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MINIMALLY INVASIVE SURGERY: A PROMISING APPROACH IN BREAST CANCER TREATMENT

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ABSTRACT

Minimally invasive surgery (MIS) has emerged as a groundbreaking approach in the treatment of breast cancer, offering numerous benefits over traditional surgical methods. This technique combines advanced technologies and breast preservation strategies, enabling more precise and less traumatic procedures for patients. By minimizing physical and psychological impact, MIS promotes faster recovery times and enhances the overall quality of life for patients. Recent studies highlight the effectiveness of MIS, particularly for early-stage breast cancer. Procedures such as breast-conserving surgery, which may include lumpectomy or the use of minimally invasive tools like high-intensity focused ultrasound (HIFU) or radiofrequency ablation (RFA), offer an attractive alternative to more invasive treatments like mastectomy. These techniques are especially valuable for managing patients' aesthetic concerns and emotional expectations, as they reduce scarring and preserve the breast's natural appearance. Moreover, MIS generally leads to shorter hospital stays, reduced post-operative pain, and lower complication rates. Despite these advantages, the choice of surgical method must be tailored to each patient, taking into account the specific characteristics of the tumor, the patient's health status, and personal preferences. While MIS is not suitable for all cases, it presents a highly effective option for many patients with early-stage breast cancer, providing excellent clinical and cosmetic outcomes. Looking ahead, ongoing research will continue to refine and expand the use of minimally invasive techniques. As these procedures evolve, it is expected that MIS will play a more central role in breast cancer treatment, providing less invasive, more effective alternatives that significantly improve patient outcomes.

Keywords: Minimally Invasive Surgery. Breast Cancer. Breast Preservation. Advanced Technologies. Early-Stage Tumors.

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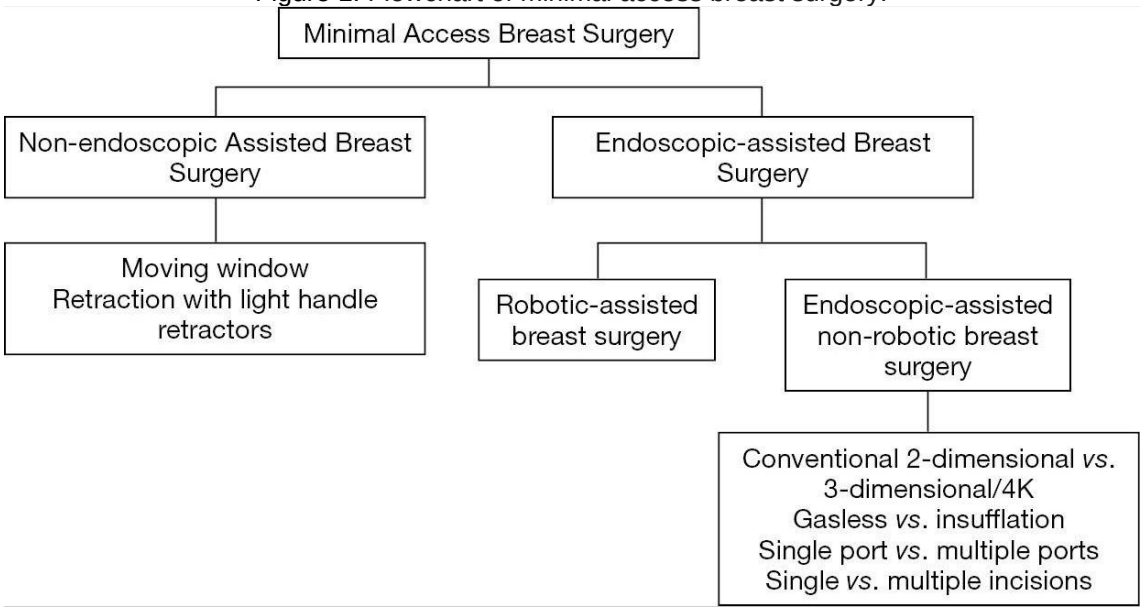
INTRODUCTION

Minimally invasive surgery has emerged as an innovative and effective approach to treating breast cancer, offering significant benefits over traditional methods. Procedures like lumpectomy and video-assisted biopsy aim to remove tumors with minimal incisions, reducing both physical and psychological trauma for patients. Over recent years, advancements in technologies such as video-laparoscopy and radiology have enhanced the precision and control of these surgeries, allowing for more accurate tumor removal while preserving healthy tissue. This not only improves cosmetic outcomes but also minimizes the risks of complications like infections, bruising, and prolonged recovery times, enabling patients to return to their normal lives more quickly.

Figure 1: Flowchart of minimal access breast surgery.



Source: Mok and Lai (2019).

One of the major advantages of minimally invasive techniques is their ability to preserve the breast, unlike mastectomy, which involves the complete removal of breast tissue. Techniques such as breast-conserving surgery, combined with adjuvant radiotherapy, have proven effective for early-stage breast cancer, providing excellent aesthetic results without compromising treatment efficacy. Moreover, these methods offer a quicker recovery, with reduced postoperative pain and shorter hospital stays, significantly improving the overall quality of life for patients, both physically and psychologically.

However, the choice of surgical technique should be a carefully considered decision between the patient and the physician, taking into account factors like cancer type, stage, the patient's health, and personal preferences regarding aesthetics and life quality. Minimally invasive surgery may not be suitable for every patient, but for those with early-stage breast cancer, it has proven to be a promising option, delivering great results with less impact on the body and daily activities.

Several studies support the growing role of minimally invasive techniques in breast cancer treatment. McIntosh et al. (2022) explored the feasibility of vacuum-assisted excision (VAE) for treating small invasive tumors detected via mammography, finding that VAE was effective for tumors with favorable biological features. The SMALL trial, a phase III multicenter randomized study, compared VAE with standard surgery and showed positive recruitment rates despite challenges posed by the COVID-19 pandemic. The study has the potential to impact treatment strategies by reducing overtreatment in mammographic screening programs.

Vlastos and Verkooijen (2007) reviewed the shift toward minimally invasive techniques in breast cancer management, highlighting innovations such as image-guided percutaneous biopsy and breast conservation therapy, which have become the standard for early-stage cases. The review also discussed emerging minimally invasive treatments for primary tumors, including radiofrequency ablation and cryotherapy, which are proving to be promising alternatives to traditional surgery, providing effective tumor management with better cosmetic outcomes.

In a systematic review, Peek et al. (2016) evaluated the clinical effectiveness of various minimally invasive ablative techniques, such as radiofrequency ablation (RFA) and high-intensity focused ultrasound (HIFU), concluding that these methods are effective in inducing tumor necrosis while maintaining a low side-effect profile. However, they emphasized the need for further studies to confirm their effectiveness. Hung et al. (2009) arrived at similar conclusions, noting that RFA and microwave ablation had the highest rates of complete tumor ablation, with RFA offering the shortest treatment time.

In terms of patient preferences, Knuttel et al. (2017) studied how breast cancer patients and healthy women view minimally invasive treatments compared to conventional surgeries. The study found that breast-conserving therapy (BCT) was the most preferred option among breast cancer patients, while healthy women favored minimally invasive treatments like single-dose ablative radiotherapy. Despite this,

overall, breast cancer patients did not show a significant preference for minimally invasive approaches, suggesting that BCT remains the most appealing option for many.

Garcia (2021) introduced a technical modification to Skin-Sparing Modified Radical Mastectomy (SSMR) with nipple-areola complex preservation and immediate reconstruction through minimally invasive surgery. The study, which involved three patients, showed excellent clinical and aesthetic results, with no complications and high patient satisfaction. The research concluded that this approach, using a single periareolar incision for retropectoral implant placement, is both safe and effective for patients undergoing SSMR, including the preservation of the nipple-areola complex and axillary management.

Minimally invasive surgery (MIS) has proven to be a transformative approach in the field of breast cancer treatment, offering numerous advantages over traditional surgical procedures. The integration of advanced technologies, such as high-intensity focused ultrasound (HIFU), radiofrequency ablation (RFA), and video-assisted procedures, has significantly improved the precision of tumor excision while minimizing the physical and psychological trauma associated with surgery. These innovations enable surgeons to target tumors more accurately, reduce the extent of tissue removal, and, crucially, preserve the breast's natural form, which has profound implications for the patient's quality of life.

One of the most notable advantages of MIS is its ability to maintain breast tissue integrity, which is of great importance to many patients undergoing treatment. Breast-conserving surgeries, which are facilitated by these minimally invasive techniques, not only provide effective cancer treatment but also address aesthetic concerns. This is particularly relevant for younger patients and those who value breast preservation for emotional and psychological reasons. The ability to offer an effective cancer treatment option without the extensive physical changes associated with more invasive surgeries, such as mastectomy, represents a significant advancement in patient care.

In addition to its aesthetic benefits, MIS also offers a faster recovery time, reduced risk of complications such as infections and bleeding, and lower postoperative pain, all of which contribute to improved patient satisfaction. Shorter hospital stays and a quicker return to daily activities help patients regain normalcy more swiftly, promoting a sense of well-being and reducing the emotional toll often associated with lengthy recovery periods.

However, the adoption of MIS is not without limitations. It is crucial to recognize that this approach is not universally applicable to all types of breast cancer. The decision to pursue minimally invasive surgery should be made on an individualized basis, considering factors such as the size, location, and biological characteristics of the tumor, as well as the patient's overall health and personal preferences. For patients with early-stage breast cancer, MIS offers an excellent treatment option, with promising results in terms of both clinical efficacy and cosmetic outcomes.

Looking ahead, ongoing research and technological advancements will continue to refine and expand the capabilities of minimally invasive surgery in breast cancer treatment. As these methods evolve, it is expected that MIS will play an increasingly central role in treatment protocols, offering patients a broader range of options that are less invasive, more precise, and more aligned with their aesthetic and emotional needs. As healthcare providers continue to adopt and refine these techniques, the future of breast cancer treatment looks promising, with MIS offering a less traumatic, highly effective alternative to traditional surgical methods.

Ultimately, MIS exemplifies the future of breast cancer treatment, where patient-centric care, advanced technology, and innovative surgical techniques converge to deliver better outcomes and improve the overall experience for those affected by this disease.

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