

# Examining the Pathological Diagnostic Impact of Frozen Sections in Breast Cancer

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**Abstract:** *Objective:* To analyze the diagnostic value of frozen section pathology in the diagnosis of breast cancer. *Methods:* A total of 50 patients with breast tumors treated between July 2021 and February 2023 were randomly selected as samples. Both paraffin section and frozen section diagnoses were conducted. The paraffin section results served as the gold standard for evaluating the value of frozen section examination. *Results:* Among the frozen section diagnoses, 48 cases (96.00%) were confirmed, 1 case was misdiagnosed (2.00%), and 1 case was delayed (2.00%). Among the confirmed patients, 45 cases (90.00%) were entirely consistent, and 3 cases (6.00%) were basically consistent. The diagnostic rate of the frozen section was 96.00%, compared with 100.00% for the paraffin section ( $P > 0.05$ ). The diagnostic time of the frozen section ( $35.25 \pm 2.11$  min) was significantly shorter than that for the paraffin section ( $6911.36 \pm 58.36$  min;  $P < 0.05$ ). *Conclusion:* Frozen section diagnosis is rapid and demonstrates relatively high diagnostic accuracy. It can guide doctors in determining whether to pursue breast-conserving treatment and aid in selecting appropriate surgical methods. This is beneficial for preventing unnecessary medical interventions and reducing the need for secondary surgeries in breast cancer patients.

**Keywords:** Frozen section diagnosis; Pathological diagnosis; Diagnostic results

**Online publication:** November 22, 2023

## 1. Introduction

Breast cancer constitutes a significant portion of female malignant tumors and poses a threat to the lives of female patients. In recent years, the age of onset of breast cancer has been decreasing, making it a growing social and public health concern. Clinical treatments for breast cancer typically encompass surgery, chemotherapy, radiotherapy, and endocrine regulation. Often, breast cancer patients undergo adjuvant radiotherapy or chemotherapy after surgery to reduce the risk of recurrence. Relevant literature suggests that early diagnosis and timely surgical intervention play a pivotal role in improving the prognosis of breast cancer<sup>[1]</sup>.

While breast MRI examinations exhibit high sensitivity, they may yield false positives and can be mistaken for benign breast tumors, making it challenging for doctors to devise accurate surgical plans. Conventional needle biopsy techniques are employed to perform preoperative pathological diagnoses, enabling the initial

differentiation between benign and malignant breast cancers and helping avoid unnecessary surgeries. However, these techniques are influenced by factors such as the quantity of tissue cells obtained, scattered calcifications, and the skill of the performing physician, leading to issues with false positives and false negatives. This hinders their clinical applicability. Intraoperative frozen pathology, on the other hand, assists doctors in clarifying the nature of tumors and making initial assessments of tissue grade and type, thereby offering valuable guidance for the precise selection of surgical plans. This study investigates the diagnostic value of intraoperative frozen sections, using a sample of 50 patients with breast tumors randomly selected from those treated between July 2021 and February 2023.

## **2. Materials and methods**

### **2.1. General information**

A total of 50 patients with breast tumors treated between July 2021 and February 2023 were randomly selected as samples. The age of the patients ranged from 16 to 81 years, with an average age of  $50.11 \pm 7.33$  years. The breast tumors had appeared within the range of 2 to 12 months before examination, and the size of the breast tissue specimens submitted for examination varied from  $0.5 \times 0.5 \times 0.5$  cm to  $4.0 \times 4.0 \times 4.0$  cm. In terms of lesion location, 24 cases were on the left side, 12 cases were bilateral, and 14 cases were on the right side. Tumor tissue samples were obtained from patients with breast disease. Frozen sections and routine paraffin sections of tumor tissue samples were prepared for corresponding pathological examinations. Inclusion criteria included patients with imaging examinations showing breast masses and normal liver and heart functions. Exclusion criteria included patients with other malignant tumors, immune system disorders, a history of radiotherapy or chemotherapy before enrollment, or abnormal organ function.

### **2.2. Methods**

All patients with breast tumors who received surgical treatment underwent preoperative frozen examination, and various examination equipment and items were prepared. After obtaining breast tissue specimens, freezing tests were performed. The test environment temperature was maintained between  $-30^{\circ}\text{C}$  and  $-18^{\circ}\text{C}$  to ensure test accuracy. The slices were sealed with ordinary adhesive, and the pathological slices were cut to a controlled thickness of  $4 \mu\text{m}$ . Fixative was used to secure the slices. After completing the fixation process, the slices were stained and sealed. The sealed specimens were first observed with the naked eye, followed by microscopic observation, and diagnostic results were evaluated based on histological diagnostic criteria. In addition, clinical data, such as X-ray mammography calcium results and clinical diagnoses, were comprehensively analyzed.

### **2.3. Observation indicators**

Patient data for breast tumors were analyzed. The frozen section examinations and paraffin section examinations were evaluated. After obtaining the paraffin section examination results, comparative analysis results of the frozen section examinations could be categorized as follows:

- (1) Frozen section results were completely/basically consistent with the paraffin section results (indicating similar tissue properties but different disease types), recorded as “diagnosed.”
- (2) Cases where malignant tumors were incorrectly identified as benign tumors (false negative) or benign tumors were incorrectly identified as malignant tumors (false positive), recorded as “misdiagnosed.”
- (3) Cases where the frozen section was providing inconclusive results and paraffin section results were needed to confirm benign or malignant status and formulate a treatment plan, recorded as “delayed diagnosis.”

## 2.4. Statistical research

The patient data for breast tumors were processed with SPSS 21.0. Count data were recorded as % (using the  $\chi^2$  test), and measurement data were presented as mean  $\pm$  standard deviation (using the *t*-test). A statistical difference was considered significant if  $P < 0.05$ .

## 3. Results

### 3.1. Comparison of frozen section diagnostic results and paraffin section diagnostic results

The frozen section pathological examination revealed that among the 50 patients who underwent examination for breast masses, 12 had malignant tumors, constituting 24.00% of the intraoperative breast disease rate. Of these, 10 were diagnosed with cancerous lesions, accounting for 83.33% of intraoperative malignant breast tumors, while 1 case was diagnosed with lymphatic tumors, making up 8.33% of malignant breast tumors during surgery. One case of malignant tumor awaited routine paraffin diagnosis. Additionally, there were 9 cases of intraductal papilloma, 17 cases of fibroadenomas, 4 cases of cystic breast lesions, 4 cases of inflammatory breast lesions, 1 case of breast adenosis, and 3 cases of benign breast hyperplasia, each accounting for 18.00%, 34.00%, 8.00%, 8.00%, 2.00%, and 6.00% of the intraoperative breast diseases, respectively.

Upon comparing the results of intraoperative frozen section diagnosis with postoperative paraffin section diagnosis (Table 1), it was found that 48 cases were confirmed by intraoperative frozen section diagnosis, resulting in a diagnosis rate of 96.00%. There was one case of misdiagnosis (false negative), leading to a misdiagnosis rate of 2.00%, and one case of delayed diagnosis, with a delay rate of 2.00%. Among the confirmed patients, 45 cases (90.00%) exhibited complete consistency, while 3 cases (6.00%) showed basic consistency. Routine paraffin sections diagnosed all 50 cases, achieving a diagnosis rate of 100.00%.

**Table 1.** Comparison of intraoperative frozen section diagnostic results and postoperative paraffin section diagnostic [n (%)]

Frozen section diagnostic results		n (%)	Diagnosed		Misdiagnosed (false negative)	Delayed diagnosis
			Completely consistent	Basically consistent		
Malignant tumor	Breast cancer	10 (20.00)	10 (20.00)	1 (2.00)	0 (0.00)	1 (2.00)
	Lymphoma	1 (2.00)				
	Other	1 (2.00)				
Benign and borderline tumors	Intraductal papilloma	9 (18.00)	25 (50.00)	0 (0.00)	1 (2.00)	0 (0.00)
	Fibroadenoma	17 (34.00)				
Non-neoplastic diseases	Cystic lesions	4 (8.00)	10 (20.00)	2 (4.00)	0 (0.00)	0 (0.00)
	Inflammatory lesions	4 (8.00)				
	Breast adenosis	1 (2.00)				
	Benign hyperplasia	3 (6.00)				
Total		50 (100.00)	45 (90.00)	3 (6.00)	1 (2.00)	1 (2.00)

### 3.2. Comparison of accuracy and inspection time between frozen sections and paraffin sections

The diagnosis rate of the frozen section was 96.00%, compared to 100.00% for the paraffin section ( $P > 0.05$ ). The diagnostic time of the frozen section was  $35.25 \pm 2.11$  min, including the time for multiple submissions of bilateral breasts and unilateral breasts, which was significantly shorter than that for the paraffin section ( $6,911.36 \pm 58.36$  min;  $P < 0.05$ ), as shown in Table 2.

**Table 2.** Comparison of accuracy and inspection time between frozen sections and paraffin sections

Group	Diagnosis rate (%)	Diagnosis time (min)
Frozen sections ( $n = 50$ )	48 (96.00)	35.25 ± 2.11
Paraffin sections ( $n = 50$ )	50 (100.00)	6,911.36 ± 58.36
$\chi^2 / t$	2.0408	832.5856
$P$	0.1531	0.0000

## 4. Discussion

Breast cancer poses a significant threat to the physical and mental well-being of women. It is a disease characterized by the infiltration of multiple carcinogens, which stimulate breast epithelial cells and lead to uncontrolled breast hyperplasia [2]. After the onset of breast cancer, female patients may exhibit the following symptoms:

- (1) Mass: The earliest sign of breast cancer is the presence of a mass. These masses are often located in the outer upper region of the breast, typically have a firm texture, are unilateral, solitary, and exhibit limited mobility. Additionally, most breast tumors are painless, though some may cause mild discomfort or a dull ache.
- (2) Local skin abnormalities: As cancer progresses and invades adjacent skin, patients may develop specific signs. For instance, mass invasion can lead to dimple-like depressions in the breast, block lymphatic vessels causing lymphedema, or result in hard nodules when they invade the skin.
- (3) Areola lesions: Cancer lesions that invade the areola area can cause the nipple to retract inward. In severe cases, the nipple may shrink toward the nipple base and behind the areola.
- (4) Nipple discharge: Breast cancer patients may experience nipple discharge outside of pregnancy and lactation periods, with unilateral nipple discharge being common. The nature of the discharge is usually serous or bloody.
- (5) Swollen lymph nodes: As breast cancer progresses, cancer cells can detach and enter local lymphatic vessels, causing signs of swollen lymph nodes. These local lymph nodes may exhibit mobility upon touch [3].

Surgical treatment is currently the primary approach for breast cancer, often involving mastectomy combined with axillary lymph node dissection. However, this approach can result in substantial trauma, prolonged operation times, increased risk of postoperative complications, and changes in breast shape, impacting the aesthetics and the physical and mental health of patients. Therefore, some patients prefer breast-conserving surgery to improve breast aesthetics. To enhance the prognosis of breast cancer patients and their postoperative quality of life, early surgical intervention and appropriate surgical plans are essential.

In the treatment of breast cancer patients, doctors frequently select surgical methods based on tumor histology, pathohistology, and other indicators to minimize surgical trauma while ensuring effectiveness. In the preoperative diagnosis of breast cancer, frozen diagnosis is a commonly employed pathological examination. Compared to conventional pathological examination techniques, frozen diagnosis offers speed and efficiency, aiding breast cancer patients in choosing a more efficient and reasonable surgical plan [4].

During a frozen section pathological examination, tissues are rapidly cooled, leading to increased tissue hardness, after which local sections are taken for qualitative diagnosis of the mass tissue. Frozen section examinations are less challenging and offer various techniques, such as the cryostat section, CO<sub>2</sub> frozen section,

and methanol cycle section. Among these, cryostat sectioning technology is widely utilized based on clinical practice analysis <sup>[5]</sup>. Compared to conventional fine needle aspiration cell protocols, frozen sections are less complex and exhibit a lower misdiagnosis rate. They swiftly clarify the pathological characteristics of breast cancer tissue, offering speed, accuracy, and efficiency, making them widely used in clinical diagnosis <sup>[6]</sup>.

Based on the data analysis in this study, frozen section diagnosis achieved a confirmation rate of 96.00%, with one case of misdiagnosis (false negative) and one case of delayed diagnosis, while paraffin section diagnosis had a 100.00% confirmation rate. The diagnostic time for the frozen sections was significantly shorter ( $35.25 \pm 2.11$  min, including multiple examinations of bilateral and unilateral breasts) than that of the paraffin sections ( $6,911.36 \pm 58.36$  min) These results suggest that frozen section diagnosis offers high diagnostic efficiency and high concordance with paraffin sections, though it still presents a misdiagnosis risk.

To ensure the accuracy of frozen section diagnosis, several factors must be considered during the actual examination:

- (1) Medical history: A thorough review of the patient's medical history and pathology submission form is crucial. Understanding the patient's background, evaluating tumor invasiveness, and controlling the spread of tumor cells is vital. Collecting tumor tissue correctly, obtaining adjacent tissues to prevent cancer cell infiltration into healthy areas, and maintaining diagnostic quality is also important.
- (2) Tissue selection: When conducting frozen section examination on patients with small breast tumors, care should be taken to avoid local tissue destruction and loss, which can increase the rate of missed or misdiagnosis. Therefore, selecting larger tissue samples for examination is recommended to prevent bias in diagnostic results.
- (3) Quality control: High-quality frozen sections should be produced to enhance the accuracy of identifying benign and malignant breast tissues. Varying section depths should be utilized, and multiple microscopic examinations should be performed on specimens to ensure diagnostic accuracy <sup>[7]</sup>.

For cases involving borderline tissue or highly suspected cancerous tissue, paraffin section technology is more suitable for diagnosis, as frozen sections may not yield accurate data <sup>[8]</sup>.

Considering the diagnostic time, frozen section examinations are notably faster, taking only 6–41 minutes (including multiple breast examinations) compared to the 4–5 days required for paraffin section examinations. This is because the tissues submitted for frozen section examinations do not need to be dehydrated or wax-immersed, hence preserving their original appearance and shortening the diagnosis time. While frozen section examinations are invaluable in guiding doctors and selecting surgical techniques <sup>[9]</sup>, in cases of misdiagnosis or missed diagnosis, clinical experience often helps to evaluate the tumor's nature and select the appropriate treatment plan. In situations where the surgical method remains uncertain, surgery may be postponed until paraffin section results are obtained, ensuring the best diagnostic and treatment outcomes and enhancing the prognosis of breast disease patients <sup>[10]</sup>.

In summary, frozen section examination in breast disease diagnosis offers the advantages of rapid examination and high accuracy. It guides doctors in making flexible decisions regarding breast-conserving treatment and serves as a foundation for selecting appropriate surgical procedures, ultimately preventing unnecessary medical intervention and reducing the need for secondary surgeries, thus providing substantial value.

## Disclosure statement

The author declares no conflict of interest.

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