KOREA UNIVERSITY ANAM HOSPITAL

2026 대한부인종양학회 **제31차 추계 심포지엄**

부인암 수술에서 감시림프절의 활용

Updates of Sentinel Lymph Node Mapping in Gynecologic Cancers

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Presenter : **Seongmin Kim**
Korea University Medicine



"Beyond Feasibility: Oncologic Safety in SLN Mapping"





2026 KSGO
제31차 추계 심포지엄

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lymphatic anatomy · UPP / LPP / IPP

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robotics · mechanism hypotheses · pathology AI

01

Background



lymphatic anatomy of the uterus

Figure 2: Most common location of SLNs (blue, arrow) following a cervical injection[a]

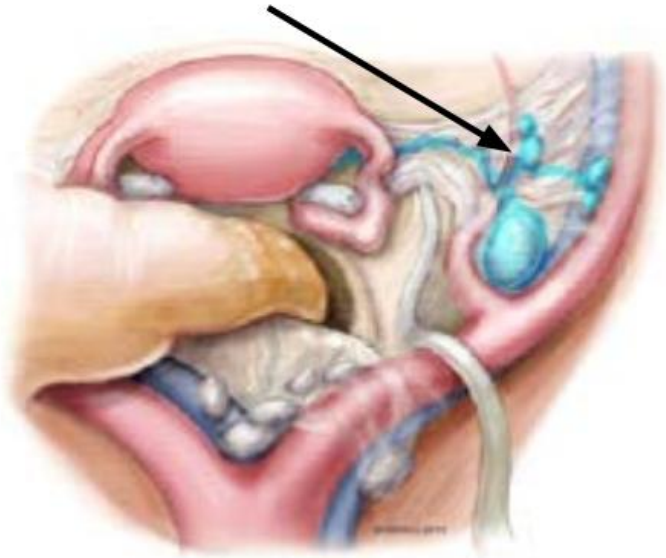


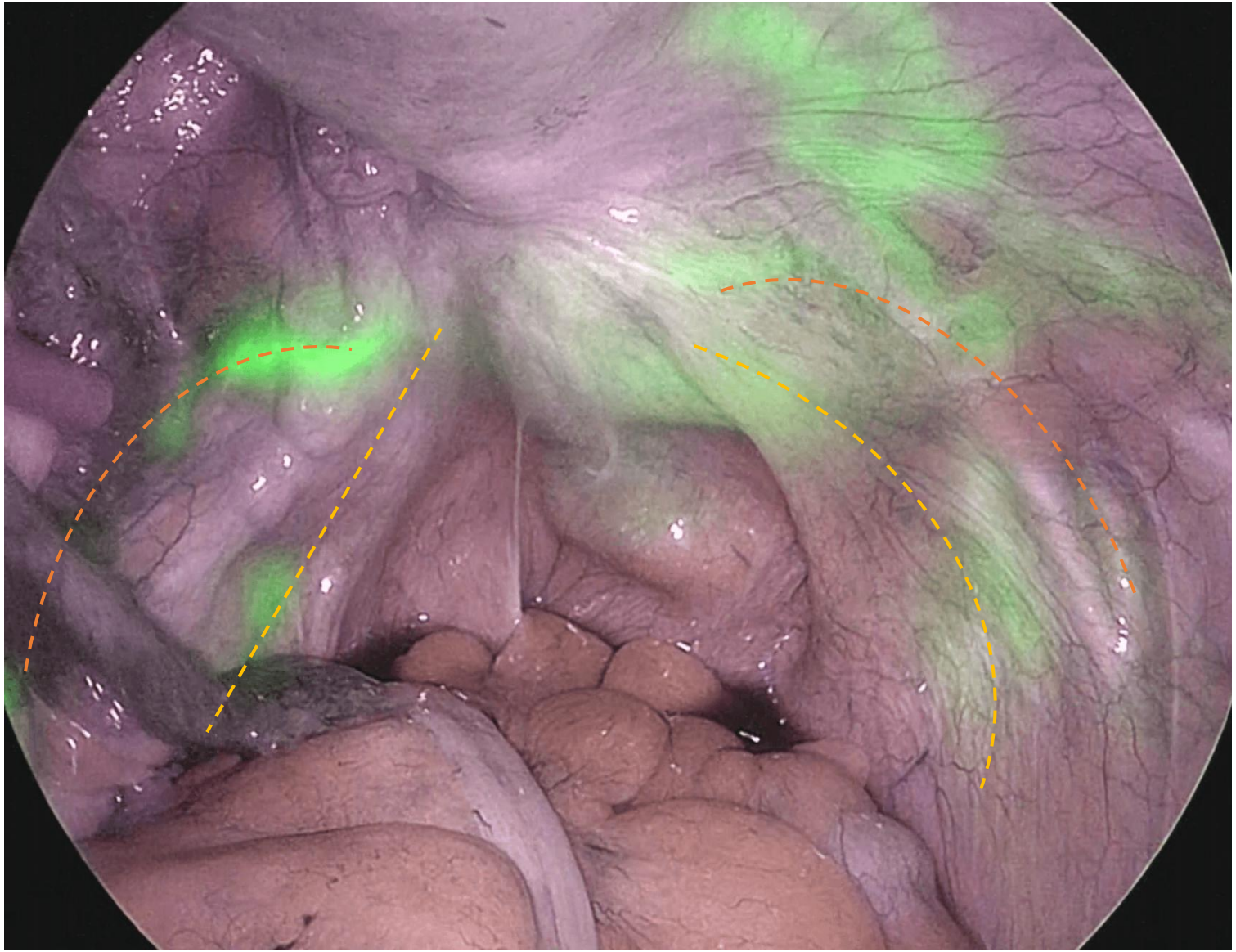
Figure 3: Less common location of SLNs (green, arrow) usually seen when lymphatic trunks are not crossing over the umbilical ligament but following the mesoureter cephalad to common iliac and presacral region[a]



→ cervical injection captures UPP + LPP — covering ~100% of endometrioid metastases. PA dissection adds little except in non-endometrioid histology.

Eur J Cancer 2024, article 114049
Eur J Cancer 2019;116:77–85

UPP & LPP



02

Era 2010s



SENTICOL I — proof-of-principle in CX CA

Lécuru et al. · J Clin Oncol 2011;29(13):1686–1691 · 7 French centers · prospective multicenter

VOLUME 29 · NUMBER 13 · MAY 1 2011

JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT

Bilateral Negative Sentinel Nodes Accurately Predict Absence of Lymph Node Metastasis in Early Cervical Cancer: Results of the SENTICOL Study

Fabrice Lécuru, Patrice Mathevet, Denis Querleu, Eric Leblanc, Philipe Morice, Emile Daraï, Henri Marret, Laurent Magaud, Florence Gillaizeau, Gilles Chatellier, and Daniel Dargent†

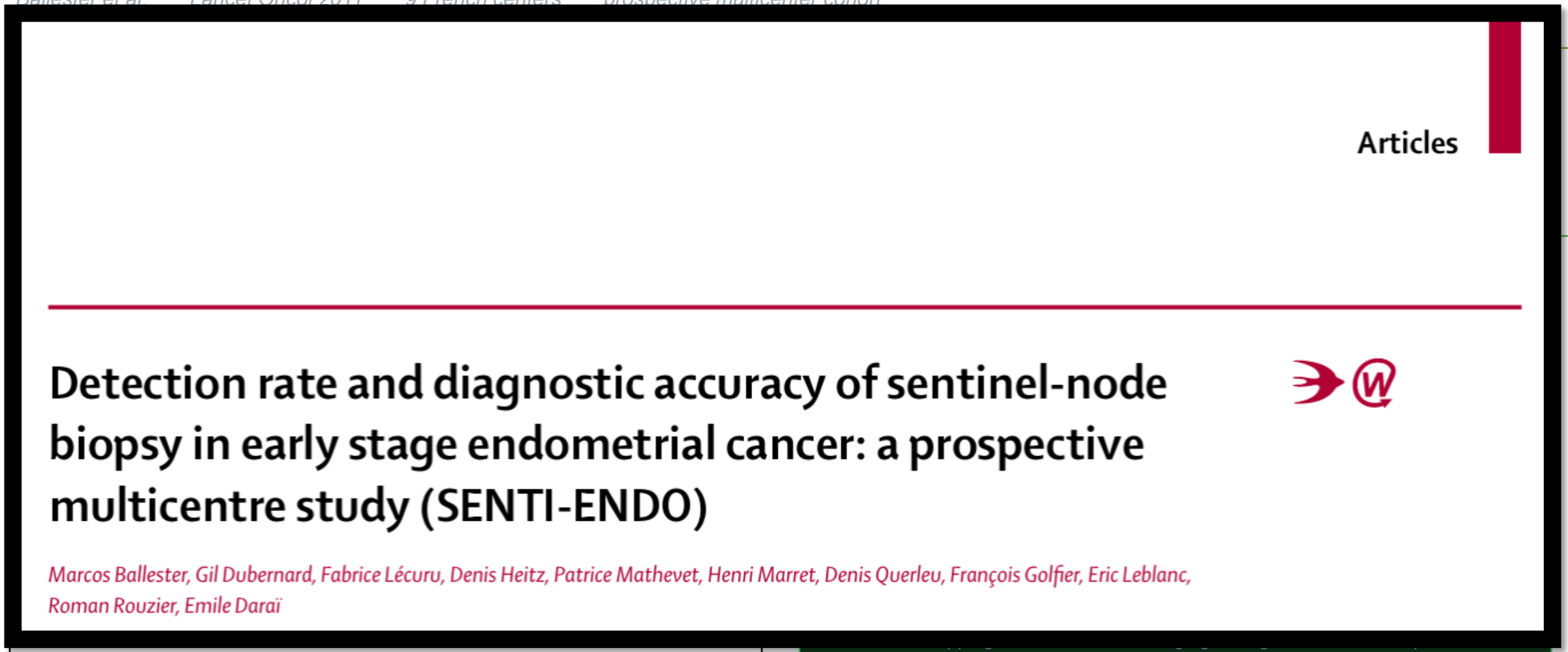
Tc-99m lymphoscintigraphy + Patent Blue (combined detection), laparosco pic mapping

ZERO false-negatives in the bilateral subgroup.

→ *Bilateral negativity reliably excludes nodal metastasis in early cervical cancer (Lécuru, J Clin Oncol 2011).*

SENTI-ENDO Trial — the proof-of-principle in EM CA

Ballester et al. · Lancet Oncol 2011 · 9 French centers · prospective multicenter cohort



Articles

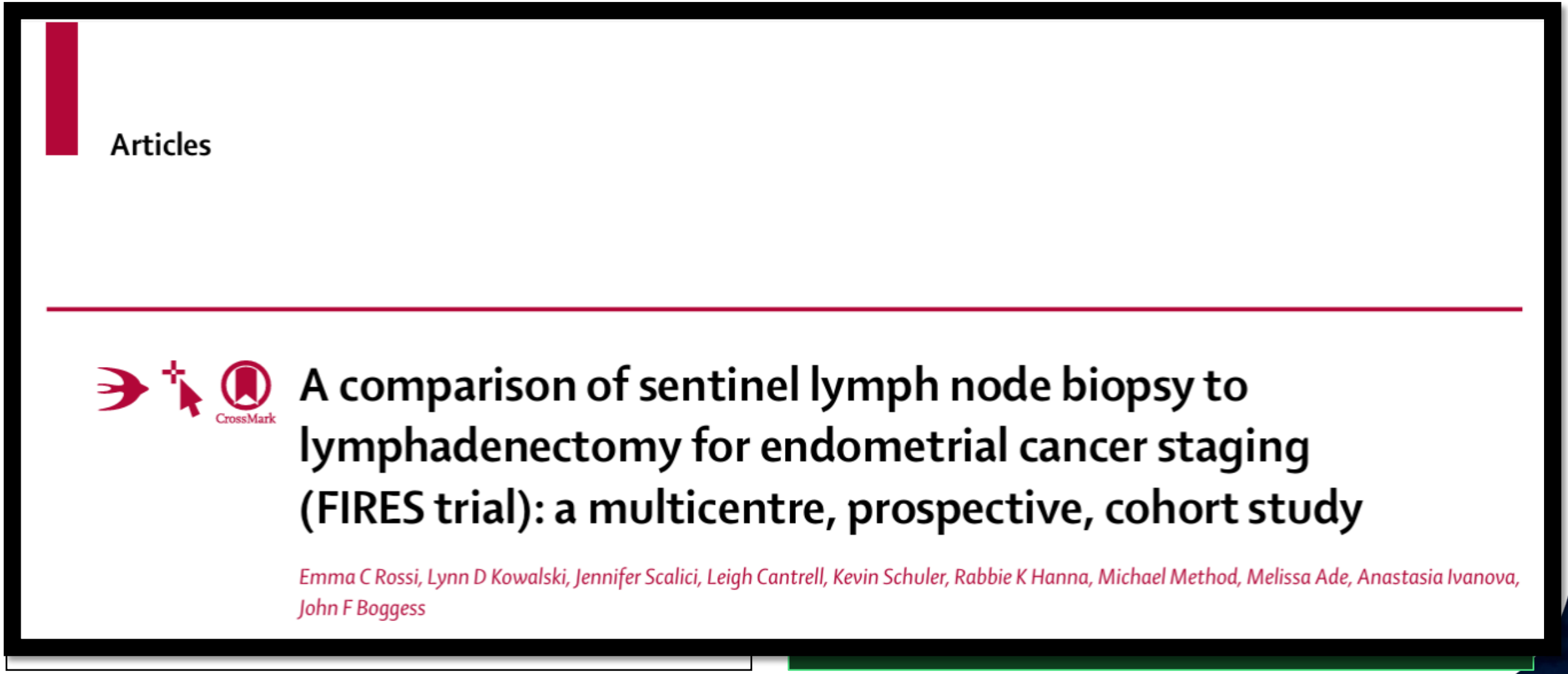
Detection rate and diagnostic accuracy of sentinel-node biopsy in early stage endometrial cancer: a prospective multicentre study (SENTI-ENDO)

Marcos Ballester, Gil Dubernard, Fabrice Lécuru, Denis Heitz, Patrice Mathevet, Henri Marret, Denis Querleu, François Golfier, Eric Leblanc, Roman Rouzier, Emile Daraï

(Ballester, Lancet Oncol 2011).

FIRES Trial — the ICG era begins

Rossi et al. · Lancet Oncol 2017;18:384–392 · 10 US sites, 18 surgeons · prospective multicenter cohort



Articles

A comparison of sentinel lymph node biopsy to lymphadenectomy for endometrial cancer staging (FIRES trial): a multicentre, prospective, cohort study

Emma C Rossi, Lynn D Kowalski, Jennifer Scalici, Leigh Cantrell, Kevin Schuler, Rabbie K Hanna, Michael Method, Melissa Ade, Anastasia Ivanova, John F Boggess

03

Era 2020s — Endometrial



European Journal of Cancer 116 (2019) 77–85

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.ejcancer.com



Original Research

Pelvic Sentinel lymph node detection in High-Risk Endometrial Cancer (SHREC-trial)—the final step towards a paradigm shift in surgical staging

Jan Persson [a,b,*], Sahar Salehi [c], Michele Bollino [a,b], Celine Lönnerfors [a,b], Henrik Falconer [c], Barbara Geppert [a,b]

[a] Department of Obstetrics and Gynaecology, Division of Gynaecologic Oncology, Skåne University Hospital, Lund, Sweden
[b] Lund University, Faculty of Medicine, Department of Clinical Sciences, Obstetrics and Gynaecology, Lund, Sweden
[c] Department of Obstetrics and Gynaecology, Karolinska University Hospital, Division of Gynaecologic Oncology, Karolinska Institute, Stockholm, Sweden

SENTOR Trial — high-risk endometrial validation

Cusimano et al. · JAMA Surg 2021;156(2):157–164 · 3 Canadian academic centers · prospective

Research

JAMA Surgery | Original Investigation

Assessment of Sentinel Lymph Node Biopsy vs Lymphadenectomy for Intermediate- and High-Grade Endometrial Cancer Staging

Maria C. Cusimano, MD; Danielle Vicus, MD; Katherine Pulman, MD; Manjula Maganti, MSc; Marcus Q. Bernardini, MD, MSc; Genevieve Bouchard-Fortier, MD; Stephane Laframboise, MD; Taymaa May, MD; Liat F. Hogen, MD; Allan L. Covens, MD; Lilian T. Gien, MD; Rachel Kupets, MD; Marjan Rouzbahman, MD; Blaise A. Clarke, MD; Jelena Mirkovic, MD; Matthew Cesari, MD; Gulisa Turashvili, MD; Aysha Zia, MD; Gabrielle E. V. Ene, BSc; Sarah E. Ferguson, MD

Tracer

Cervical ICG 2.5 mg/mL, 0.5 mL superficial + 0.5 mL deep at 3 & 9 o'clock (2 mL); bilateral mapping 77.6%

all micrometastases or ITC;
26% (7/27) lay outside LND boundaries or needed IHC.

→ *sensitivity 96.3% (26/27), FNR 3.7%, NPV 99.2%*
— ***SLN detects MORE metastases*** *than systematic LND alone in high-grade EC*

SENTIREC-endo — Danish national LR/IR adoption

Bjørnholt et al. · Gynecol Oncol 2023;171:121–128 · Danish multicenter · pros

Contents lists available at ScienceDirect

Gynecologic Oncology

journal homepage: www.elsevier.com/locate/ygyno

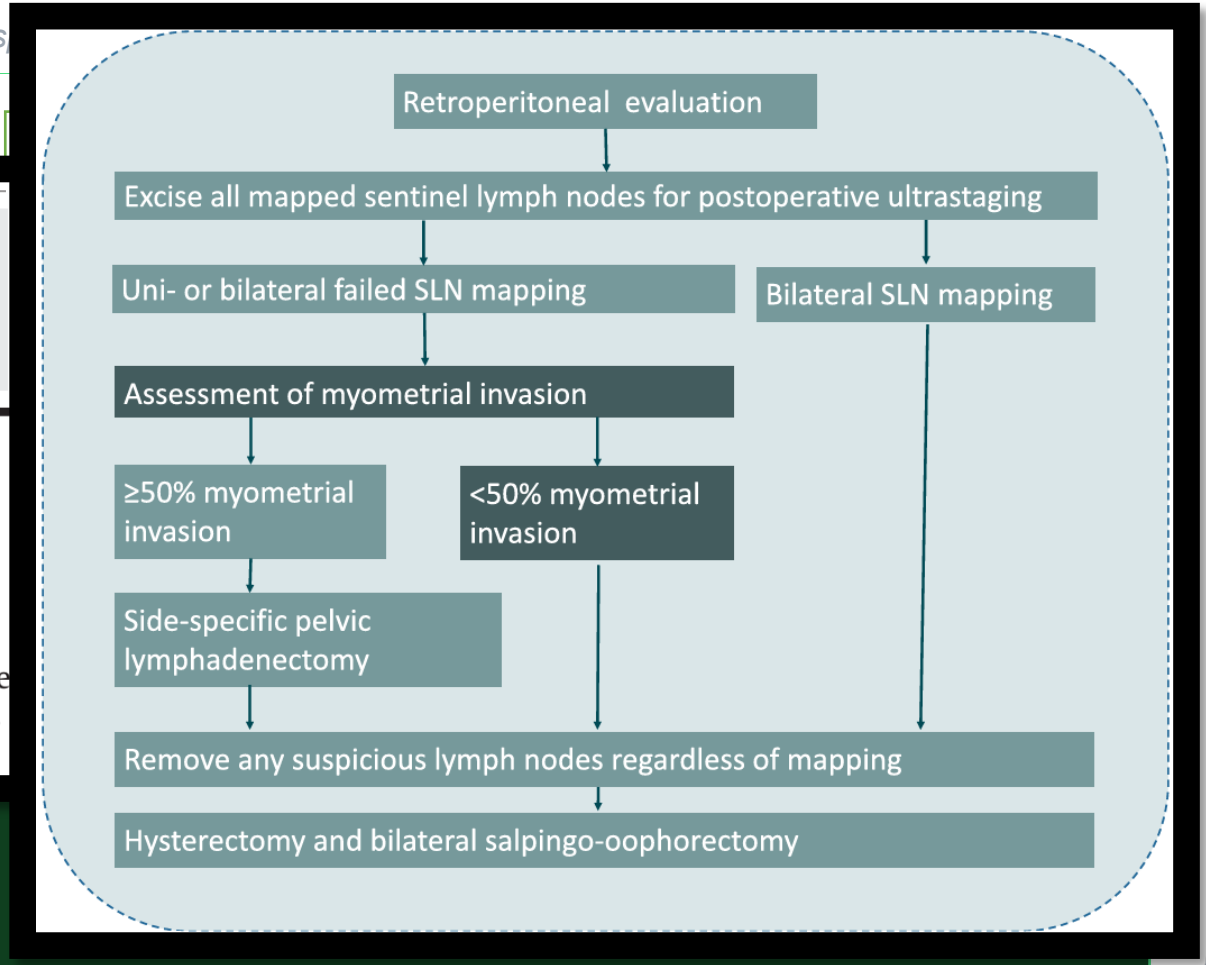
The SENTIREC-endo study – Risks and benefits of a national adoption of sentinel node mapping in low and intermediate risk endometrial cancer

Sarah Marie Bjørnholt [a,b,*], Sarah Elizabeth Sponholtz [c], Ole Mogensen [a,b], Kirsten Bouchelouche, Erik Thorlund Parner [e], Gudrun Neumann [f], Kirsten Marie Jochumsen [f], Bushra Hassan Hamid [g], Morten Bülow Davidsen [g], Signe Frahm Bjørn [h], Katja Dahl [a], Pernille Tine Jensen [a,b,c]

Node-positive: 4.4% (LR) vs 22.5% (IR); ultrastaging identified 62% of met astases

Tracer

Cervical ICG, robotic NIR fluorescence imaging



→ National adoption: significant benefits, negligible harm; high-risk extension confirms safety (Bjørnholt, Gynecol Oncol 2023; 2024).

SENTIREC-endo — high-risk EC: SLN algorithms vs PLD + PALD

Bjørnholt et al. · Gynecol Oncol 2024;182:179–187 · 3 Danish centers (~80% of

216

73.1%

Contents lists available at ScienceDirect

Gynecologic Oncology

journal homepage: www.elsevier.com/locate/ygyno

Identifying safe diagnostic algorithms for sentinel lymph node mapping in high-risk endometrial cancer: The SENTIREC-endo study

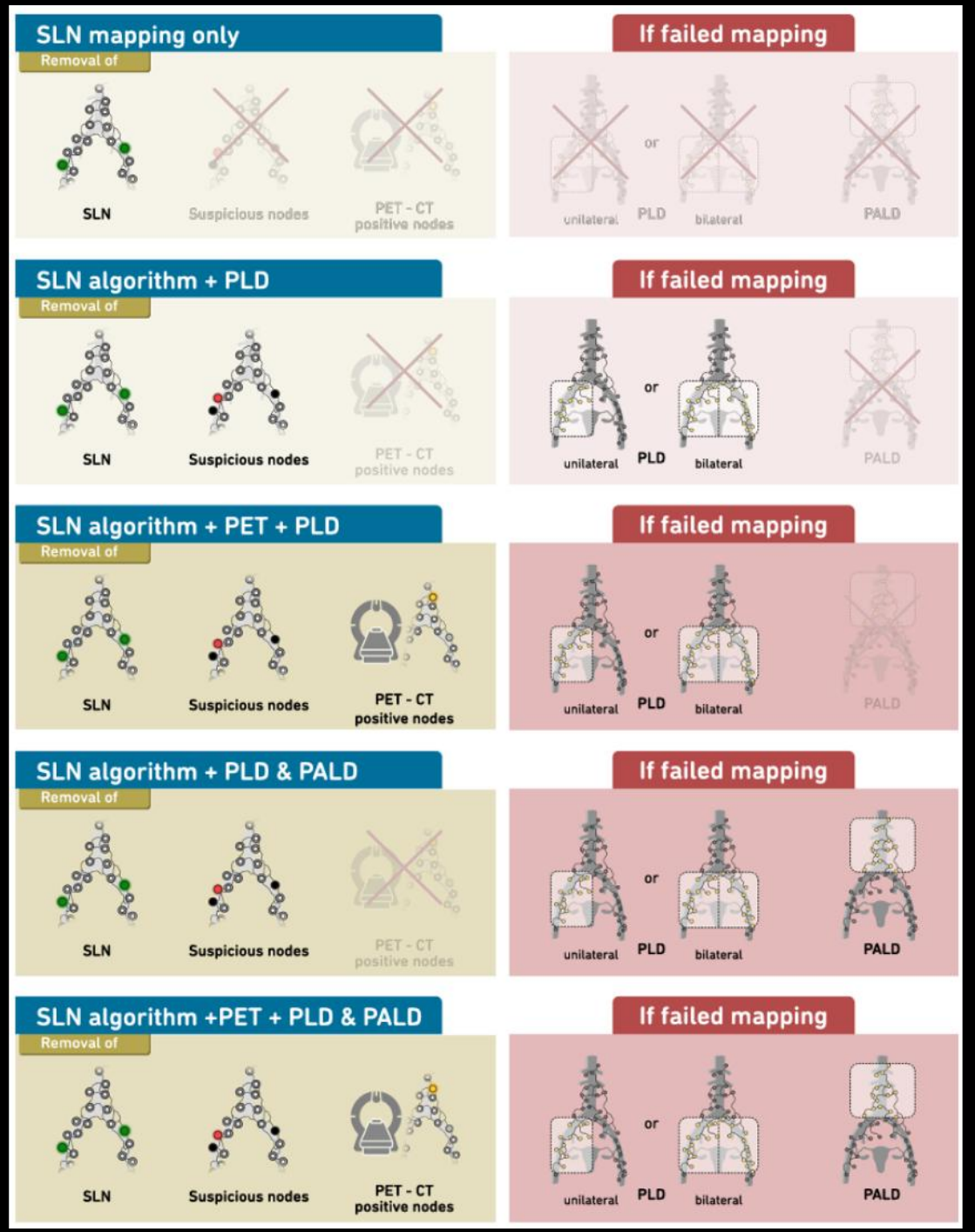
d FIGO I; 3 centers, 2017–2023

Reference standard

SLN (ultrastaged) + any suspicious / PET+ node + PLD + infrarenal PALD (n=170); NPV-powered (>94% acceptable)

Technique

Robotic · ICG (national protocol), no re-injection · FDG-PET/CT in all



molecular subtype × nodal metastasis

Scarpelli IJGC 2026 · Chacon (SENECA) IJGC 2024;34:1313–21 · Fanfani (PROMISE-EC) IJGC 2026;36:104796

molecular class ( ) = % of cohort	Scarpelli 2026 Italy · n=2,592		SENECA 2024 16 countries · n=2,139 · SLN+ 9.6%	PROMISE-EC 2026 16 EU centers · n=2,003 · SLN+ 14.1% per class: adjusted OR / HR vs NSMP
POLEmut	8.0%	median 56 y · BMI 27.0 · 26 mm → FIGO 2023 IAm	6.3%	SLN MIC+MAC OR 0.30 (p=0.032) PFS vs NSMP: p=0.103 (KM)
NSMP	11.0%	BMI 29.0 · low-grade 84.2% · endometrioid 92.5% ER−/high-grade NSMP (22%): MAC 18.2% · mapping failure 24.3%	7.8%	reference
MMRd	19.4%	median 63 y · BMI 28.5 · endometrioid 90.4% · LVSI 28.3% → immunotherapy-relevant	12.4%	SLN MIC+MAC OR 0.77 (p=0.36) PFS adj. HR 1.67 (p=0.031) · KM p=0.484
p53abn	26.1%	median 67 y · 35 mm · non-endometrioid 78.4% → IICm if myoinvasive	12.5%	SLN MIC+MAC OR 1.19 (p=0.57) PFS adj. HR 2.98 (p<0.001)
multivariable	**class NOT independent** nodal involvement p=0.20 mapping failure p=0.75	**classic histopathology remains the strongest predictor** of nodal spread and SLN mapping failure	**class differs (p=0.004)** p53abn OR 1.69 · MMRd OR 1.67	**SLN mets: LVSI strongest (p<0.00001)** class n.s. except POLEmut

FIGO 2023 molecular annotation / report stage with "m" + subtype · IAm POLEmut (stage I–II POLEmut) · IICm p53abn (stage I–II p53abn with myoinvasion) · ESGO 2025 splits NSMP into ER+/low-grade vs ER−/high-grade

so what */ nodal risk climbs POLEmut → p53abn where per-class rates exist (8 → 26%; 6.3 → 12.5%), yet after adjustment class is not independent (Scarpelli p=0.20; PROMISE-EC p53abn OR 1.19, n.s.) and LVSI is the strongest SLN predictor → molecular class does not replace nodal staging: SLN for all.*

ongoing endometrial RCTs

ENDO-3

ANZGOG / QCGC
n=760

NCT04073706

DESIGN
apparent stage I EC: SLN biopsy vs NO retroperitoneal node dissection

PRIMARY 4.5-yr DFS (non-inferiority)
STATUS *recruiting · 444 / 760 (Jul 2026) → 2031*

SELYE

KGOG 2029 — Korea
n=810

NCT04845828

DESIGN
clinical stage I–II EC: ICG SLN (two-step in high-risk) vs LND

PRIMARY 3-yr DFS
STATUS 24 institutions · accrual 36 mo + follow-up 36 mo

ALICE

Brazil-led
n=180 randomized

NCT03366051

DESIGN
HIR / HR EC: SLN alone vs SLN + pelvic & para-aortic LND

PRIMARY 3-yr DFS
IGCS 2026 complications 9.0 vs 30.8% (p<0.001) · clinical lymphedema 5.6 vs 20.9%

SENTIMETREP53

France · 32 centers
n=374

NCT06900582

DESIGN
p53abn EC (FIGO 2023 I–II, PET-negative): SLN vs pelvic + para-aortic LND

PRIMARY 3-yr DFS (non-inferiority)
STATUS recruiting (IJGC 2026) → results 2031

Also in China — INSEC (Zhejiang, n=722; stage I endometrioid; SLN vs SLN + PLND; 3-yr DFS, ~2028) · NCT04276532 (Shanghai, n=780; intermediate–high risk; SLN vs PLND; active, not recruiting)

04

Era 2020s — Cervical



SENTICOL II — first morbidity benefit RCT in cervical cancer

Mathevet et al. · Eur J Cancer 2021;148:307–315. Front Oncol 2021;10:621518. · 28 French centers · randomized trial (NCT01639820)

206

patients (RCT)

DESIGN

Population

FIGO 2009 sta

Endpoint

Open-label RC
hysterectomy/t
Primary: lymph
8). SN-positive

Tracer

Tc-99m lymph
pic mapping

p=0.0046)
p=0.53).

cancer

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.ejcancer.com

ELSEVIER



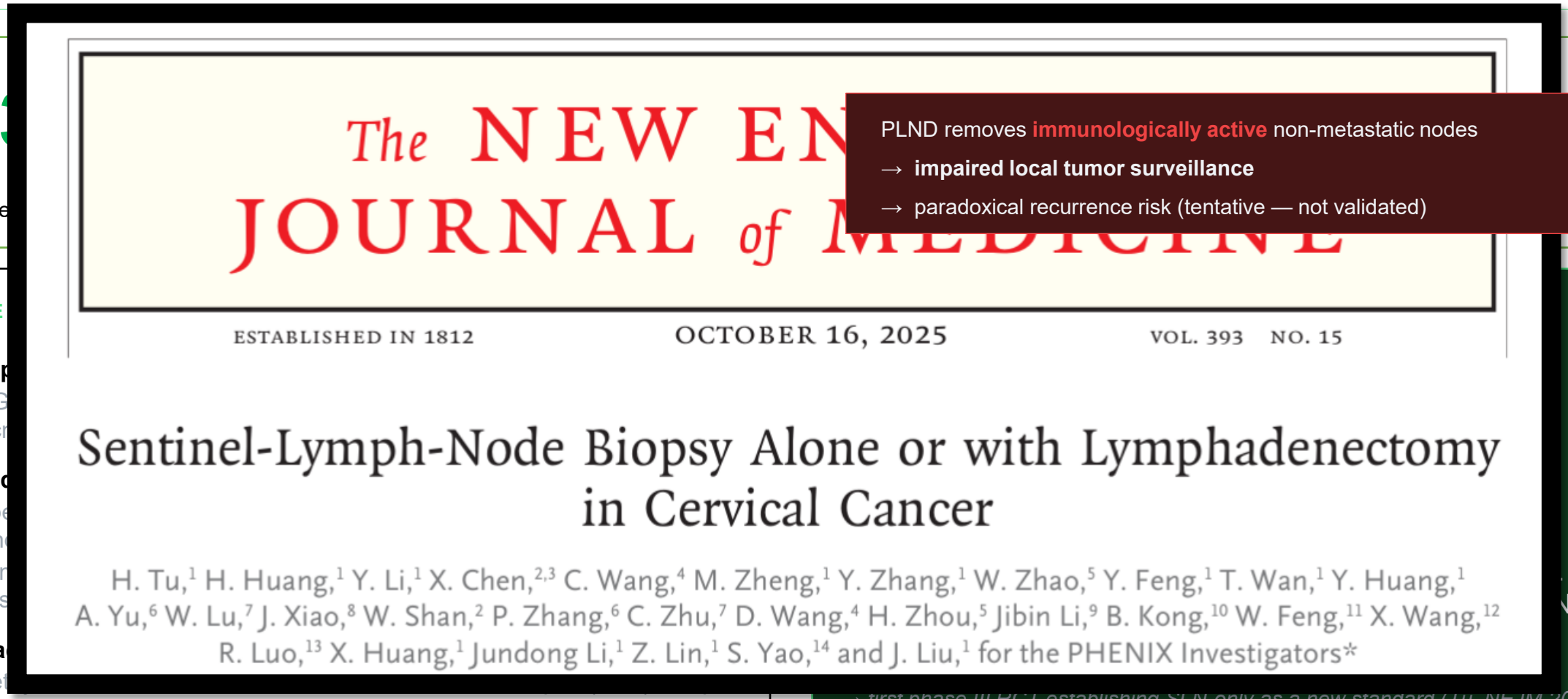
Clinical Trial

Sentinel lymph node biopsy and morbidity outcomes in early cervical cancer: Results of a multicentre randomised trial (SENTICOL-2)☆

Patrice Mathevet [a,j,*], Fabrice Lécuru [b], Catherine Uzan [c,k,l], Florent Boutitie [d,m], Laurent Magaud [e,n], Frederic Guyon [f], Denis Querleu [g,o], Virginie Fourchotte [b], Marc Baron [h], Anne-Sophie Bats [i] on behalf of the Senticol 2 group

PHENIX-I — phase III RCT proving SLN-only survival non-inferiority

Tu et al. · N Engl J Med 2025;393:1463–1474 · phase III RCT, 11 Chinese centers



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 OCTOBER 16, 2025 VOL. 393 NO. 15

Sentinel-Lymph-Node Biopsy Alone or with Lymphadenectomy in Cervical Cancer

H. Tu,[1] H. Huang,[1] Y. Li,[1] X. Chen,[2,3] C. Wang,[4] M. Zheng,[1] Y. Zhang,[1] W. Zhao,[5] Y. Feng,[1] T. Wan,[1] Y. Huang,[1] A. Yu,[6] W. Lu,[7] J. Xiao,[8] W. Shan,[2] P. Zhang,[6] C. Zhu,[7] D. Wang,[4] H. Zhou,[5] Jibin Li,[9] B. Kong,[10] W. Feng,[11] X. Wang,[12] R. Luo,[13] X. Huang,[1] Jundong Li,[1] Z. Lin,[1] S. Yao,[14] and J. Liu,[1] for the PHENIX Investigators*

PLND removes **immunologically active** non-metastatic nodes

→ **impaired local tumor surveillance**

→ paradoxical recurrence risk (tentative — not validated)

oscopic (62%) approach

→ first phase III RCT establishing SLN-only as a new standard (Tu, NEJM 2025) · la
p subgroup HR 0.40 (0.18–0.92): prespecified, exploratory

SENTIX Trial

Cibula et al. · Nat Cancer 2025;6(9):1585–1594 , Gynecol Oncol 2024;188:83–89 · 18 countries, 47 sites · prospective single-arm non-inferiority

594

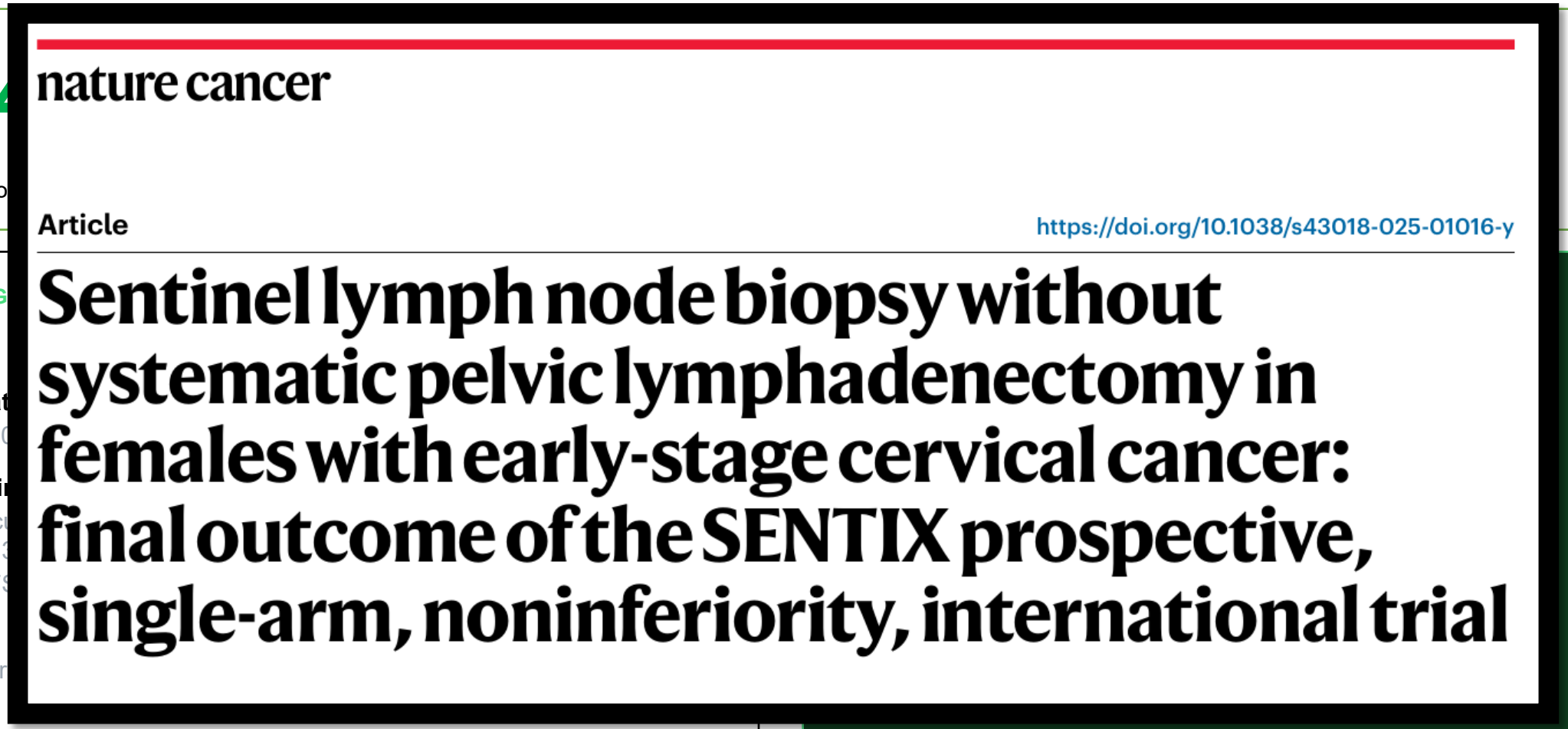
ITT coho

DESIG

Populat
FIGO 20

Endpoi
2-yr rec
erapy 13
3-yr DFS

Tracer
Mixed tr



nature cancer

Article

https://doi.org/10.1038/s43018-025-01016-y

Sentinel lymph node biopsy without systematic pelvic lymphadenectomy in females with early-stage cervical cancer: final outcome of the SENTIX prospective, single-arm, noninferiority, international trial

cervical RCTs — ongoing & newly reported

SENTICOL III

GINECO / ENGOT / GCIG
n=989

NCT03386734

DESIGN

SLN biopsy alone vs SLN + PLND (1:1 RCT)

PRIMARY 3-yr DFS + QoL co-primary
STATUS *accrual closed 6/2024 (target met) · final DFS ~2027*

PHENIX-II

China
SLN+ · n=70 (35 vs 35) · early terminated

NCT02642471 (PHENIX cohort II)

DESIGN

SLN-positive: SLN biopsy alone vs completion PLND (RH in all) — RCT

IGCS 2026 3-yr DFS 88.4 vs 74.3% (p=0.32)
· CSS 97.1 vs 74.3% (HR 0.20, p=0.02) · lymphedema 8.6 vs 31.4%

WHY SENTICOL III STILL MATTERS

PHENIX one country · methylene blue 85% · ultrastaging not mandatory · ≤ 3 cm

SENTIX single-arm, judged against a historical 7% benchmark

SENTICOL III international RCT (GINECO / ENGOT / GCIG), IA1 LVSI+ → IIA1 ≤ 4 cm, DFS + QoL co-primary → the generalizability test

2026 META-ANALYSIS · Xiao et al., Front Oncol 2026

17 studies · 3,855 pts
CSS HR 0.93 (0.27–3.20) · OS HR 0.92 (0.65–1.31)
complications RR 0.70 (0.50–1.00; p=0.04)
SLN positivity 8% (5–12) · after SLN alone: 5-yr OS 97%, DFS 94%
caveat: 2–4 studies per comparison, mostly retrospective → low certainty

Also in China — Zhengzhou single-center RCT (IJGC 2025; n=208, IA2–IB1): carbon-nanoparticle SLN vs PLND · lymphedema 3.8 vs 19.2% · DFS 98.2 vs 95.2% (median FU 18 mo, p=0.42)

05

Ovarian



still investigational

complex drainage, mixed evidence, no standard

WHY HARD

- 3 lymphatic pathways (para-aortic via IP ligament; pelvic via utero-ovarian; rare inguinal)
- Most disease presents advanced → small candidate pool
- Standard approach is laparotomy, in staging context
- Injection site unsettled (utero-ovarian vs IP vs cervical)

SELLY trial · EJC 2024 · n=174

58.6%

detection rate, ICG 2 mL alone

26.7%

false-negative (4 of 15 node+)

35%

of node+ ONLY by ultrastaging

WHAT'S BEEN LEARNED

- Tc-99m + ICG series: DR 90–100% vs 58.6% with ICG alone — indirect comparison; meta-analysis favors the combination (Agustí, IJGC 2023)
- ultrastaging detects 35% of node-positive cases otherwise missed — same lesson as cervix/endometrium
- **2025–26:** dual tracer (MELISA) DR 93.3% vs 79.4% with 99mTc alone · true hybrid 99mTc-ICG (HibrOv) DR 92.5%, 3/3 N+ found

current status / investigational only. *Tracer optimization (combination, volume, site) is the active question.*

ovarian SLN — phase II to phase III

building the evidence base — feasibility → accuracy → validation

01 COMPLETED — feasibility & accuracy proven

SENTOV

Lago / Spain
n=20

Lago · IJGC 2020

DESIGN
Feasibility — 99mTc + ICG into IP & UO ligaments

PRIMARY *DR / safety AE ≤30d*

STATUS *completed — IJGC 2020*

MELISA

Hospita

Italy — 7 sites
n=174

Agustí · Gynecol Oncol 2023

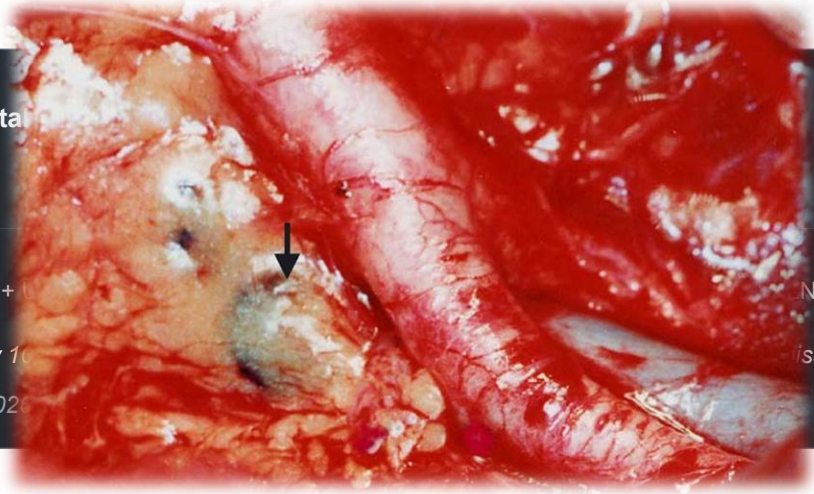
DESIGN
Combined 99mTc + ICG, dual injection (IP +

ND reference

PRIMARY *DR 90% (27/30) · sensitivity 1*

issed

STATUS *GO 2023 (n=30) · EJNMMI 202*



02 ONGOING — validation in progress

SENTOV II

La Fe / Spain
FIGO I-II EOC

NCT06963268

DESIGN
99mTc + ICG, dual injection (IP stump + cervix); single-arm NPV

PRIMARY *NPV vs LND gold standard*

STATUS *recruiting 2025–28 / results 2029*

Charcoal-EOC

Istanbul University
FIGO I-II EOC

NCT05927818

DESIGN
Sterile charcoal as novel tracer vs systematic LND

PRIMARY *Sensitivity / NPV vs LND*

STATUS *recruiting since 2023*

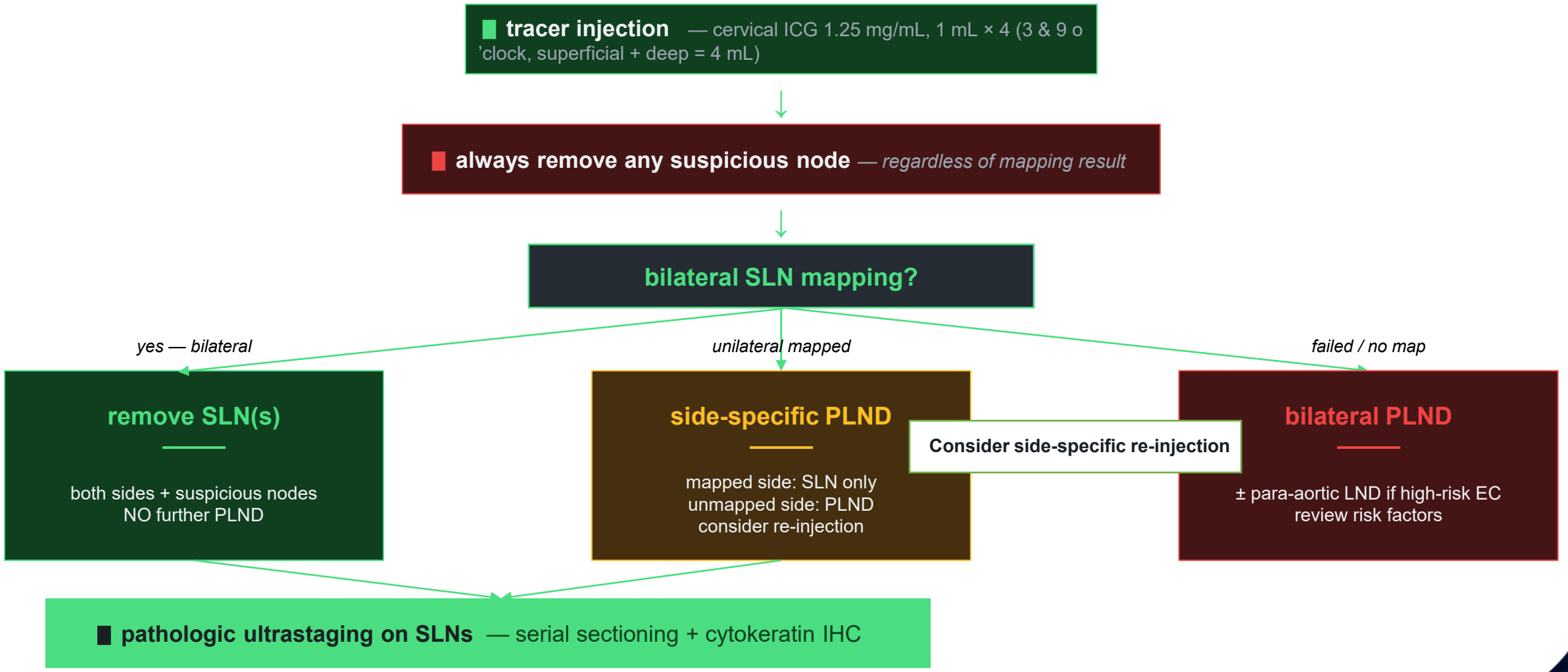
Practice note / *Practice implication — SLN remains investigational in EOC.*

06

Algorithm & Pathology



the algorithm — shared across cervical & endometrial



Ultrastaging

프로토콜	암종	Grossing	Level 수	Level 간격	절편 / 염색	비고
NCCN	자궁내막암 자궁경부암	명시 X	명시 X	명시 X	"Multiple H&E sections ± cytokeratin IHC"	"No standard protocol"
MSKCC (전통)	자궁내막암	2 mm, 장축 평행	2 (L1, L2)	50 μm	각 level: H&E 1 + AE1:AE3 IHC 1 (초기 H&E 포함 총 5장/블록)	자궁내막암 사실상 표준
MSKCC Limited (Chiang, IJGC 2024)	자궁내막암	2 mm, 장축 평행	1	50 μm	단일 level: H&E 1 + AE1:AE3 IHC 1	임상적 유의 병변 FN 0–0.9%, 비용 50%↓
ESGO–ESTRO–ESP 2025	자궁내막암 자궁경부암	2 mm, 전체 embedding	초기 절편 + ≥2 levels	50–250 μm	각 level H&E + IHC (IV, C)	MAC+MIC = 전이; ITC 의의 불명확
MD Anderson (Euscher 2008)	자궁경부암	2 mm, 장축 수직	5	40 μm	각 level H&E 1 + unstained 2 (음성 시 IHC 1장)	Cervical SLN 대표적 강도형 (EC 2018 프로토콜은 250 μm)
SENTIX trial	자궁경부암	2 mm	블록 전체 (상한 없음)	150 μm	각 level H&E + IHC	FS 검출률: MAC 83.7 / MIC 26.3 / ITC 9.1 % (나머지는 ultrastaging)

FIGO 2023 low-volume metastasis & the ITC question

FIGO 2023 · NODAL CATEGORIES

MAC — **> 2 mm**
IIIC1ii / IIIC2ii
pN1 — adjuvant per stage IIIC

MIC — **0.2 – 2 mm (or > 200 cells)**
IIIC1i / IIIC2i
pN1 (ESGO 2025: metastatic involvement, IV C)

ITC — **≤ 0.2 mm (≤ 200 cells)**
pN0(i+) — NO upstage
ESGO 2025: prognostic significance unclear (IV C)

ITC OUTCOMES — POPULATION COHORT 2026

Stockholm–Gotland 2010–2024 · n=1,219 · Acta Oncol 2026;65:702

HR 1.94
OS, ITC (n=60) vs node-negative
95% CI 0.75–5.06 · p=0.17

47% vs 11%
received adjuvant therapy (ITC vs pN0)
23% treated specifically because of ITC

- nodal burden among pN1: micro vs macro HR 0.95, bulky 1.19 — no clear OS gradient
- survival driven by age > 68 and p53abn (HR ≈ 3), not by ITC
- exploratory (p53-stratified): no ITC effect in p53-wt; poorer survival in p53-mutated

take-away */ ITC alone should not trigger adjuvant therapy — uterine factors and molecular class decide. Prospective answer: ENDO-ITC (Mayo, NCT06689956, observation-only low-risk cohort, 2029).*

guideline landscape 2025–26 — where SLN stands today

ESGO–ESTRO–ESP 2025

ENDOMETRIAL

SLN biopsy for staging in ALL presumed **uterus-confined disease** (II, A)

ICG **cervical injection** preferred; **re-injection** if not visualized

failed side → side-specific LND (HIR/HR); consider in IR

ultrastaging of all SLNs (II, A); MAC + MIC = metastatic

AGO (Germany) 2026

ENDOMETRIAL

Uterus Commission on ESGO 2025: substantial agreement — MIS preferred, avoid unnecessary radicality

differences mainly in the indication for SLN staging

German S3: molecular markers as supportive information

→ SLN-for-all is NOT yet universal

NCCN 2026

CERVICAL & ENDOMETRIAL

NCCN cervical: SLN “may be considered”; **PLND remains standard** except IA1 LVSI−

NCCN uterine: SLN mapping endorsed for apparent uterine-confined disease

KSGO 2024–25

KOREA · v5.0 (2024) → v5.1 (2025)

cervical v5.0 (KQ5): “SLN mapping can be selectively performed” — evidence low, weak/conditional

cervical v5.1 (JGO 2025): SLN KQ removed — “insufficient clinical evidence”

uterine v5.0 (KQ4): “SLN mapping can be performed” — evidence very low, weak/conditional

now: SENTIX + PHENIX published; SENTICOL III final ~2027 → basis for a KSGO upgrade

07

Future Directions



PATHOLOGY AI / AUTOMATING ULTRASTAGING

Baeten et al. · Cancers 2024;16(21):3619 · Netherlands

21

patients (early-stage cervical)

47

SLNs · 473 H&E whole-slide images

100%

sensitivity — H&E-visible MAC 13/13 · MIC 12/12

HOW IT WORKS

Input

H&E-stained whole slide images of SLN sections

Algorithm

Visiopharm Metastasis Detection App (CE-IVD / IVDR), trained on breast & colon LN — used off-label

Output

color-coded suspicious areas (95 / 80 / 50% operating points) + largest-me tastasis length

Status

CE-IVD certified · commercially available · off-label pilot in early-stage cer vical cancer (ESGO 2024)

WHY IT MATTERS

ultrastaging is the bottleneck.

4-level serial sectioning + pan-cytokeratin IHC =

labor-intensive · expensive · delays results

→ **AI as a triage tool:** pathologist reviews flagged regions only.

→ democratizes ultrastaging at low-volume centers.

→ caveat: node-positive cases only (specificity untested); median 81 annotations pe r patient (excl. frozen sections) still need pathologist review.

Thank You

2026 **KSGO 제31차 추계 심포지엄**

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