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Review

Current role of Histolog® in real-time histopathologic assessment: a systematic review

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Summary

Achieving complete tumor removal with negative margins remains a major goal in oncologic surgery. Frozen section analysis is still the most widely used method for intraoperative margin assessment, but it has several limitations, including time consumption, costs, and the need for dedicated pathology support. In this context, Histolog® Scanner has emerged as a fluorescence confocal microscopy device that enables rapid digital evaluation of freshly excised tissue without conventional histological processing.

This systematic review aimed to evaluate the current clinical applications of Histolog® Scanner, its diagnostic performance, and its concordance with conventional histopathological assessment. Most included studies focused on breast surgery, followed by dermatologic, prostatic, and head and neck applications. Reported sensitivity ranged from 30% to 100%, specificity from 75% to 100%, and overall diagnostic accuracy reached up to 99% in selected settings.

Current evidence supports the feasibility and promising diagnostic performance of Histolog® Scanner in selected oncologic fields. However, the available literature remains limited and heterogeneous and is still insufficient to support replacement of frozen section analysis in routine practice. Further large-scale prospective studies are needed to better define its reproducibility, cost-effectiveness, and potential role across different oncologic settings, particularly in head and neck surgery.

Keywords: Histolog Scanner, frozen section, confocal microscopy

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Introduction

Assessment of surgical margins remains an open and critical issue as it directly influences both intraoperative and postoperative management. Currently, frozen section analysis is the most widely used technique for intraoperative margin evaluation, while conventional histopathology remains the gold standard for final specimen assessment.

However, traditional histopathological processing presents several limitations, including high costs, the need for specialized pathologists, and significant time consumption throughout the entire workflow[1].

Due to these preliminary considerations, several innovative techniques have been developed to address these challenges. Among them, the Histolog® Scanner (SamanTree Medical, Lausanne, Switzerland) is a CE-marked fluorescence confocal microscopy system that enables rapid, high-resolution tissue imaging and can be used for intraoperative assessment of surgical margins.

Histolog® Scanner is a digital microscopy scanner for ultra-fast confocal imaging of freshly excised tissues that can be placed within the operating

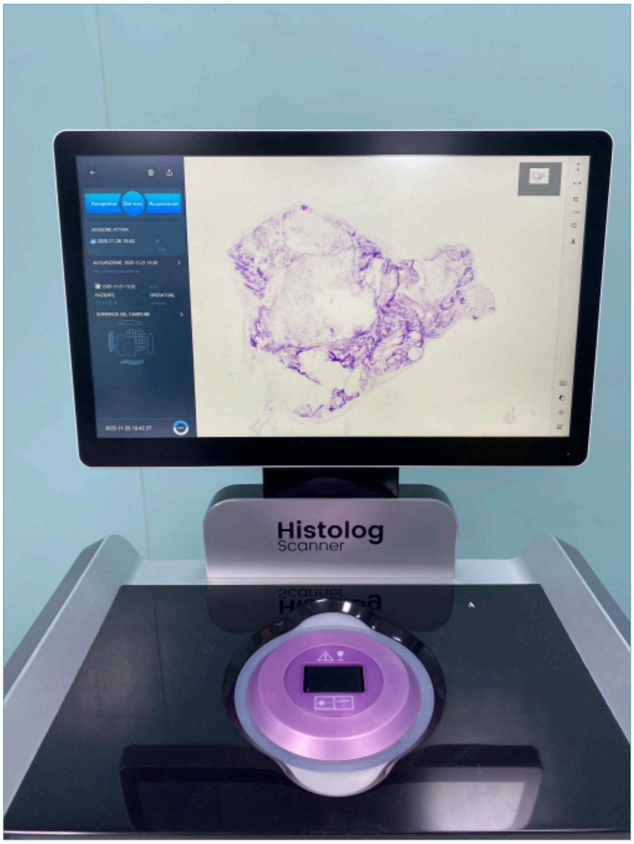

Figure 1. Figure 1. Histolog® Scanner, picture in the operating room of University Hospital of Modena.

room. In a few minutes, it reveals the morphology of the tissue at the subcellular level within minutes without any calibration or parameters set by users. There is no need for fixation, embedding, nor mounting of excised tissues on slides. The specimens are placed in an acridine orange-based photoreactive solution (Histolog® Dip, SamanTree Medical SA) for 10 seconds, then rinsed with 0.9% saline solution, carefully dried with absorbent paper and placed on the scanner to obtain the images. A digital image of the specimen surface is displayed in artificial purple colouring on a touch screen, which allows the surgeon to zoom in and move around the image (Fig. 1).
The aim of this systematic review is to assess the current clinical applications of Histolog®, its diagnostic accuracy, and the concordance of its analyses across various subsites.

Materials and methods

This systematic review of literature was conducted in accordance with the PRISMA statement[2]. Two independent reviewers (CL and SP) performed a comprehensive literature search across three databases (PubMed, Scopus and Cochrane) on October 24th, 2025. All articles concerning the use of Histolog® Scanner were identified using the keywords "surgical margins" AND "Histolog scanner".
The inclusion criteria comprised all studies employing Histolog® Scanner in humans and in ex-vivo settings, as well as case series (with more than 10 patients). Conversely, preclinical studies on animal models, opinion articles, reviews and case reports were excluded.
The reviewers independently screened titles and abstracts to identify potentially eligible studies and excluded the duplicates. Full texts were then assessed for eligibility.
For each included article, the following data were extracted: authors, year of publication, study type, site, number of patients, number of analyzed images, aim, alternative analysis performed, concordance/inter rate agreement, sensitivity and specificity.
Quality Assessment of Diagnostic Accuracy Studies-2 (QUADAS-2) tool was used to assess the quality of the included studies[3].

Results

The initial literature search yielded forty-one records. After removal of duplicates, eighteen records were screened based on their titles and abstracts, leading to the exclusion of two additional studies that were not consistent with the aim of this review. Sixteen studies subsequently assessed for eligibility through full-text review. Three studies were excluded with reasons. One full-text article was excluded as it described an ongoing study protocol. Although patient recruitment had already started, no analysis of FCM images had been performed at the time of publication and no diagnostic accuracy data were available[4]. Another article[5] was excluded because it was a review article reporting aggregated results from previously published studies, without providing original patient-level or diagnostic accuracy data and was therefore not eligible for inclusion. A further article[6] was excluded because it evaluated a different imaging device (VivaScope 2500) rather than Histolog® Scanner and was therefore not consistent with the scope of this review.
Ultimately, thirteen studies met the inclusion criteria and were included in this systematic review[7-19]. Figure 2 shows the PRISMA flow diagram of the search process. The main characteristics of the included studies are summarized in Table I.

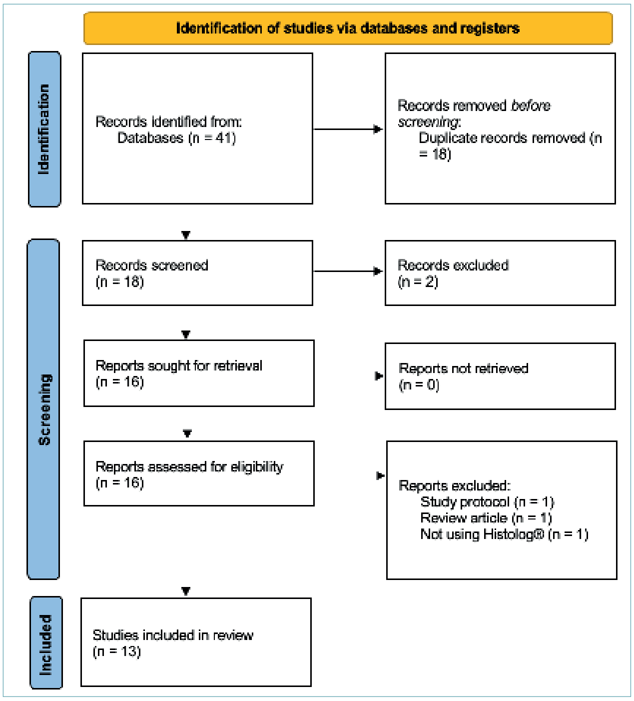

Figure 2. PRISMA flow diagram of the search process.

The methodological quality of the included studies was assessed using QUADAS-2 tool (Tab. II). Risk of bias was generally low across most domains. Specifically, patient selection showed some concerns: two studies were rated as high risk and one as unclear, mainly due to non-consecutive or selectively included cases. The index test domain was mostly low risk, although one study was rated high and one unclear because either the reading was not blinded or information on blinding was not reported. The reference standard was uniformly low risk across all studies, as histopathology of the surgical specimen is considered the gold standard. Finally, the flow and timing domain was consistently low risk, indicating that all patients were included in both analyses in the reported studies.
All the included studies were case series, published between 2018 and 2025. Among these, eight studies investigated the use of Histolog® Scanner in oncologic breast surgery[8,9,12-14,16-18], two in oncologic prostate surgery[7,19], two in oncologic dermatologic surgery[11,15] and one in oncologic head and neck surgery[10].
Among the studies reviews, eight employed Histolog® Scanner to evaluate margin positivity[7-9,12-14,16,19], four for diagnostic purposes[10,15,17,18] and one for both[11].
In all the studies included, surgical specimens were analysed using Histolog® Scanner.
Histolog® analysis of surgical specimens was carried out by the pathologist in five studies[7,10,15,17,19], by the surgeon in three cases with subsequent comparison to the conventional analysis by the pathologist[11,12,16] and finally by both in five studies[8,9,13,14,18].
In the included studies, Histolog® was assessed against different routine clinical practices, depending on the specific oncologic setting. In most cases, the reference comparator was conventional histopathology, including both frozen section and paraffin-embedded analysis. Intraoperative assessment workflows represented the most common clinical scenario in which Histolog® was intended to be implemented, particularly for surgical margin evaluation. Within this context, it was mainly compared with standard intraoperative pathology assessment, especially frozen section analysis. In breast surgery studies, Histolog® was instead evaluated against imaging-base approaches, such as specimen radiography and ultrasound, with final histopathological diagnosis used as the reference standard.
In prostate surgery, Almeida-Magana et al.[7] applied the Histolog® Scanner in the so-called LaserSAFE technique, an approach conceptually similar to NeuroSAFE, as it provides intraoperative evaluation of the posterolateral prostatic margins without the need for frozen sections (paraffin-embedded analysis). Sixty Histolog® images were collected from 31 patients and independently evaluated by four blinded pathologists. The analysis showed that the sensitivity for detecting of positive surgical margins (PSM) ranged between 73% and 91% and specificity between 94% and 100%. Fleiss' kappa agreement among the pathologist regarding margin positivity was 0.779 (95% CI = 0.635-0.923), indicating good diagnostic reproducibility of the LaserSAFE technique.
Comparable findings were reported by Mayor et al.[19], who analysed the entire prostate surface in a larger cohort of 156 patients, with a total of 869 images. The sensitivity of fluorescence confocal microscopy (FCM) in detecting clinically significant PSM (> / = 3 mm) reached 79% (95% CI, 54-94%), with a specificity of 94% (95% CI, 99-98%), confirming the reliability of FCM for intraoperative margin assessment. Differences in sensitivity between the two studies are mainly attributable to the area examined (posterolateral surface versus whole gland), the mean length of PSM (larger in Almeida-Magana's series) and the greater anatomical complexity of apical and basal regions analysed in the study by Mayor et al.
In breast-conserving surgery (BCS), several studies have evaluated the use of Histolog® Scanner for intraoperative margin assessment. The results showed consistent improvements in diagnostic accuracy and potential reductions in re-operation rates.

Table I. Main features of the analysed studies.

N	Title	Authors
1	Diagnostic accuracy of a new ex vivo confocal laser scanning microscope compared to H&E-stained paraffin slides for micrographic surgery of basal cell carcinoma	Peters N, Schubert M, Metzler G, Geppert JP, Moehrle M
2	Comparative analysis of confocal microscopy on fresh breast core needle biopsies and conventional histology	Elfgen C, Papassotiropoulos B, Varga Z, Moskovszky L, Nap M, Güth U, Baege A, Amann E, Chiesa F, Tausch C
3	Ex vivo confocal microscopy for surgical margin assessment: A histology-compared study on 109 specimens	Grizzetti L, Kuonen F
4	Imaging of lumpectomy surface with large field-of-view confocal laser scanning microscope for intraoperative margin assessment -POLARHIS study	Sandor MF, Schwalbach B, Hofmann V, Istrate SE, Schuller Z, Ionescu E, Heimann S, Ragazzi M, Lux MP
5	Imaging of lumpectomy surface with large field-of-view confocal laser scanningmicroscopy ‘Histolog® scanner’ for breast margin assessment in comparison with conventional specimen radiography	Togawa R, Hederer J, Ragazzi M, Bruckner T, Fastner S, Gomez C, Hennigs A, Nees J, Pfob A, Riedel F, Schäfgen B, Stieber A, Lux MP, Heil J, Golatta M.
6	Breast carcinoma detection in ex vivo fresh human breast surgical specimens using a fast slide-free confocal microscopy scanner: HIBISCUSS project	Conversano A, Abbaci M, van Diest P, Roulot A, Falco G, Ferchiou M, Coiro S, Richir M, Genolet PM, Clement C, Casiraghi O, Lahkdar AB, Labaied N, Ragazzi M, Mathieu MC.
7	SENOSI Confocal Microscopy: A New and Innovating Way to Detect Positive Margins in Non-Palpable Breast Cancer?	Wernly D, Beniere C, Besse V, Seidler S, Lachat R, Letovanec I, Huber D, Simonson C.
8	Ultra-fast confocal fluorescence microscopy for neck lymph node imaging in head and neck	Abbaci M, Villard A, Auperin A, Asmandar S, Moya-Plana A, Casiraghi O, Breuskin I
9	Accuracy of the LaserSAFE technique for detecting positive surgical margins during robot-assisted radical prostatectomy: blind assessment and inter-rater agreement analysis	Almeida-Magana R, Au M, Al-Hammouri T, Mathew M, Dinneen K, Mendes LST, Dinneen E, Vreuls W, Shaw G, Freeman A, Haider A
10	Re-Operation Rate for Breast Conserving Surgery Using Confocal Histolog Scanner for Intraoperative Margin Assessment-SHIELD Study	Lux MP, Schuller Z, Heimann S, Reichert VMC, Kersting C, Buerger H, Sandor MF
11	Confocal Microscopy for Intraoperative Margin Assessment of Lumpectomies by Surgeons in Breast Cancer: Training, Implementation in Routine Practice, and Two-YearRetrospective Analysis	Cattacin I, Rochat T, Feki A, Fruscalzo A, Boulvain M, Guani B
12	Confocal Laser Microscopy for Intraoperative Margin Assessment in Breast-Conserving Surgery: A New Procedure in the Pathology Laboratory Workflow	Colard-Thomas J, Pialoux-Guibal A, Gemival P, Maran-Gonzalez A, Khellaf L, Leaha C, Verdanet E, Mourregot A, Gutowski M, Pourquier D
13	IP8-FLUORESCE: A Prospective Paired Cohort Study Evaluating the Diagnostic Accuracy of Fluorescence Confocal Microscopy for Real-time Assessment of Surgical Margins in Radical Prostatectomy.	Mayor N, Light A, Silvanto A, Haider A, Cullen E, Ng C, Boaz RJ, Gopalakrishnan A, Khoubehi B, Hellawell G, Almeida-Magana R, Mendes L, Dinneen E, Shaw G, Challacombe B, Cathcart P, Connor MJ, Shah TT, Ahmed HU, Fiorentino F, Winkler M

Year	Site	n° patients	n° analyzed images	scope 1: margins 2: diagnosis 3: both	% concordance / inter rate agreement / accuracy 1: pathologist 2: surgeon 3: both	Sensitivity 1: pathologist 2: surgeon 3: both	Specificity 1: pathologist 2: surgeon 3: both
2018	skin	148	525	2	/	1: 73%	1: 96%
2019	breast	24	42	2	1: 95%	/	/
2022	skin	109	109	3	/	2: 50%-100%	2: 91%-100%
2022	breast	40	240	1	/	3: 30.7%-53.8%	3: 85.1%-85.2%
2023	breast	50	300	1	1: 74% 2: 69.2%	1: 37.5% 2: 37.5%	1: 81% 2: 75.2%
2023	breast	126	300	2	1: 99.6% 2: 98%	1: 99.9% 2: 97%	1: 97% 2: 99%
2024	breast	52	unspecified	1	1: 78.4% 2: 76.5%	1: 36.4% 2: 27.3%	1: 90% 2: 90%
2024	H&N	44	201	2	1: 95.5%	1: 76.7%	1: 98.8%
2025	prostate	31	60	1	1: 0.78	1: 73-91%	1: 94-100%
2025	breast	50	unspecified	1	2: 97.8%	2: 80.9%	2: 99.5%
2025	breast	68	68	1	2: 96.9%	2: 100%	2: 96.3%
2025	breast	20	21	1	3: 76.2%	3: 100%	3: 92.3%
2025	prostate	156	869	1	/	1: 79%	1: 94%

Table II. Assessment of risk of bias and applicability concerns using QUADAS-2. Four domains were evaluated for each study: patient selection (consecutive vs selected cases), index test (blind vs non-blinded analysis), reference standard (gold standard vs alternative) and flow and timing (whether all patients were included in both analysis).

Study	Patient selection	Index test	Reference standard	Flow and timing
1	Low	Low	Low	Low
2	Unclear	Low	Low	Low
3	Low	Low	Low	Low
4	Low	Low	Low	Low
5	Low	Low	Low	Low
6	High	Low	Low	Low
7	Low	Low	Low	Low
8	Low	Low	Low	Low
9	Low	Low	Low	Low
10	High	Unclear	Low	Low
11	Low	Low	Low	Low
12	High	High	Low	Low
13	Low	Low	Low	Low

Elfgen et al.[17] conducted one of the first studies assessing the diagnostic reliability of Histolog® Scanner for breast cancer detection on fresh core needle biopsies. In this study, 42 biopsy scans were analysed using FCM and compared to conventional histology. The results demonstrated an overall agreement of 95%.
In the POLARHIS study[13], surgeons and a pathologist analysed blindly Histolog® images from forty patients, evaluating the entire surface of the specimen, looking for PSM. The dataset consisted in 240 images. The authors compared re-operation rates deriving from standard of care, consisting in intraoperative margin assessment with ultrasound, specimen radiography or both (27.5%) and from Histolog® intraoperative evaluation. The overall sensitivity and specificity of the Histolog® Scanner assessment was 30.7% and 85.1% respectively when performed by surgeons, and 53.8% and 85.2% when performed by pathologists. The analysis identified a potential reduction of re-operation rates by 30-75%, compared to the standard intraoperative assessment.
Building on these findings, Togawa et al.[8] conducted a single-centre pilot study on 50 patients, comparing 300 Histolog® scans with conventional specimen radiography. Results showed that with standard clinical routine, the sensitivity in detecting PSM was 37.5%, specificity 78.2%, with a proportion of overall agreement of 71.7%. On the other side, with Histolog® Scanner the results were respectively 37.5%, 75.6% and 69.2% if performed by surgeons and 37.5%, 81% and 74% if performed by pathologists. Although the diagnostic performance was moderate, the study confirmed the feasibility and integration of Histolog® Scanner into the intraoperative workflow, highlighting the need for structured image-interpretation training.
The SENOSI project[9] further explored Histolog® Scanner performance in non-palpable breast cancers, analysing 52 patients. The Histolog® Scanner procedure performed by surgeons and pathologists had an accuracy of 76.47% and 78.43%, sensitivity of 27.27% and 36.36% and specificity of 90% for both; compared with standard of care that showed an accuracy of 62.75%, sensitivity of 63.64% and specificity 62.50%. The McNemar's chi-squared test showed that Histolog® Scanner analysis performed better than the standard of care, being a reliable and time-efficient intraoperative margin assessment.
Furthermore, the SHIELD study[12] evaluated PSM in 50 BCS patients, showing that with Histolog® Scanner surgeons achieved 80.9% sensitivity, 99.5% specificity and 97.8% in accuracy in detecting positive margins. Standard of care techniques demonstrated 19.05% sensitivity, 97.27% specificity and 93.60% accuracy. In addition, the use of Histolog® Scanner for intraoperative margin assessment resulted in a reduction of the re-operation rate from 30% to 10%.
The HIBISCUSS project[18] focused on training and diagnostic validation. In a multicentre study involving 181 patients, both surgeons and pathologists achieved high accuracy in identifying malignant tissue on 300 Histolog® Scanner images after short learning curve. Pathologists reached 99.6% accuracy, while surgeons improved from 83% to 98% across seven training sessions. These results underline the rapid learning potential and high diagnostic agreement achievable with structured training.
Colard-Thomas et al.[14] included in their study 21 specimens of invasive breast carcinoma, reporting a concordance rate of 76.2% between Histolog® Scanner and macroscopic examination. Interestingly, in 19% of cases, the Histolog® images revealed positive margins that had been classified as negative on macroscopic assessment.
Finally, Cattacin et al.[16] demonstrated the successful integration of Histolog® Scanner in routine surgical practice. After a six-hour online training, one surgeon implemented Histolog® Scanner in 68 consecutive BCS procedures over two years, achieving 100% sensitivity, 96.3% specificity and 96.9% accuracy, completing elimination of re-excision. This study confirms

that, once incorporated into the workflow, confocal microscopy can significantly enhance surgical precision and reduce reoperation burden.

Two studies have evaluated the diagnostic performance of ex vivo confocal laser scanning microscopy (CLSM) for surgical margin assessment in non-melanoma skin cancer, in particular basal cell carcinoma (BCC).

Peters et al.[15] conducted one of the first large-scale analysis using the Histolog® Scanner v1 on 525 fresh specimens from 148 BCCs excised during surgery. CLSM images were compared to paraffin-embedded H&E slides, demonstrating a sensitivity of 73% and a specificity of 96%. Both increased to 100% when punch biopsies were analysed.

Grizzetti and Kuonen[11] evaluated the Histolog® Scanner v2 in a prospective study of 109 specimens (BCC and SCC). When compared with H&S-stained sections, CLSM achieved a global sensitivity of 61.5% and specificity of 95% for margin assessment. For BCC specifically, sensitivity and specificity increased to 80% and 100% respectively.

Abbaci et al.[10] conducted the first ex vivo study assessing ultra-fast confocal fluorescence microscopy (UFCM) with Histolog® Scanner for the detection of metastatic lymph nodes in head and neck cancer. The study included 44 patients who underwent sentinel node biopsy or selective or neck dissection, yielding a total of 201 lymph nodes imaged immediately after excision.

UFCM achieved an overall diagnostic accuracy of 95.5%, a specificity of 98.8% and a sensitivity of 76.7%. The agreement between pathologists was high (Cohen's k = 0.80), corresponding to substantial concordance.

Discussion

Determining adequate surgical margins remains a matter of debate. Currently, the most widely used technique for intraoperative margin assessment is the frozen section analysis. Frozen sections are a reliable method to determine the presence or absence of tumor at the margins; however, they require significant resources, including a dedicated pathologist, a fully equipped laboratory, and specimen transportation between the operating room and the lab, which are not always in close proximity[20].

Given these considerations, recent studies have focused on identifying alternative methods for assessing surgical margins that require fewer resources and personnel, aiming to reduce turnaround time and improve success rates[20].

The goal is to provide surgeons with tools that can be easily used directly in the operating room, reducing dependence on traditional histopathological processing. Among these innovations, the Histolog® Scanner has emerged as a promising device, capable of producing high-resolution fluorescence images of fresh tissue specimens within minutes. Histolog® is designed for intraoperative scanning of specimens directly in the operating room. The device features a touchscreen interface for easy operation and image navigation. Specimens are treated with fluorescent dye solution to enhance tissue contrast and are placed on a plastic foil on the imaging window, which can accommodate up to 8 cm in diameter. Tissue fluorescence is excited by a 488 nm laser and emission above 500 nm is collected to generate the images. Fluorescence images are seamlessly displayed in real time, with an artificial purple colouring, without requiring additional post-processing. Operation is straightforward and can be performed by standard medical staff after brief training. The device offers a fast-imaging mode, providing an overview of the specimen in 5 seconds for positioning verification and a high-resolution, producing detailed images in 50 seconds, sufficient to visualise tissue morphology down to the cell nuclei level.[13]

The performance of Histolog® may vary depending on the type and size of the specimen. Small biopsies are generally easy to handle and quickly scanned, allowing rapid assessment of tissue morphology with minimal preparation. Larger surgical specimens, however, may require careful positioning on the imaging window and slightly longer scanning times, and there is a higher risk of minor imaging artifacts due to tissue folding or uneven dye distribution.

Its application has been explored across various surgical specialties, including urologic, breast, dermatologic, and head and neck surgery. Ongoing studies are evaluating its potential to enhance intraoperative decision-making by enabling rapid and accurate detection of tumor involvement at resection margins, as well as its possible role in supporting diagnostic orientation.

Almeida et al.[7] reported high sensitivity and specificity, supporting the accuracy and reliability of fluorescence confocal microscopy (FCM) in detecting positive surgical margins (PSM). The use of multiple evaluators strengthened reproducibility, while remote digital interpretation by pathologists represents a practical advantage, reducing specimen transport and turnaround time. The digital format also opens opportunities for AI-based image analysis. However, the limited sample size and absence of a predefined power analysis weaken the statistical robustness of the results. Mayor et al.[19] highlighted that performing FCM directly in the operating room, in the presence of the surgeon, may provide a better understanding of the exact location of PSM compared with frozen section analysis. Nevertheless, reported sensitivity (48-79%) for clinically significant margins remains lower than that of frozen sections and insufficient to support immediate clinical implementation, partly due to imaging artefacts in anatomically complex regions such as the prostate apex and base. Elfgen et al.[17] noted similar limitations related to small sample size and selective inclusion of highly suspicious lesions. Wernly et al.[9] demonstrated that intraoperative margin assessment with the Histolog® Scanner could outperform standard perioperative radiography in terms of efficiency, reducing evaluation time by up to 30%. Moreover, it mitigates logistical issues such as staff or equipment unavailability and offers surgeons technical autonomy and immediate accessibility. Lux et al.[12] observed a marked improvement in diagnostic performance following dedicated training, confirming that user experience significantly influences accuracy. Cattacin et al.[16] further showed that FCM provides rapid, real-time margin assessment without extending operative time or affecting final histopathology. With structured training, sensitivity reached 81-100%. Nonetheless, the technique is limited to one or two planar projections, producing two-dimensional images subject to tissue overlap and positioning artefacts, which may reduce spatial precision.

The comparison with routine clinical practice highlights that Histolog® is mainly positioned as a tool to support intraoperative pathological assessment, particularly frozen section analysis.

An important aspect emerging from the included studies is the variability in how Histolog® is implemented across different oncologic settings. Three main modalities of use can be identified. First, in some studies, Histolog® images were directly interpreted by surgeon intraoperatively, suggesting a potential role in partially replacing the need for immediate pathological consultation. Second, other studies evaluated Histolog® as a support tool for the pathologist, to be used alongside standard histopathological assessment, particularly in intraoperative settings. Third, in several cases, the device was investigated as a possible adjunct or alternative to established intraoperative assessment methods, such as frozen section analysis, without fully replacing the conventional workflow.

This heterogeneity reflects both the versatility of the technology and the current lack of standardization in its clinical integration. It also has relevant implications for the interpretation of diagnostic performance, as accuracy may vary depending on the operator and the intended role of the device within the clinical pathway.

Some limitations should be acknowledged. Several studies presented a high risk of bias in patient selection domain, which may limit the generalisability of the findings. The reference standard and flow and timing domains were robust. These findings suggest that while the majority of included studies were methodologically sound, some caution is warranted when interpreting the reported diagnostic accuracy.

The currently available data are preliminary and not extensive enough to draw definitive conclusions. Nevertheless, the results obtained so far are promising, as the Histolog® Scanner appears to produce findings consistent with those of traditional techniques. However, the existing evidence remains too limited to support broad generalization or to consider replacing conventional frozen section analysis with this technology.

Although only limited head and neck-specific evidence is currently available, this field may represent one of the most clinically relevant future applications of Histolog® technology. In head and neck oncology, intraoperative decision-making is particularly challenging because of complex anatomy, narrow functional margins, and the logistical burden of frozen section analysis. For these reasons, the encouraging results observed in other oncologic settings provide a rationale for dedicated prospective investigations in head and neck surgery, where the technology may prove particularly valuable.

Overall, FCM and Histolog® technology show promising potential for rapid and reliable intraoperative margin evaluation, offering workflow efficiency and independence from conventional pathology resources.

However, current evidence is limited by small sample sizes, technical constraints, and heterogeneous methodologies. Larger, standardized prospective studies are needed to validate these findings and define their role in routine surgical practice.

Future large-scale prospective clinical studies are warranted to validate the potential of the Histolog® Scanner for intraoperative margin assessment, to further define the learning curve among surgeons, and to quantify its real impact on operative workflow, response times, and overall cost-effectiveness.

Conclusions

Histolog® Scanner represents a promising tool for rapid ex vivo tissue assessment in oncologic surgery. Current evidence suggests good feasibility and encouraging diagnostic performance in selected clinical settings, particularly for intraoperative support and margin evaluation. However, the available evidence is still limited by small sample sizes, heterogeneous methodologies, and variable study endpoints.

At present, the literature is insufficient to support the routine replacement of frozen section analysis with Histolog® Scanner. Dedicated prospective studies are needed to clarify its real impact on workflow, diagnostic reproducibility, cost-effectiveness, and clinical outcomes. Evidence in head and neck surgery remains particularly scarce, although this field may represent one of the most relevant future areas of development for the technology.

Conflicts of interest statement

The authors declare that they have no conflict of interest.

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Authors' contributions

FM and AE conceived the project and defined the objectives of the review. CL and SP conducted the literature search and data extraction, analysed the selected studies and drafted the first version of the manuscript. All authors critically revised the text and approved the final version of the manuscript.

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