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Research article

The clinical significance of complete process management for the quality control of horizontal rotational resection of a breast mass

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ABSTRACT

Objective: To explore the clinical outcomes of the complete process management of horizontal rotational resection of a breast mass.
Methods: A retrospective study was conducted involving 638 patients who underwent horizontal rotational resection of breast tissue in the Department of Thyroid and Breast Surgery of the People's Hospital of China Medical University from August 2018 to August 2020 using the ultrasound Breast Imaging-Reporting and Data System (BI-RADS) classification of 4A and below. These patients were divided into the experimental group and the control group based on whether the surgery had been performed following the order of the complete process management. The time cutoff point for the two groups was June 2019. The propensity score matching method was used to implement 1:1 ratio matching according to age, mass size, location, ultrasound BI-RADS classification, and breast size (measured by basal diameter), and the patients in the two groups were compared for the duration of surgery (the time needed to performed the three-step 3D positioning), postoperative skin hematoma and ecchymosis, postoperative pathological malignancy rate, residual rate of the mass, and satisfaction rate.
Results: After 278 pairs were matched, no statistically significant differences were found between the two groups in terms of demographics ($P > 0.05$). The duration of surgery in the experimental group was significantly shorter compared with the control group (7.90 ± 2.18 min vs. 10.20 ± 5.99 min, respectively; $P < 0.05$); the satisfaction score in the experimental group (8.33 ± 1.36) was higher compared with the control group (6.48 ± 1.22) ($P < 0.05$); the malignant and residual rates of mass in the experimental group were lower than those in the control group, i.e., 6 vs. 21 cases ($P < 0.05$), and 4 vs. 16 cases, respectively ($P < 0.05$); the incidence of skin hematoma and ecchymosis was lower in the experimental group, i.e., 3 vs. 21 cases ($P < 0.05$).
Conclusion: Complete process management for horizontal rotational resection of a breast mass can shorten the duration of surgery, reduce the residual mass, postoperative bleeding, and postoperative malignancy rates, and improve the breast preservation rate and patient satisfaction. Accordingly, its popularization represents research value.

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1. Introduction

Established in 1995, the minimally invasive rotational resection of breast tissue was introduced in China in 1999 and has become the preferred surgical method for treating benign breast tumors. Nevertheless, postoperative bleeding, mass residue, postoperative pathology, and other issues impact the cosmetic and minimally invasive effect of the surgery to some extent. In July 2017, the Department of Thyroid and Breast Surgery of Liaoning Provincial People's Hospital carried out traditional (vertical) rotational resection of the breast and modified and innovated three-dimensional (3D) horizontal rotational resection of breast tissue technology in August 2018 [1]. To further reduce postoperative complications and enhance training, teaching, and technical generalization, we launched complete process management for horizontal rotational resection surgery in June 2019, based on a summary of existing surgical experiences. This study aimed to compare the clinical outcomes of patients with or without complete process management of horizontal rotational resection. The results showed that horizontal minimally invasive rotational resection using complete process management could effectively reduce postoperative bleeding rate, the residual rate of the mass, and the postoperative malignancy rate, shorten the duration of surgery, and improve the postoperative cosmetic effect and patient satisfaction.

2. Materials and methods

2.1. Demographics

A total of 638 female patients aged 18–46 years (31.1 $\pm$ 6.5) without nipple discharge, and who underwent horizontal minimally invasive rotational resection of the breast tissue in the Department of Thyroid and Breast Surgery of Liaoning Provincial People's Hospital from August 2018 to May 2021 were retrospectively selected. The Breast Imaging-Reporting and Data System (BI-RADS) classification of 4A and below was applied, and all cases comprised single and non-superficial masses (the upper margin of the mass was located more than 1.0 cm from the skin), except in those aged above 40 years, who received molybdenum target testing due to the possibility of malignancy diagnosed by calcification; the median diameter of the masses was 1.14 cm (0.5–2.0 cm).

In terms of mass site, 77 were near the axilla (the lateral edges of the masses were less than 2.0 cm from the edge of the gland in the axilla), 51 were near the sternum (the medial edges of the masses were less than 2.0 cm from the edge of the lateral gland in the sternum), and 510 masses were located at other conventional sites (excluding masses less than 1.0 cm around the nipple). There were no heart, lung, or diabetes complications involved, and no previous breast surgical history at the surgery side; blood routine examination, coagulation function, and hepatic and renal functioning were all normal.

The patients were divided into the experimental group and the control group based on whether the surgery was performed following the order of the complete process management. The time cutoff point for the two groups was June 2019. There were no significant demographic differences between the two groups. All surgeons involved in this study had independently performed more than 40 cases of this type of surgery and were all skilled in operating independently.

2.1.1. Inclusion criteria

1) Patients with a BI-RADS classification of 4A or 3 who experienced anxiety and actively requested surgery; 2) patients who actively requested minimally invasive surgery and refused traditional invasive surgery; 3) the distance between the upper margin of the mass and the skin was greater than 1.0 cm, and the diameter of the mass was 0.5–2.0 cm; 4) single or multiple masses were present

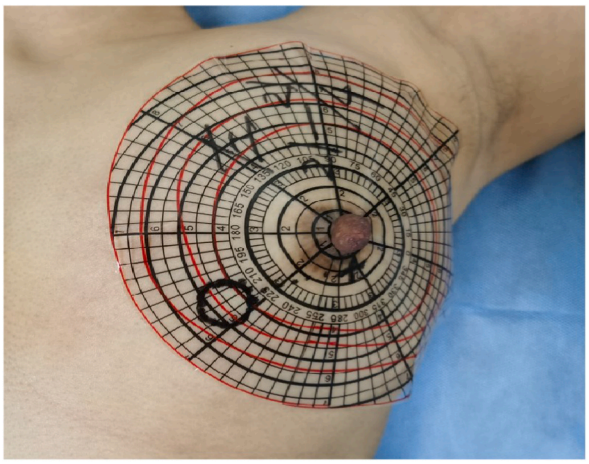

Fig. 1. Locating the breast using an ulnar membrane, creating ultrasound-guided rolling on the skin's surface of target mass with a non-cotton end of a cotton swab, wiping the coupling agent, marking with a marking pen, and finally, pasting the localization membrane on the breast mass. The position of the mass is developed to the ulnar membrane of the breast, and the ulnar membrane is removed for archival purposes. This process helps to achieve the accurate surface localization of the breast mass.

but surgery was required for only one mass.

2.1.2. Exclusion criteria

1) Patients in the menstrual period or with a bleeding tendency and taking anticoagulant drugs; 2) patients with major underlying diseases such as circulatory respiration who could not tolerate surgery; 3) patients with masses in the nipple and within 1.0 cm around it; 4) patients who had previously undergone breast augmentation/surgery in the breast at the proposed surgical site; 4) patient who had anxiety or did not actively request for surgery.

2.2. Surgical methods

2.2.1. Experimental group

Based on the expert consensus and operating guidelines for ultrasound-guided vacuum-assisted breast biopsy surgery (2017) [2], the standardized complete process of horizontal rotational resection is summarized as follows [3].

1. **Ultrasound diagnosis in tertiary hospitals.** Prior to hospitalization, an ultrasound diagnosis report of BI-RADS classification from a tertiary hospital was required including the size, location, number, distance from the skin, distance from the pectoral muscle, and classification of the mass. Prior to surgery, a surgical ultrasound was required to review the mass information presented in the ultrasound report. For BI-RADS classification not conforming to 4A and potentially indicating 4B, contrast-enhanced ultrasound or breast magnetic resonance imaging (MRI) must be performed for further clarification.
2. **Ulnar membrane breast positioning** (see Fig. 1). Following a review, the skin of the breast is marked with a pen to determine the location of the breast mass to be excised. Then, paste the ulnar membrane and develop the location and puncture point of the breast mass to be excised on the ulnar membrane. The patient's name, surgical site, and the date of surgery are noted and archived after taking photos.
3. **Ultrasound split-screen display operation.** The mass detected by ultrasound is locked and fixed on the left half of the ultrasound display screen before surgery, and real-time monitoring of the surgical procedures is conducted using the right half of the screen during surgery, see Fig. 2A.
4. **Deep/light dual anesthesia.** Anesthesia is administered by injecting a 0.5% lidocaine and 1:100,000 epinephrine mixture ($\leq$80 ml) into the subcutaneous and posterior glandular spaces corresponding to the breast mass, puncture site, and needle passage. Anesthesia under ultrasound monitoring was required for smaller masses.
5. **Positioning.** The patient's body position is adjusted to situate the surgical target mass at the highest level of the thorax; by doing so, the rotational resection knife-head is always horizontal for surgical operation.
6. **Surgical puncture site.** Based on the specific placement of the breast mass, a small incision of 0.3–0.5 cm is made at the rim of the areola or the lateral side of the breast as the puncture point (except for the incision at the rim of the areola for a medial hemi-mammary mass near the sternum, all others were made at the anterior axillary line).
7. **The double line method to identify the knife groove.** A "double line" is made to appear on the ultrasonic image by rotating the knife slot, i.e., the position of the knife groove, see Fig. 2(A and B).
8. **The three-step 3D positioning.** The first step is to locate the lateral boundary of the breast tumor on the coronal plane (i.e., in the left–right direction), ensuring that the ultrasound probe is parallel to the rotational resection knife groove. Then move in a left–right direction to keep the knife groove close to the lateral side of the breast mass as much as possible (Fig. 3A). The second step is to locate the depth of the breast mass on the sagittal plane (i.e., in the upper–lower direction) and keeping the ultrasonic probe perpendicular to the rotational resection knife groove, thereby locating it on the horizontal side of the breast mass (Fig. 3B). The third step is to locate the relative position of the breast mass to the rotational resection knife groove on the

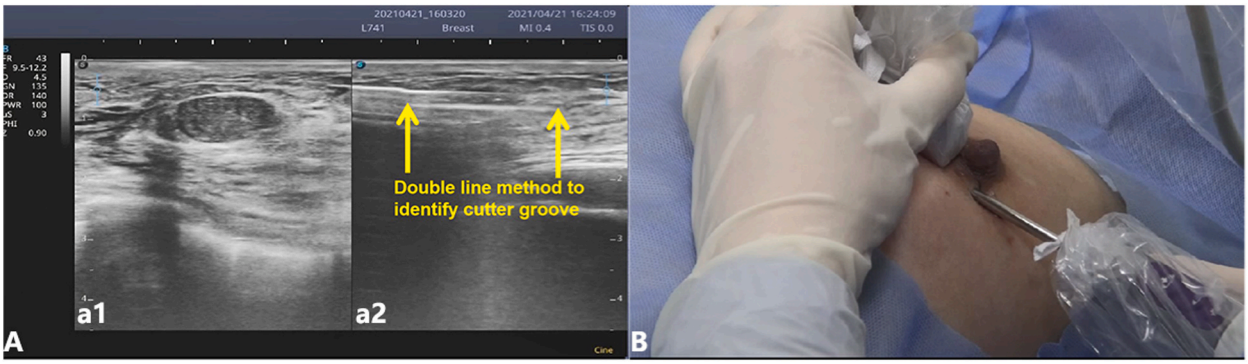

Fig. 2. A dual-screen display and dual-line method for knife groove recognition. a1 shows a static image of the breast mass; a2 shows a dynamic image of the surgery, where the yellow arrow indicates the position of the rotational resection knife groove. B shows the identification of the knife groove with the "double-line sign" (appearing on the ultrasound screen in the right half of the left image), which is achieved by rotating the knife groove when the ultrasonic probe is parallel to the rotational resection knife groove.

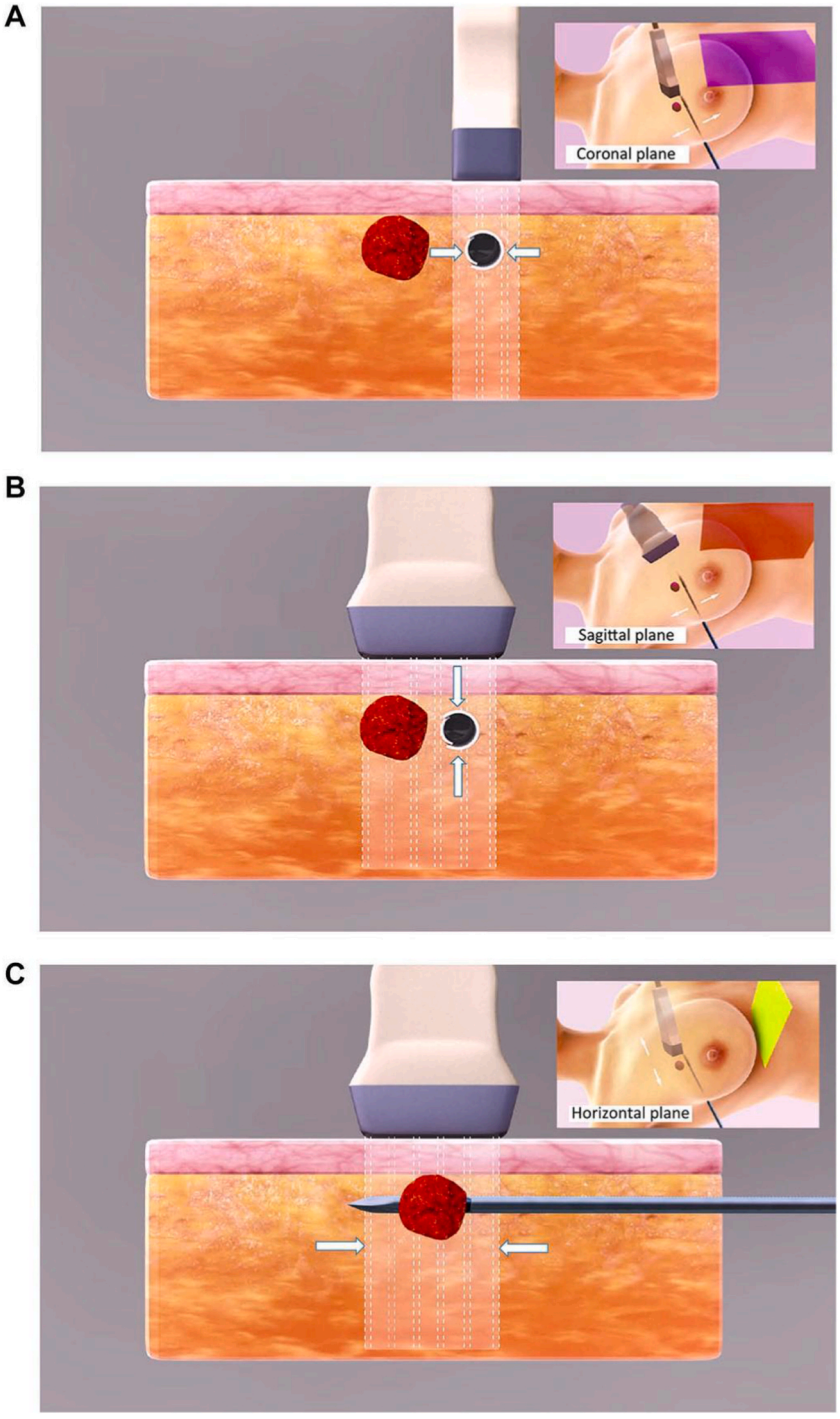

Fig. 3. Three-dimensional positioning was achieved as follows: in the first step, rotary knife groove is positioned on the coronal plane (left–right direction) (A). In the second step, the rotary knife groove is positioned in the sagittal plane (up–down direction) (B). In the third step, the rotary knife groove is positioned on the horizontal plane (forward–backward direction) and the rotary knife groove is accurately located to the horizontal positive side of the breast mass, followed by rotational resection, effected by continuously pressing the resection button (C).

horizontal plane (i.e., in the anterior–posterior direction); the ultrasound probe is then placed parallel to the knife groove and moved in a left–right direction, thereby locating the knife groove on the horizontal side of the breast mass. In this way, the breast mass is completely within the range of the rotational resection knife groove (Fig. 3C). Three-dimensional positioning can

be achieved by following these steps, and the rotational resection knife groove can be accurately punctured to the horizontal positive side of the breast mass. Then, the rotational resection was performed continuously by pressing the resection button.

9. **Surgical procedures away from blood vessels.** The length of the rotational resection knife groove is accurately adjusted and 3D positioning is implemented at the edge of the blood vessels, based on their positioning around the breast mass (indicated by color Doppler ultrasound). The procedure then commences in the direction of the tumor, away from the blood vessels. The procedure starts from near the axilla, nipple, and areola and moves away from these three areas; the part of the rotational resection knife groove beyond the diameter of the mass should be placed on the side away from the sternum for masses located near it.
10. **Cross-scanning.** After resection of the breast mass, a cross-scan with an ultrasound probe is performed to check whether mass residue remains.
11. **Satisfactory hemostasis.** Surgical hemostasis includes stopping anticoagulant drugs for at least one week before surgery. Epinephrine should be mixed with the intraoperative local anesthetics. Active bleeding must be compressed locally for 10 min at first, and a small incision in the skin of the mass residual cavity should be made with an electric knife to stop the bleeding if it cannot be controlled. Local pressure dressing in the postoperative area should be accurate, and the upper limb of the affected side should be immobilized for 7 days.

2.2.2. Control group

In contrast to the experimental group, management in the control group may miss, reverse, and/or add unnecessary steps throughout the treatment process. The main steps for the horizontal rotational resection of breast tissue under non-standard procedures were as follows: 1) Providing a definitive diagnosis by ultrasound report before surgery; 2) during surgery, the first step is to locate the mass, followed by effecting anesthesia, and horizontal rotational resection (for which methods may differ among surgeons); 3) establish hemostasis by postoperative compression.

2.2.3. Surgical instruments

The following tools and instruments were used during surgery: a BCR EnCor System Host (DR ENCOR; approval no., China Food and Drug Administration (Import) Word 2013 No. 3541849), a rotational resection knife head (ECP017G; approval no., GXZJ No. 20173156309), and a 7G knife head. The ultrasonic instrument employed was a LOGIQP3 (GE). An ulnar membrane was used for localization on the surface of breast masses (patent no. ZL 201020172673.2) [4].

2.3. Indicators for further observation

Differences in the duration of surgery (the time needed to performed the three-step 3D positioning), postoperative skin hematoma or ecchymosis, patient satisfaction, postoperative pathological malignancy rate, and postoperative mass residual rate at 6 months after surgery were observed between the two groups. The malignancy rate was determined based on the postoperative paraffin pathological analysis. The residual tumor rate was determined based on the results of the ultrasound examination at 6 months after the operation. When tumor-like echo is seen in the operation area in ultrasound examination, after excluding the residual cavity, the remaining area is the residual tumor. The satisfaction degree of patients was investigated using a self-evaluation questionnaire method one week after surgery, and the scores in the self-made simple rating scale ranged from 1 to 10 (see Supplementary Material); a higher score indicated higher satisfaction. The patients scored the questionnaire according to the treatment process and postoperative effect.

2.4. Statistical methods

The SPSS Statistics 26.0 software program was used to conduct data analysis. The propensity score matching function was realized by installing the R software and plug-in associated with the corresponding version of SPSS, and 1:1 ratio case matching was performed for the two groups. The propensity score for each patient was calculated using the multivariable logistic regression model, and the logic

Table 1
Comparison of general conditions of patients in the two groups before and after the matching of propensity scores.

	Group	Age (years)	Basal transverse diameter of breast	BIRADS classification	Mass position		
					Near the axillary	Near the sternum	Conventional
Before matching	Management group n = 316	33.4 ± 4.0	12.2 ± 2.6	3.0 ± 0.2	36	24	256
	Non-management group n = 322	35.6 ± 7.1	13.3 ± 1.74	3.0 ± 0.3	41	27	254
	p	0.438	0.534	0.261	0.732		
After matching	Management group n = 278	32.4 ± 3.1	11.7 ± 1.62	3.0 ± 0.3	29	22	227
	Non-management group n = 278	34.6 ± 2.4	12.1 ± 2.04	3.1 ± 0.4	32	23	223
	p	0.334	0.415	0.204	0.534		

standard deviation tolerance for propensity score (Caliper) was set to 0.02; patients who were treated before the optimized procedure were matched with patients who had the most similar scores following the optimized procedure, based on recent substitution and matching principles; that is, the individual cases could not be subjected to multiple selection. The measurement data were expressed as mean ± standard deviation ($\overline{X} \pm s$). An independent sample *t*-test was used for comparison between the groups, and the enumeration data were compared by chi-square (x^2) test. The difference was considered statistically significant if $P < 0.05$.

3. Results

Before matching, there were 316 patients in the experimental group and 322 patients in the control group. After matching, there were 278 patients in the experimental group and 278 patients in the control group. According to the inclusion and exclusion criteria, there were no significant statistical demographic differences between the two groups (see Table 1). The duration of surgery in the experimental group was shorter compared with the control group (7.90 ± 2.18 min vs. (10.20 ± 5.99 min, respectively; $P = 0.026$). The satisfaction score for postoperative cosmetic effect in the experimental group was significantly higher compared with the control group (8.33 ± 1.36 vs. 6.48 ± 1.22 points, respectively; $P < 0.05$). Additionally, the malignant and mass residual rates of postoperative pathology in the experimental group were lower compared with the control group (6 vs. 21 cases; $P < 0.05$, and 4 cases vs. 16 cases; $P < 0.05$, respectively). The incidence of postoperative cutaneous hematoma and ecchymosis in the experimental group was lower compared with the control group (3 vs. 21 cases, respectively; $P < 0.05$) (see Table 2).

4. Discussion

The technology of minimally invasive rotational resection of the breast (vacuum-assisted core-needle biopsy) was approved by the United States Food and Drug Administration (FDA) for the biopsy of breast masses in 1995. The first brand of equipment for rotational resection of breast tissue, the Mammotome System, was introduced in China in 1999 and was approved by FDA for the excision of benign breast masses in 2004. In the subsequent 20 years, minimally invasive rotational resection of breast tissue has gradually become a commonly used surgical technique in breast surgery due to its obvious advantages, e.g., accuracy, aesthetic outcomes, convenience, and simultaneous diagnosis and treatment [2]. Postoperative bleeding, mass residue, and postoperative pathological malignancy are common complications of rotational resection of breast tissue and affect the minimally invasive and aesthetic effects of surgery to varying degrees. Existing studies [5] found that the standardization of preoperative, intraoperative, and postoperative processes and the creation of a unified medical process could improve surgical technical level, enhance the curative effect, accelerate innovation, and facilitate popularization of this surgery technique, Accordingly, establishing standardized surgical processes are essential.

4.1. Bleeding after the rotational resection of breast tissue

The bleeding rate following rotational resection is generally 2.54%–5.52% [6] but can be up to 10% [7] in severe cases. Skin ecchymosis, hematoma, and intraoperative active bleeding constitute the three common clinical manifestations of bleeding. As the most common, skin ecchymosis has some influence on the short-term cosmetic effect of surgery. Hematoma in the surgical area can gradually be absorbed but the process is slow, which will increase the psychological burden of patients after surgery. Ultrasound-guided puncture and aspiration are required to prevent the formation of an abscess for a small number of liquefied hematomas, and directly observed electrosurgical hemostasis is required for rare cases complicated with uncontrollable intraoperative bleeding, thereby increasing trauma and affecting the minimally invasive effect.

For complete process management, our research required routine menstrual avoidance, normal blood routine examination results and coagulation functioning, and local anesthesia mixed with epinephrine. Our process emphasized the accurate intraoperative adjustment of the length of the rotational resection knife groove according to the size of the breast mass, followed by the accurate positioning and evaluation of the blood vessels around the mass. Finally, the procedure was performed in a direction away from the blood vessels and moving away from the axillary, nipple, areola, sternum, and other areas involving abundant blood transport [8]. The incidence of postoperative bleeding in the experimental group was 1.07%, indicating that complete process management could effectively reduce the incidence of postoperative skin hematoma and ecchymosis.

Table 2
Comparison of patients in the two groups.

Group	Duration of surgery	Satisfaction score	Malignant rate of postoperative pathology	Residual rate of mass	Postoperative hematoma and ecchymosis
Management group n = 278	7.90 ± 2.18	8.33 ± 1.36	6	4	3
Non-management group n = 278	10.20 ± 5.99	6.48 ± 1.22	21	16	21
T (χ2)	−6.17	−4.35	1.741	1.573	1.522
P	0.006	0.012	0.031	0.026	0.024

4.2. Residual breast mass after rotational resection

Lee et al. [9] reported a 5.48%–6.94% residual rate of mass for masses with a diameter <2.5 cm. Achim Elleret al. [10] reported that the in-situ relapse rate was 5.13%, among which masses with a diameter >2.0 cm accounted for 70.76%, indicating that tumor diameter was closely related to the postoperative relapse rate. It was emphasized in the guidelines that open surgery could be an option for treatment if the complete removal of a mass could not be confirmed [2]. However, the auxiliary role of ultrasound was still absent following the conversion to open surgery. The expanded resection method had to be used to ultimately avoid tumor residue but this should not be used as a first choice due to the significantly increased surgical trauma involved.

The surgical method was a key factor for reducing mass residue. Traditional vertical rotational resection, in which the ultrasonic probe is parallel to the rotary knife groove, is intuitive and easy to master; however, since the real-time monitoring of tumor tissue on the left and right sides of the rotary knife groove is not available under ultrasound, fan-shaped resection is routinely used to avoid mass tissue residue on the two sides of the rotary knife groove, which cannot be monitored under ultrasound. Some studies changed the ultrasonic probe to be perpendicular to the rotational resection knife head in vertical rotational resection to achieve real-time monitoring in the process of mass resection; as a result, the residual rate of mass could be reduced from 11.76% to 1.82% three years after surgery, thereby improving the accuracy of the surgery [11].

Following the implementation of complete process management, the surgeon was first required to review the ultrasound report of the patient before surgery to clearly mark the accurate position and shape of the breast mass to be surgically removed and to ensure accurate identification. Second, prior to effecting surgery, we established a dual-screen display method to clearly display the position and shape of the breast mass on the left half of the ultrasound screen and monitored the complete process of breast resection in real-time on the right half of the screen. Third, we performed the horizontal rotational resection of the breast mass using three-step 3D technology. Finally, we examined the mass residual cavity and the area around the mass by cross-scanning before finishing the surgery and treated anything that appeared suspicious. In addition, it was conducive to the determination of in-situ relapse of the tumor, or the relapse of other sites during the postoperative review, to carry out preoperative localization of the breast mass to be removed by the ulnar membrane. Moreover, the deep/light dual anesthesia in the subcutaneous and posterior glandular spaces of the breast not only increased an accurate anesthesia effect and the cooperation of patients but also reduced the influence of anesthetics on the morphology of the breast mass compared with anesthesia around the mass, thereby further reducing the possibility of mass recognition error [12]. It is emphasized that anesthesia must be performed under ultrasound monitoring to avoid the “loss” of masses after anesthesia for small masses. The residual rate of mass in the experimental group was lower than in the control group, and the difference was statistically significant.

4.3. Malignant pathology after rotational resection of breast tissue

In theory, it is possible to perform complete resection of a malignant lesion with a diameter smaller than the rotational resection knife groove, and the clinical application of technology in rotational resection of breast tissue during breast-conserving surgery for early breast cancer remains ongoing [13–15]. The most critical problem in this regard is the accurate identification of the incision edge. The specimen groove of the EnCor minimally invasive rotational resection system cannot sort the excised specimen strips; as such, it is not feasible for accurate identification of the incision edge. However, the Mammotome II Revolve instrument can sort the specimen strips through specimen slots and clean bloodstaining on the specimen strips promptly using a saline flushing function, thereby providing cleaner specimens. This provides a theoretical basis for visual identification of excised specimen margins but several problems remain to be solved in practical application.

The BI-RADS classification diagnosis system for breast ultrasound has a diagnostic accuracy of 93% for benign breast lesions.[16] However, 5%–10% cases are still considered benign before surgery, followed by a postoperative pathology indicating malignancy. In such cases, secondary surgery is generally required, during which the key aspect is to improve the breast-conserving rate.

In this study, we carried out complete process management for breast tissue resection. The preoperative ultrasound report of the tertiary hospital was the first choice for ensuring that the BI-RADS classification diagnosis of the ultrasound report on breast masses was as accurate as possible. Secondly, surgeons personally reviewed the conclusions of the ultrasound report, including the BI-RADS classification diagnosis and the location of the masses. Contrast-enhanced ultrasonography or contrast-enhanced MR examination was required for suspicious lesions, core-needle biopsy for very suspicious lesions, and neo-adjuvant chemotherapy or direct excision surgery could be determined according to the results of histological pathology biopsy. In addition, prior to the rotational resection of breast tissue, an ulnar membrane should be used to accurately locate the original location of the breast mass to facilitate determining the location of the original lesion in cases where the postoperative pathology result indicated a malignancy in the second surgery. Finally, for masses considered to be benign by breast ultrasonography, contrast-enhanced ultrasonography, and breast MR but not completely consistent with the conclusion of the surgeon in reexamination ultrasonography. The puncture site for rotational resection should be as close to the breast mass as possible to avoid difficulties related to breast conservation during a second surgery and potentially even reducing the breast-conserving rate. In this study, the malignant rate of postoperative pathology in the experimental group in was lower than in the control group, and the difference was statistically significant.

In conclusion, surgical procedures and methods were unified and standardized through complete process management of horizontal minimally invasive rotational resection of breast masses to significantly shorten the duration of surgery, reduce the bleeding and the residual rate of the mass, reduce the postoperative malignancy rate, increase the rate of secondary breast surgery, improve patient satisfaction and minimally invasive and cosmetic outcomes, and to make the procedure more appropriate for teaching, communication, and training contexts. Further investigations with a multi-center design are needed to validate the current findings.

Declarations

Ethics approval and consent to participate

I confirm that I have read the Editorial Policy pages. This study was conducted with approval from the Ethics Committee of Liaoning Provincial People's Hospital ((2021)KS005). This study was conducted in accordance with the declaration of Helsinki. Written informed consent was obtained from all participants.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

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Authors' contributions

Xiang Fei: Conceived and designed the study; Wrote the paper.
Renfeng Song, Xuewei Yu, Siyuan Zhang and Ying Zhang: Performed the study.
Yang Gao and Dongning Bi: Analysed and interpreted the data.
Shengsheng Yao: Contributed reagents, materials, analysis tools or data.
Jianchun Cui: Conceived and designed the study.

Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We would like to acknowledge the hard and dedicated work of all the staff that implemented the intervention and evaluation components of the study.

Abbreviations

3D	Three-dimensional
MRI	Magnetic resonance imaging
FDA	Food and Drug Administration

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e13537.

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