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Diagnosis and treatment of breast cancer. Physical activity recommendations for breast cancer survivors: A Narrative Review

Oliwia Krazińska

ORCID: <https://orcid.org/0009-0006-1210-1468>

oliwia.kraska@op.pl

Central Clinical Hospital of the Medical University of Lodz ul. Pomorska 251, 92-213 Łódź

Małgorzata Niewęglowska

ORCID: <https://orcid.org/0009-0008-5148-6801>

mal.niew23@gmail.com

Masovian Voivodeship Hospital of St. John Paul II in Siedlce, Ltd. ul. Księcia Józefa Poniatowskiego 26, 08-110 Siedlce

Mateusz Bernad

ORCID: <https://orcid.org/0009-0004-3793-1789>

mateusz.bernad.mail@gmail.com

National Medical Institute of the Ministry of the Interior and Administration ul. Wołoska 137, 02-507 Warszawa, Poland

Katarzyna Widomska

ORCID: <https://orcid.org/0009-0004-6955-6194>

k.widomska2cg@gmail.com

National Medical Institute of the Ministry of the Interior and Administration ul. Wołoska 137, 02-507 Warszawa, Poland

Aleksandra Bender

ORCID: <https://orcid.org/0009-0003-0715-0431>

aleksandrabender00@gmail.com

Southern Hospital of Warsaw ul. Rotmistrza Witolda Pileckiego 99, 02-781 Warszawa

Paulina Walczak

ORCID: <https://orcid.org/0009-0002-2277-7366>

walczak.paulina1998@gmail.com

Masovian Voivodeship Hospital of St. John Paul II in Siedlce, Ltd ul. Księcia Józefa Poniatowskiego 26, 08-110 Siedlce

Bartłomiej Szymulewicz

ORCID: <https://orcid.org/0009-0003-7462-9063>

bartekszymulewicz@gmail.com

Masovian Voivodeship Hospital of St. John Paul II in Siedlce, Ltd. ul. Księcia Józefa Poniatowskiego 26, 08-110 Siedlce

Kacper Dąbrowski

ORCID: <https://orcid.org/0009-0009-0760-3975>

ama.kacper.dabrowski@gmail.com

Independent Public Complex of Healthcare in Kozenice Al. Generała Władysława Sikorskiego 10, 26-900 Kozenice

Jakub Łukaszewicz

ORCID: <https://orcid.org/0009-0007-2629-3509>

jakub.lukas101@gmail.com

Masovian Voivodeship Hospital of St. John Paul II in Siedlce, Ltd. ul. Księcia Józefa Poniatowskiego 26, 08-110 Siedlce

Magdalena Galach

ORCID: <https://orcid.org/0009-0004-8717-8182>

magdalena.galach00@gmail.com

Independent Public Health Care Institution in Siedlce ul. Kilińskiego 29, 08-110 Siedlce

Abstract

Background. Modern breast cancer management balances oncological safety with functional preservation. While surgical resection and radiotherapy ensure local control, post-treatment sequelae significantly impair long-term quality of life.

Aim. To synthesize contemporary diagnostic and therapeutic standards in breast cancer—focusing on conserving surgery, oncoplastic reconstruction, and hypofractionated radiotherapy—and to establish a structured, post-treatment physical activity framework.

Methods. A literature review was conducted across PubMed, Scopus, and PEDro databases (2015–2025), focusing on clinical guidelines from the Polish Society of Clinical Oncology (PTOK) and the St. Gallen Consensus.

Results. Breast-conserving surgery combined with sentinel lymph node biopsy reduces surgical morbidity without compromising survival, while hypofractionated radiotherapy optimizes treatment workflows. Early active physiotherapy (lymphatic self-drainage and mobility exercises) initiated on postoperative days 10–14 effectively prevents upper-limb lymphedema. Long-term adherence to ≥ 150 minutes of moderate aerobic exercise weekly alongside progressive resistance training (2–3 times/week) counteracts endocrine-therapy-induced bone loss, alleviates fatigue, and reduces recurrence risk by 20–40%.

Conclusions. Shifting from a sedentary postoperative lifestyle to structured physical rehabilitation is essential. Integrating phase-specific exercise regimens minimizes treatment side effects, restores functional capacity, and substantially improves quality of life for breast cancer survivors.

Keywords: Breast cancer, Breast-conserving surgery, Radiotherapy, Oncological rehabilitation, Physical activity, Lymphedema prevention, PTOK standards.

Introduction

Malignancy-related incidence and mortality constitute a major global health concern. In Poland, there has been an approximate 2.5-fold increase in the number of cancer diagnoses and deaths since 1960. Currently, malignancies represent the second leading cause of death in Poland [1], [2], [3].

In 2022, approximately 181.3 thousand new cases of malignancy were diagnosed and registered in Poland. In the same year, 96 thousand people died due to malignant neoplasms. Malignancies were the leading cause of death among women under the age of 65 in Poland in 2022 [2], [3].

Among women in Poland in 2022, breast cancer was the most frequently occurring malignancy, accounting for 23.6% of all newly diagnosed and registered cases of malignant neoplasms and 14.9% of all cancer-related deaths (data from the report "Malignant Neoplasms in Poland in 2022" are presented in Figure 1.1 and Figure 1.2) [2].

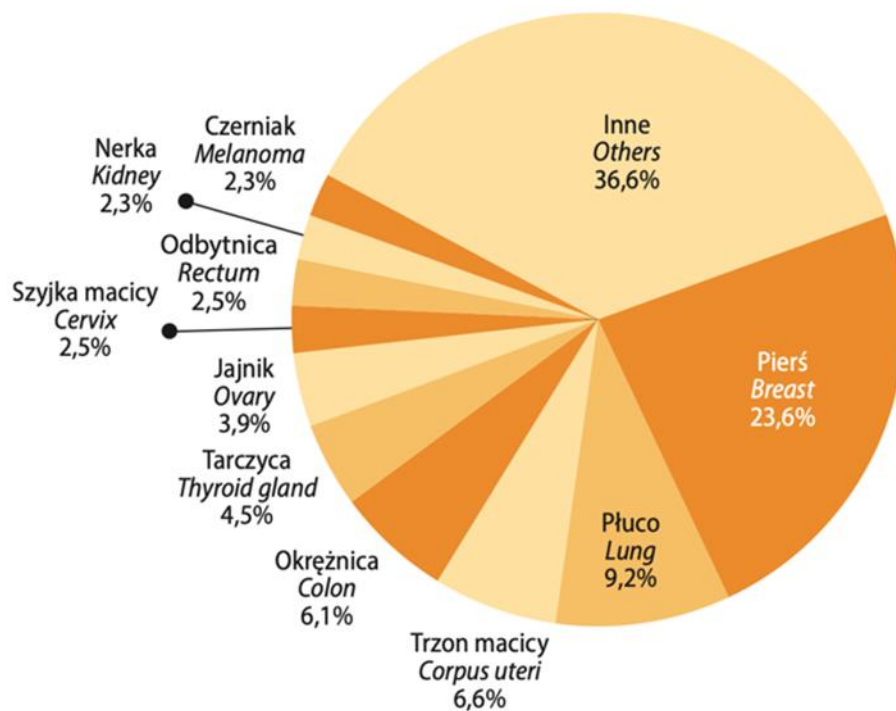


Figure 1.1 Structure of cancer incidence among women in Poland in 2022 [2].

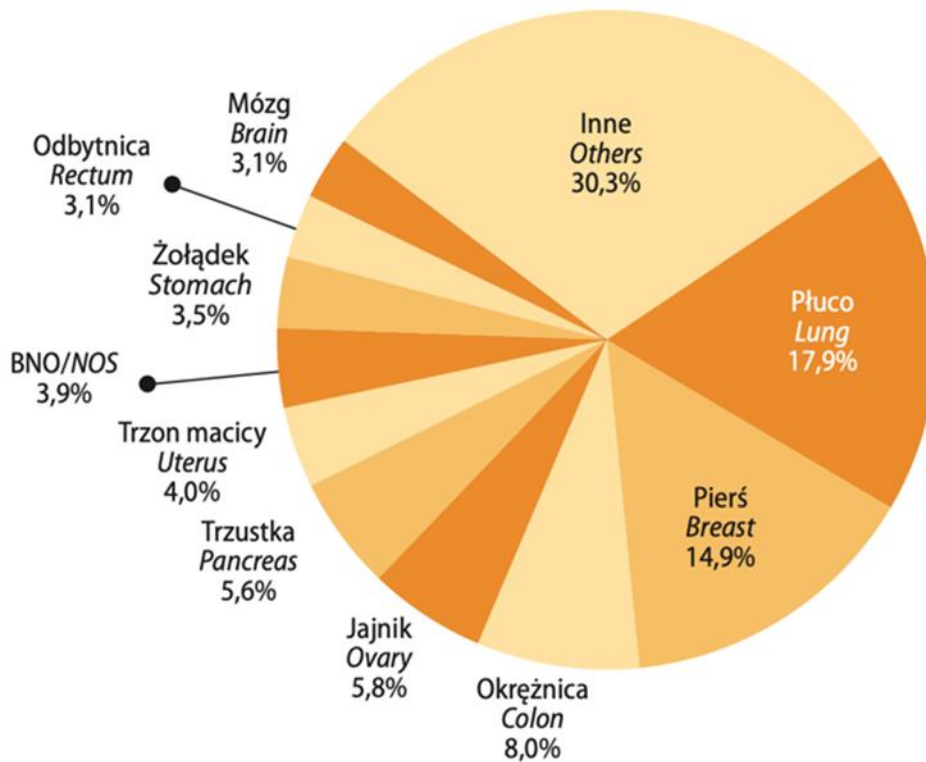


Figure 1.2 Structure of cancer mortality among women in Poland in 2022 [2].

Methods

To synthesize current scientific evidence regarding breast cancer diagnostics, surgical oncology, adjuvant therapies, and postoperative physical rehabilitation, a structured literature review was conducted, and a structural framework for clinical recommendations was developed. A literature search was performed across major medical databases, including PubMed/MEDLINE, Scopus, and the Physiotherapy Evidence Database (PEDro). The search strategy utilized a combination of Medical Subject Headings (MeSH) terms and keywords: ("breast cancer" or "breast carcinoma") and ("mastectomy" or "breast-conserving surgery" or "oncoplastic reconstruction") and ("radiotherapy" or "hypofractionation" or "boost") and ("physical activity" or "exercise oncology" or "physiotherapy" or "lymphedema prevention").

The scope of the analysis encompassed standardized surgical management (e.g., radical or conserving techniques), axillary staging (SLNB vs. ALND), hypofractionated radiotherapy, and structured physical activity programs (aerobic, resistance, or combined training). Outcomes of interest included local recurrence rates, cosmetic results, restoration of the range of motion (ROM) in the glenohumeral joint, prevention or mitigation of breast cancer-related lymphedema (BCRL), and health-related quality of life (HRQOL). Priority was given to clinical practice guidelines—specifically those developed by the Polish Society of Clinical Oncology (PTOK) and the international St. Gallen consensus panel—as well as high-quality randomized controlled trials (RCTs), systematic reviews, and meta-analyses. Narrative reviews, studies focusing exclusively on advanced metastatic disease (Stage IV), and publications lacking detailed rehabilitation data for breast cancer patients were excluded from the analysis.

Data regarding surgical and radiotherapeutic standards were extracted and compared with current oncological protocols. For the rehabilitation recommendations, the therapeutic timeline was stratified into distinct postoperative phases (early postoperative, implementation, adaptation, and full rehabilitation phases).

Diagnosis

In its early stages, the disease is frequently asymptomatic, whereas in advanced stages of the malignancy, symptoms depend on the extent of local lesions as well as the potential presence and anatomical location of distant metastases. Symptoms indicative of breast cancer development can be categorized into physical, psychological, and social. [4], [5], [6], [7]. Physical symptoms are presented in Table 3.1.

Table 3.1. Physical symptoms of breast cancer [4].

Palpable mass/palpable lump, nipple discharge, enlarged ipsilateral lymph nodes (axillary, occasionally cervical and supraclavicular), breast asymmetry, nipple retraction/nipple inversion, ulceration of the nipple and breast skin, satellite nodules/additional localized nodules, pain/mastalgia, skin thickening, "Peau d'orange" appearance/orange peel skin, pruritus (itching) or burning of the nipple, localized symptoms of inflammation: edema (swelling), localized hyperthermia (increased skin temperature), erythema (redness), and pain

Psychological features include: decreased self-esteem, anxiety, mood disorders, depressive episodes, body image disturbances, and disintegrative personality disorders. Social features encompass: deterioration of financial status, occupational difficulties, decline in social status, social withdrawal, alienation from the environment, a perceived lack of support, fear of marital and family breakdown, and loss of social ties. Newly observed physical symptoms constitute the most frequent reason for patients presenting to a physician [4], [5], [6], [7].

In patients presenting with the described symptoms, a medical history, a physical examination, and diagnostic imaging are performed. The imaging modalities utilized include mammography (MMG), breast ultrasonography (USG), and breast magnetic resonance imaging (MRI). Breast mammography is an examination that utilizes X-ray radiation, with images acquired in two projections: craniocaudal (CC) and mediolateral oblique (MLO). Breast ultrasound is a valuable tool for differentiating between solid and cystic lesions. It is performed in younger patients with glandular or dense fibroglandular breast tissue architecture. Breast magnetic resonance imaging is characterized by high sensitivity and high specificity. However, this modality has its limitations, including restricted accessibility and a high rate of false-negative results [8], [9]. To standardize the reporting and interpretation of breast radiology studies, the BI-RADS (Breast Imaging Reporting and Data System) lexicon is utilized. Categorizing breast lesions into specific sub-groups allows for the assessment of the probability of malignancy and guides further recommended patient management. The BI-RADS scale is presented in Table 3.2 [9], [10].

Table 3.2. BI-RADS (Breast Imaging-Reporting and Data System) radiological classification [9], [10].

Category	Description	Description/Management
0	Incomplete assessment	Requires additional imaging evaluation; the risk of malignancy at this stage is uncertain and difficult to assess.
1	Negative	Normal findings. Risk of malignancy: 0%. No further diagnostic workup required.
2	Benign	Presence of benign findings. Risk of malignancy: 0%. No further diagnostic workup required.
3	Probably benign	Risk of malignancy: <2%. Standard management: short-interval follow-up/ surveillance.

		MMG/USG – follow-up at 6 months; if stable, subsequent follow-up at 12 months, followed by 24 and 36 months. MRI – follow-up at 3 months.
4	Suspicious	Risk of malignancy: 2–95%. 4a – low suspicion for malignancy: >2% to ≤10% 4b – moderate suspicion for malignancy: >10% to ≤50% 4c – high suspicion for malignancy: >50% to <95%
5	Highly suggestive of malignancy	Risk of malignancy: ≥95%. Standard management: histopathological verification/ tissue biopsy.
6	Known biopsy-proven malignancy	Lesion previously confirmed via histopathological examination.

In cases of suspected distant metastases, a chest radiograph (CXR/X-ray) and an abdominal ultrasound (USG) are performed. The most accurate imaging modalities include computed tomography of the chest, abdomen, and pelvis (CT), bone scintigraphy (bone scan), and positron emission tomography (PET). Computed tomography is performed to assess the stage of breast cancer, as well as to detect potential lymph node metastases and distant metastases to other organs. Scintigraphy enables the detection of potential distant osseous (bone) metastases. PET allows for the detection of occult (very small) neoplastic foci throughout the entire body. This modality is utilized to evaluate treatment efficacy and to diagnose disease recurrence [8], [9].

Furthermore, patients with a significant family history in whom a risk of hereditary breast cancer is suspected should be referred for genetic counseling [11].

Based on diagnostic imaging, the stage of the malignancy is determined according to the TNM classification system, which guides decision-making regarding the subsequent course of treatment and establishes the patient's prognosis.

Prior to initiating treatment, a tissue sample from the suspicious breast lesion must be obtained and submitted for histopathological evaluation to establish a definitive diagnosis. Tissue sampling is performed under mammography (MG), magnetic resonance imaging (MRI), or ultrasound (USG) guidance using core needle biopsy (CNB) or vacuum-assisted breast biopsy (VABB) [10], [biopsje]. Histopathological examination of the stained tissue specimen under a microscope enables the identification of breast cancer, establishes the diagnosis, and guides the subsequent clinical and therapeutic pathway [8], [9].

During the microscopic evaluation of the tissue specimen, the pathologist determines the following: the histological type of the tumor (NST vs. special types), the tumor grade according to the Nottingham Histologic Scoring System, the estrogen receptor (ER) status, the progesterone receptor (PgR) status, the human epidermal growth factor receptor 2 (HER2) status, and the Ki67 proliferation index [12], [13], [14], [15].

The expression of steroid receptors, namely estrogen receptors (ER) and progesterone receptors (PgR), is classified as positive or negative based on the microscopic quantitative and qualitative evaluation of cell nuclei within the specimen obtained during a diagnostic biopsy. To assess the expression of these receptors, the Allred score is utilized. The total score is the sum of the proportion score (PS) — which measures the percentage of stained cell nuclei (Table 3.3) — and the intensity score (IS) — which measures the degree of nuclear staining intensity (Table 3.4). An ER or PgR positive reaction in ≥ 1% of cancer cells is considered positive, and such a tumor is defined as hormone-receptor-positive (hormone-sensitive). In the Allred scoring system, values greater than 2/8 (i.e., a score of 3 or higher) are considered positive [16].

Table 3.3. Allred scoring system – proportion score (PS) for nuclear staining [16].

PS	Percentage of stained cell nuclei
PS 0	0%
PS 1	> 0-1%
PS 2	> 1-10%
PS 3	> 10-33%
PS 4	> 33-66%
PS 5	> 66-100%

Table 3.4. Allred scoring system – intensity score (IS) for nuclear staining [16].

IS	Nuclear staining intensity score
IS 0	None
IS 1	Weak
IS 2	Intermediate / Moderate
IS 3	Strong

When evaluating human epidermal growth factor receptor 2 (HER2) status, a 4-tier grading scale is utilized to assess the intensity of membrane staining in tumor cells. A score of 0 or 1+ indicates negative status, a score of 3+ indicates positive status, whereas for a borderline (equivocal) score of 2+, determination of the gene copy number via *in situ* hybridization (e.g., FISH, fluorescent *in situ* hybridization, or CISH, chromogenic *in situ* hybridization) is recommended. The test result is expressed as the ratio of the *HER2* gene copy number to the chromosome 17 copy number. Table 3.5 presents the borderline values and interpretations of *HER2* gene amplification testing. In cases where the ratio is between 1.8 and 2.2, corresponding to equivocal amplification, re-testing is recommended [16].

Table 3.5. *HER2* gene amplification [16].

Result (Ratio)	<i>HER2</i> gene amplification	HER2 status
< 1.8	Negative / Absent	Negative
1.8–2.2	Equivocal	Equivocal / Borderline
> 2.2	Positive / Present	Positive

Treatment

The selection of therapeutic modalities is based on the histopathological evaluation, taking into account the histological type and histological grade of the cancer, ER/PgR and Ki67 expression, and HER2 status. It also considers the stage of the primary breast tumor, the presence of metastases to axillary lymph nodes and distant organs, the patient's age and performance status, comorbidities, menopausal status, as well as patient preferences.

If breast-conserving surgery is planned, the suspicious breast lesion is marked with a metallic wire anchor (hookwire) or clip marker prior to the initiation of systemic therapy to enable tumor localization during the subsequent surgical procedure [9].

Preoperative chemotherapy favorably improves local surgical conditions and allows for the individualization of subsequent systemic therapy based on the histopathological response within the surgical specimen. Following preoperative systemic therapy, surgical treatment is performed in the form of either breast-conserving surgery or mastectomy. The indications and contraindications for breast-conserving surgery are presented in Table 4.1 [9].

Table 4.1. Indications and contraindications for breast-conserving therapy [9].

Indications for breast-conserving therapy	Contraindications for breast-conserving therapy
Patient's consent	BRCA1 or BRCA2 mutation carrier status – relative contraindication
Stage T1N0M0–T2N1M0 (baseline or post-induction systemic therapy)	Multicentric breast cancer (involving more than one quadrant) – relative contraindication
Feasibility of achieving complete resection of the primary tumor	Prior radiotherapy to the breast or chest wall
Feasibility of achieving a good cosmetic outcome	Extensive microcalcifications visible on mammography
No contraindications	Cutaneous forms of collagen vascular diseases (collagenoses)

Breast-conserving therapy (BCT) consists of breast-conserving surgery (partial mastectomy/lumpectomy), a diagnostic and therapeutic axillary lymph node procedure, and postoperative radiotherapy. The margins of the excised breast lesion are marked with sutures or colored ink to allow for oriented margin re-excision from the appropriate side in the event of incomplete primary resection. The borders of the tumor bed following primary lesion excision are marked with metallic clips, which enable precise planning of postoperative radiotherapy [9], [17].

Mastectomy is a procedure that involves the removal of the entire breast along with the skin overlying the gland (skin removal does not apply to subcutaneous mastectomy). The types of mastectomy include: simple, skin-sparing, nipple-sparing, Madden's modified radical mastectomy, and Halsted's radical mastectomy. A simple mastectomy is a procedure in which axillary lymph nodes are not removed. Subcutaneous mastectomy is performed as a preparatory stage for reconstructive breast surgeries, which are carried out using both conventional (open) and laparoscopic techniques. Madden's mastectomy is performed for stage I, II, or III cancers that do not qualify for breast-conserving therapy or skin-sparing mastectomy with immediate breast reconstruction. The procedure involves the removal of the mammary gland, the overlying skin, and the nipple-areola complex, while sparing the pectoralis major and pectoralis minor muscles. Halsted's mastectomy is currently performed very rarely. It is indicated in cases of extensive tumor infiltration into the pectoralis major muscle. The Halsted method extends Madden's mastectomy by including the resection of the pectoralis major muscle [9], [18], [19].

Evaluation of the axillary lymph node status is achieved by performing a sentinel lymph node biopsy (SLNB). Identification of the sentinel lymph node can be carried out using several methods. The first, the dye method,

involves injecting a dye (such as methylene blue or indocyanine green) into the area of the primary tumor. The dye enters the lymphatic vessels and stains the sentinel lymph node. The second, the isotope method, involves administering radioactive technetium-99m (^{99m}Tc). The substance accumulates in the sentinel lymph node, and its detection is enabled by using a gamma probe. Combining both previously described approaches yields the dual dye-isotope technique, which increases the precision and detection rate of sentinel lymph node mapping. Another method for identifying the sentinel lymph node is the ferromagnetic method, in which iron oxide particles are transported to the node. This method also requires a specialized device to detect the accumulation of the substance within the sentinel lymph node [20].

In the absence of metastases or if micrometastases (<2 mm) are detected in the sentinel lymph node, axillary lymph node dissection can be omitted. In patients with metastases in 1–2 sentinel lymph nodes, radiotherapy delivered to the axillary region is equivalent to lymphadenectomy and is associated with a lower risk of arm lymphedema as a treatment-related side effect [9]. If invasion is detected in ≥ 3 sentinel lymph nodes, or if the sentinel lymph node cannot be identified and biopsied during surgery, axillary lymphadenectomy is the routine management, which comprises the removal of level I and II axillary lymph nodes. The removal of level III axillary lymph nodes is reserved for cases presenting with clinical features of metastases in level II or III axillary lymph nodes [9], [21], [22]. In patients who received preoperative systemic therapy and had baseline axillary lymph node involvement, the use of dual mapping (using both dye and isotope) and the retrieval of at least 3 sentinel lymph nodes for evaluation are required [9]. Postoperative specimens are referred for histopathological examination. The pathologist evaluates the excised tumor lesions and describes them in accordance with the TNM classification.

A component of modern breast cancer management is oncoplastic and reconstructive breast surgery. It is performed in patients following mastectomy and in those who underwent breast-conserving therapy with an unsatisfactory cosmetic outcome. Reconstruction is carried out either as an immediate or a delayed procedure. It can be performed using autologous tissue (e.g., by transferring a musculocutaneous flap), implants, or a combination of both methods. Immediate breast reconstruction, which is performed concurrently with the mastectomy, can be carried out in the absence of both anatomical and medical contraindications, provided it aligns with the patient's consent and preference. Delayed breast reconstruction is performed at least 6 months after the completion of adjuvant radiotherapy or chemotherapy, whereas in other patients, it can be undertaken earlier. The procedure can be offered to patients who express a desire for it, provided they show no evidence of tumor recurrence and have no general contraindications to surgery [9], [23].

In patients who underwent breast-conserving surgery, postoperative radiotherapy is recommended at a dose of 26 Gy in 5 fractions over 1 week, whereas in patients post-mastectomy, a dose of 40 Gy in 15 fractions over 3 weeks is administered. In cases with an elevated risk of local recurrence, a boost—amounting to an additional dose of 10–15 Gy—is delivered to the tumor bed. In all patients, the radiation field should encompass the chest wall and, if indicated, the regional lymph nodes in the presence of axillary metastases. Axillary lymphadenectomy constitutes a contraindication to routine axillary irradiation. Adjuvant radiotherapy can be initiated following the completion of adjuvant chemotherapy [9].

Physical Activity in Breast Cancer Survivors

Physical activity is a cornerstone of oncological rehabilitation, contributing to a reduced risk of tumor recurrence and improved quality of life. Modern oncology is shifting away from the sedentary lifestyle model toward active rehabilitation. Polish recommendations, based on the standards of the Polish Society of Clinical Oncology (PTOK) and St. Gallen consensus experts, focus on early physiotherapy. Key aspects include:

Prevention of lymphedema through self-massage and upper-extremity mobility exercises as early as postoperative days 10–14 [24].

Gradual enhancement of the range of motion in the glenohumeral joint, while avoiding sudden overload during the postoperative phase [24].

Standards of early physiotherapy and physical activity in breast cancer patients following surgical treatment (according to PTOK and St. Gallen guidelines) are presented in Table 5.1. [25].

Table 5.1. Standards of early physiotherapy and physical activity in breast cancer patients following surgical treatment (according to PTOK and St. Gallen guidelines) [25]

Phase/Postoperative Timeline	Scope of Activity and Exercise	Therapeutic Goal and Precautions
Early postoperative phase (Days 1–3)	Antithrombotic and deep-breathing exercises. Gentle lymphatic self-drainage. Active movements of the hand and forearm.	Prevention of thromboembolic complications. Sparing the shoulder joint (avoiding abduction >90° to protect the wound bed).
Implementation phase (Days 10–14)	Self-massage and upper-extremity mobility exercises. Introduction of active-assisted and gravity-eliminated exercises.	Prevention of lymphedema. Initiation of lymphatic drainage stimulation following drain removal.
Adaptation phase (From weeks 2–3)	Gradual enhancement of the range of motion in the glenohumeral joint. Stretching exercises for the chest wall and shoulder girdle.	Prevention of contractures and tissue scarring. Avoiding sudden overload and heavy lifting.
Full rehabilitation phase (Post-wound healing/Post-adjuvant therapy)	Aerobic training (brisk walking, stationary cycling) – target 150 min/week. Guided resistance training (elastic bands).	Improvement of functional capacity and quality of life. Mitigation of cancer-related fatigue (CRF).

Conclusion

The management of breast cancer has undergone a paradigm shift, evolving from historically aggressive, maximally tolerated interventions toward tailored, minimally invasive, and functionally optimizing strategies. Contemporary surgical options—ranging from simple and modified radical mastectomies (such as Madden’s technique) to breast-conserving surgery (BCS)—are now carefully selected based on precise clinical staging, tumor biology, and the feasibility of achieving complete macroscopic and microscopic resection margins. Furthermore, the routine implementation of sentinel lymph node biopsy (SLNB) utilizing advanced dye, isotope, or ferromagnetic mapping has revolutionized axillary staging, allowing clinicians to safely omit morbid axillary lymph node dissections in the absence of significant nodal disease.

Adjuvant therapies, particularly radiotherapy, remain vital in securing local tumor control. Current hypofractionated regimens significantly compress treatment timelines while maintaining equivalence in oncological safety, with additional tumor bed boosts reserved for high-risk profiles. Concurrently, the integration of immediate or delayed oncoplastic and reconstructive breast surgery using autologous tissue or implants has redefined modern survivorship, heavily prioritizing the patient's cosmetic outcome and psychological well-being.

Ultimately, modern oncology successfully replaces the historical model of a sedentary, restrictive postoperative lifestyle with a framework of early, active rehabilitation. As emphasized by the Polish Society of Clinical Oncology (PTOK) and the St. Gallen consensus guidelines, structured physical activity and specialized physiotherapy—initiated as early as the first two weeks post-surgery—are paramount. Early implementation of upper-extremity mobility exercises and lymphatic self-drainage effectively mitigates the risk of arm lymphedema and joint contractures. In the long term, maintaining a minimum of 150 minutes of moderate aerobic activity supplemented by progressive resistance training is proven to alleviate cancer-related fatigue, preserve bone mineral density against endocrine-therapy-induced osteoporosis, and directly contribute to reduced tumor recurrence and superior overall quality of life. Integrating these multidisciplinary surgical, oncological, and rehabilitative modalities ensures not only optimal disease-free survival but also the comprehensive restoration of functional and psychological health in breast cancer survivors.

Disclosure

Author Contributions

Conceptualization: Oliwia Krazińska

Methodology: Oliwia Krazińska, Małgorzata Niewęłowska

Formal analysis: Mateusz Bernad, Katarzyna Widomska, Aleksandra Bender, Paulina

Walczak, Oliwia Krazińska, Bartłomiej Szymulewicz, Kacper Dąbrowski, Jakub Łukaszewicz, Małgorzata Niewęłowska, Magdalena Gałach

Investigation: Oliwia Krazińska, Bartłomiej Szymulewicz, Kacper Dąbrowski, Jakub

Łukaszewicz, Małgorzata Niewęłowska, Magdalena Gałach

Resources: Oliwia Krazińska

Writing—original draft preparation: Mateusz Bernad, Katarzyna Widomska, Aleksandra Bender, Paulina Walczak

Writing—review and editing: Oliwia Krazińska, Małgorzata Niewęłowska

Supervision: Paulina Walczak

Project administration: Oliwia Krazińska

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The authors declare no conflicts of interest.

Declaration of the Use of Generative Artificial Intelligence and AI-Assisted Technologies in the Writing Process

During the preparation of this manuscript, the authors used Jenn AI to support literature synthesis, structure the manuscript, and assist in drafting the initial text. All generated content was then reviewed and revised by the authors, who remain fully responsible for the final version and its scientific content.

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