McKenzie TJ, Thompson GB, Farley DR, Jostes ML, World J Surg 2019 Jun;5(6):1538-1543	
41	Rudin	US	World J Surg	2019	Retrospective	Total or near-total thyroidectomy	86 (+124 control)	ICG	3 mL	IV	After thyroidectomy	PINPOINT	NA	Predict parathyroid function after thyroidectomy, guide autotransplantation, and decrease the incidence of permanent hypoparathyroidism	87%	ICG imaging prevented the autotransplantation of 19 glands (6.8%)	22 of the 86 patients that received ICG imaging developed transient hypoparathyroidism	None	The learning curve of interpreting green fluorescence may be	NA	Radin AV, McKenzie TJ, Thompson GB, Farley DR, Jostes ML, World J Surg 2019 Jun;5(6):1538-1543	
42	DMarco	UK	World J Surg	2019	Prospective	Parathyroidectomy	96 (284 glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After exposing the glands	Floobeam (Fhoiptics)	NA	Assess the clinical utility of autofluorescence in parathyroid surgery	90.5% (257 glands out of 284 were visualized successfully)	NA	NA	None	NA	NA	DMarco A, Chotalia R, Hoshkam K, McInyre C, Tolley N, Palazzo FF. World J Surg 2019 Nov;43(11):1417-1427 Razavi AC, Bralcom K, Haddad A, Saparwa L, Salaby H, Abdelgawad M, et al. Head Neck 2019 Sep;41(9):1276-1281 Ludmer R, Lenzhoebner M, Al Arabi N, Gallwas RK, Steg H, Halfield KK. Molecules 2019 Jul 14;24(14):2560 DMarco A, Chotalia R, Hoshkam K, McInyre C, Tolley N, Palazzo FF, Ann R Coll Surg Engl 2019 Nov;101(7):666-671 Serra C, Silvestri L, Canudo A, Lemos MC, BMC Surg 2019 Aug 28;19(1):170 Kim Y, Kim SW, Lee KD, Ahn YC. J Biophotonics 2019 Dec;12(12):201900017	
43	Razavi	US	Head Neck	2019	Retrospective	Thyroid and/or central compartment surgeries	43 (148 control)	ICG	5 mg	IV	At the end of the surgery	Olympus scope with a NIR camera	NA	Predict parathyroid vascularization	In 43 patients, the ICG score was zero	NA	A few patients (number not given) experienced transient hypocalcaemia (not predicted by ICG score)	None	NA	NA	Razavi AC, Bralcom K, Haddad A, Saparwa L, Salaby H, Abdelgawad M, et al. Head Neck 2019 Sep;41(9):1276-1281 Ludmer R, Lenzhoebner M, Al Arabi N, Gallwas RK, Steg H, Halfield KK. Molecules 2019 Jul 14;24(14):2560 DMarco A, Chotalia R, Hoshkam K, McInyre C, Tolley N, Palazzo FF, Ann R Coll Surg Engl 2019 Nov;101(7):666-671 Serra C, Silvestri L, Canudo A, Lemos MC, BMC Surg 2019 Aug 28;19(1):170 Kim Y, Kim SW, Lee KD, Ahn YC. J Biophotonics 2019 Dec;12(12):201900017	
44	Ladurner	Germany	Molecules	2019	Retrospective	Open thyroid and parathyroid surgeries	117 (205 parathyroid glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before dissection	Karl Storz	NA	Identify the parathyroid glands	87.3% of glands were visualized successfully; in 26 cases, the glands were not visualized successfully	NA	NA	None	NA	NA	DMarco A, Chotalia R, Hoshkam K, McInyre C, Tolley N, Palazzo FF, Ann R Coll Surg Engl 2019 Nov;101(7):666-671 Serra C, Silvestri L, Canudo A, Lemos MC, BMC Surg 2019 Aug 28;19(1):170 Kim Y, Kim SW, Lee KD, Ahn YC. J Biophotonics 2019 Dec;12(12):201900017	
45	DMarco	UK	Ann R Coll Surg Engl	2019	Prospective	Thyroidectomy	106 (+163 control)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	After thyroidectomy	Floobeam (Fhoiptics)	NA	Determine whether NIR imaging prevents accidental resection of parathyroid glands and the subsequent biochemical recovery	NA	In 13 patients, NIR imaging showed accidental resection of parathyroid glands, requiring autotransplantation (the number was 17 patients in the controls)	Hypocalcaemia and later hyperparathyroidism rates did not differ between cases and controls	None	NA	NA	DMarco A, Chotalia R, Hoshkam K, McInyre C, Tolley N, Palazzo FF, Ann R Coll Surg Engl 2019 Nov;101(7):666-671 Serra C, Silvestri L, Canudo A, Lemos MC, BMC Surg 2019 Aug 28;19(1):170 Kim Y, Kim SW, Lee KD, Ahn YC. J Biophotonics 2019 Dec;12(12):201900017	
46	Serra	Portugal	BMC Surg	2019	Case series	Surgery for hyperparathyroidism (no details on actual procedures)	5	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before dissection	Edmund Optics	Fluorescence intensity	Localize the parathyroid glands to avoid accidental resection	NA	NA	No persistent parathyroidism in any patient	None	NA	NA	DMarco A, Chotalia R, Hoshkam K, McInyre C, Tolley N, Palazzo FF, Ann R Coll Surg Engl 2019 Nov;101(7):666-671 Serra C, Silvestri L, Canudo A, Lemos MC, BMC Surg 2019 Aug 28;19(1):170 Kim Y, Kim SW, Lee KD, Ahn YC. J Biophotonics 2019 Dec;12(12):201900017	
47	Kim	South Korea	J Biophotonics	2019	Prospective	Total or partial thyroidectomy	26 (56 glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before dissection	EOS (Canon) with in-house modifications	NA	Localize the parathyroid glands to avoid accidental resection	Sensitivity was 98.1% and accuracy was 96.4%	NA	NA	None	NA	NA	DMarco A, Chotalia R, Hoshkam K, McInyre C, Tolley N, Palazzo FF, Ann R Coll Surg Engl 2019 Nov;101(7):666-671 Serra C, Silvestri L, Canudo A, Lemos MC, BMC Surg 2019 Aug 28;19(1):170 Kim Y, Kim SW, Lee KD, Ahn YC. J Biophotonics 2019 Dec;12(12):201900017	
48	Kose	US	Surgery	2020	Prospective	Thyroidectomy or parathyroidectomy	173 (503 glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Both before and after dissection	Floobeam (Fhoiptics)	NA	Determine the accuracy of autofluorescence in localizing the parathyroid glands	98% (947 of 971 glands)	In 7 patients, the fluorescence assisted in identifying incidentally resected glands	NA	None	NA	NA	Kose E, Radin AV, Kalkanmangli H, Moore E, Aydin H, Duncanson M, et al. Surgery 2020 Jun;167(1):173-179	
49	Thomas	US	J Am Coll Surg	2019	Prospective	Thyroidectomy and/or parathyroidectomy	20 (33 glands)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before dissection (PTeye), before and after dissection (PTeye)	PDE Hamamatsu and PTeye	NA	Compare the performance of two systems for localizing the parathyroid glands	Accuracy in imaging was 84.6% for the PDE and 92.3% for the PTeye	NA	NA	None	NA	NA	Thomas G, Squires MR, Mehall F, Mahadevan-Jansen A, Phay JE. J Am Coll Surg 2019 Dec;228(6):666-671 Liu L, Wang S, Wang R, Xu C, Zhao R, Li H, et al. BMC Surg 2020 Jun 6;20(1):4	
50	Liu	China	BMC Surg	2020	Not stated	Thyroidectomy	20	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before dissection (although this is unclear)	i-Raman Pro	NA	Localize the parathyroid glands to avoid accidental resection	95% (19 out of 20 patients)	NA	NA	None	NA	NA	Thomas G, Squires MR, Mehall F, Mahadevan-Jansen A, Phay JE. J Am Coll Surg 2019 Dec;228(6):666-671 Liu L, Wang S, Wang R, Xu C, Zhao R, Li H, et al. BMC Surg 2020 Jun 6;20(1):4	
51	Bennilouf	France	JAMA Surg	2020	RCT	Total thyroidectomy	121 (+120 control)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before dissection	Floobeam (Fhoiptics)	NA	Localize the parathyroid glands to avoid accidental resection and reduce postoperative hypocalcaemia	NA	The number of inadvertently resected parathyroid glands was significantly lower in the NIRAF group than in the control group: 3 patients (2.5% [95% CI, 0.0%–5.2%]) vs 14 patients (11.7% [95% CI, 5.9%–17.4%], respectively, P = .006).	The temporary postoperative hypocalcaemia rate was 9.1% (11 of 121 patients) in the NIRAF group and 21.7% (26 of 120 patients) in the control group. Between-group difference, 12.6% (95% CI, 5.0%–20.1%); P = .007). Multivariate analyses found that use of NIRAF reduced the risk of hypocalcaemia with an odds ratio of 0.35 (95% CI, 0.15–0.83; P = .02).	None	None	NA	NA	Bennilouf F, Godrie-Petit G, Graa R, Gallot JC, Tarrin N, Pannema G, et al. JAMA Surg 2020 Feb 1;155(2):106-112
52	Yavuz	Turkey	Arch Endocrinol Metab	2020	Prospective	Total thyroidectomy	43 (129 glands)	ICG	2.5 mg in 3 mL	IV	After thyroidectomy	SPY Elite	NA	Assess perfusion of parathyroid glands	100%	Imaging supported decisions of autotransplantation of glands	NA	None	NA	NA	Yavuz E, Birtek A, Karagalli O, Erten C, Arici S, Yigitba H, et al. Arch Endocrinol Metab 2020 Nov;64(4):477-485	
53	Kim	US	J Surg Oncol	2020	Retrospective	Total thyroidectomy	100 (+200 control)	Autofluorescence	Not applicable (intrinsic)	Not applicable (intrinsic)	Before dissection	Floobeam (Fhoiptics)	NA	Assess whether imaging the glands prevents postoperative hypocalcaemia	36.9% (104 of 282 glands in the imaged cases were visualized by autofluorescence before the surgeon made a visual inspection and identified the other glands)	Rates of accidental resection were 6% in cases and 14% in controls	Rates of transient and permanent hypocalcaemia did not differ between cases and controls	None	NA	NA	Kim YS, Erten O, Kalkanmangli H, Aydin H, Duncanson M, Barber E. J Surg Oncol 2020 Oct;122(5):973-979	

NA, Not available or not assessed