



## Magnetic Resonance Imaging of Immediate Breast Reconstruction with Silicone Implant and Latissimus Dorsi Flap

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### Abstract

**Purpose:** Skin-sparing mastectomy followed by immediate breast reconstruction is one of the latest revolutions of surgical treatment for breast cancer.

Purpose was to analyse implants using magnetic resonance imaging after immediate breast reconstruction with a combined silicone implant and latissimus dorsi muscle flap technique and to compare the results with clinical findings using the Baker scale.

**Methods:** From May 2011 to May 2015, 22 patients with breast cancer (T1 and T2N0M0) underwent skin-sparing mastectomy and immediate breast reconstruction procedures using the latissimus dorsi muscle flap in combination with anatomical silicone breast implants. Magnetic resonance imaging was used to detect signs of capsular contracture, intracapsular or extracapsular rupture.

**Results:** Analysing magnetic resonance, 9 patients (41%) (6 of which underwent radiotherapy) presented signs of capsular contracture, manifested with an anteroposterior to mediolateral ratio of less than 2. This correlates with 6 patients who presented clinical findings of Baker grades II and III contracture.

The mean fibrous capsule thickness in patients with radiotherapy was 1.6 mm and without radiotherapy 0.9 mm. The mean value of maximum length of free fluid around the implant was 3.8 mm in patients with radiotherapy versus 2.9 mm in patients without radiotherapy. The mean value of reconstructed muscle thickness was 5 mm in patients with radiotherapy and 5.8 mm in patients without radiotherapy.

**Conclusion:** We consider immediate breast reconstruction to have better results if the operation is performed without additional radiotherapy. Magnetic resonance imaging can be used to analyse reconstructed breasts, especially for the detection of postoperative complications.

**Keywords:** Breast cancer; Capsular contracture; Immediate breast reconstruction; Magnetic resonance imaging; Skin-sparing mastectomy

### Introduction

Skin-Sparing Mastectomy (SSM) is one of the latest revolutions of surgical treatment for breast cancer. SSM followed by Immediate Breast Reconstruction (IBR) using autologous tissue and/or silicone implants has been advocated as an effective treatment option for patients with early stage breast cancer [1,2]. The greatest asset of SSM is the tremendous advantage that it provides for the reconstructive surgeon, as it preserves the intact skin envelope of the breast, thereby reducing the size of the mastectomy scar [3]. The breast can be reconstructed using prosthesis alone, using autologous tissue alone, or by combining these two methods (using the latissimus dorsi muscle flap plus implant). The cosmetic appearance of the reconstructed breast is dependent upon the quantity of remaining breast skin and the location of the skin incision. Utilising the native skin envelope, it is possible to optimise the final contour of the reconstructed breast, and to achieve an excellent cosmetic result [4-7]. SSM should not be used in patients with inflammatory breast cancer or an extensive tumour that involves the skin [8]. Evaluation of capsular contracture is

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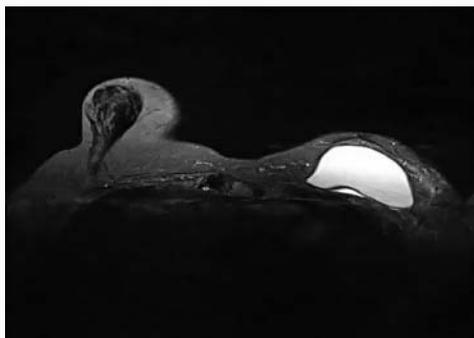
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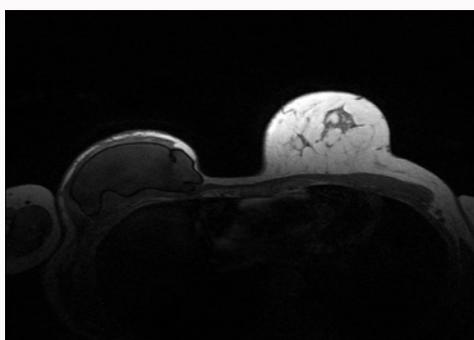
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**Figure 1:** Axial turbo inversion recovery magnitude water suppressed silicone image shows left breast silicone implant with an anteroposterior to mediolateral ratio less than 2, approximately 1.7. Fibrous capsule thickness is approximately 1.6 mm.



**Figure 2:** Axial T1 flash 3D non-fat-sat image shows a lot of radial folds. Fibrous capsule thickness is approximately 1.8 mm.

more accurate using Magnetic Resonance Imaging (MRI) compared to mammography or sonography, or clinical signs (Baker scale). Implant rupture can be a complication in patients with implants. The most reliable signs for intracapsular rupture are considered to be the linguine and keyhole signs [9]. Macroscopic extrusion of silicone through the fibrous capsule into the parenchyma, muscles, or lymph nodes is a characteristic of extracapsular rupture.

MRI is the most accurate method for evaluating implant integrity, but it requires understanding the numerous variations in implant construction that are encountered clinically. Indications for breast MRI include patients with silicone implants after mastectomy or augmentation mammoplasty, as well as for the detection of recurrence, prosthesis rupture, or capsular contracture [9]. The aim of this study was to compare the results of MRI analysis of breast implants obtained by combining silicone implants and latissimus dorsi muscle flaps in patients with and without radiotherapy, and to compare the MRI results with clinical findings using the Baker scale.

## Materials and Methods

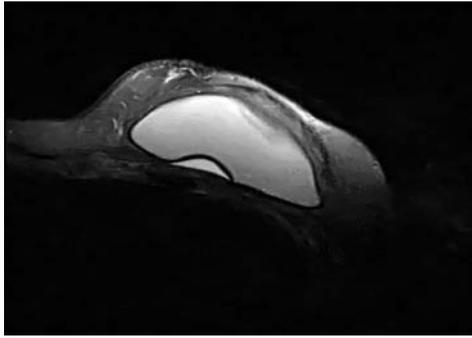
The retrospective analysis was performed at the Department of Plastic and Reconstructive Surgery, and at the Department of Radiology, during a period of 4 years from May 2011 to May 2015. Informed consent was obtained from each patient. The procedure was performed on 22 patients, mean age 50 (range 28 - 68). All 22 patients with early breast cancer underwent SSM and IBR procedures using latissimus dorsi muscle flaps in combination with anatomical silicone breast implants. The SSM was always performed by the same team of breast surgeons, and the IBR was always carried out

by the same plastic surgeon. The criteria for choosing patients were primary breast cancer stages T1N0M0 and T2N0M0, according to the TNM classification. Patients with inflammatory breast cancers, disseminated malignant disease, exulcerated breast cancers, or with mesenchymal breast tumours or tumours with two components (mesenchymal and epithelial, phyllodes tumours), and those with systemic collagenosis (such as scleroderma), were excluded from this study. We also excluded women younger than 20 and older than 70. Contour Profile gel breast implants feature an anatomic shape that closely resembles the outline of a natural breast. We considered the age, histological findings, and adjuvant radiotherapy and/or chemotherapy. One year after treatment completion, all patients underwent clinical examination using the Baker scale for capsular contracture, and MRI examination of the implant. MRI was performed by using a 1.5T system with a dedicated breast surface. Breast implants were examined using axial sagittal T2- and T1-weighted turbo spin-echo images, axial turbo inversion recovery magnitude, and T1 Dixon W and T1 Dixon F images. We evaluated the following MRI parameters: anteroposterior to mediolateral implant ratio, fibrous capsule thickness (mm), circumferential fluid collection presence, latissimus dorsi muscle flap thickness, implant contour regularity (anteroposterior or mediolateral folds), lumen homogeneity or dishomogeneity, shell interruption with silicone leakage, and free silicone presence in the breast or axilla.

We monitored for the presence of signs for capsular contracture, intracapsular rupture, or extracapsular rupture. Capsular contracture was considered when the silicone implant was asymmetrical in shape, manifested as an anteroposterior to mediolateral ratio less than 2, as decided by the authors. Patients were divided into two groups (16 patients who did not receive radiotherapy and 6 patients who underwent radiotherapy), and MRI parameters were compared. The results of MRI findings were analysed by the same qualified radiologist. Indication for radiotherapy was determined by an oncologist, based on pathohistological findings. We calculated the mean patient's age using descriptive statistics. The differences between values of various parameters in patients who underwent radiotherapy and those who did not were determined by the non-parametric Student's t-test. P-values less than 0.05 were considered statistically significant. Statistical analyses were performed using a statistical software package for Windows (new version 10 by Statsoft, Inc.).

## Results

There were 10 patients (45%) with stage T1N0M0 breast cancer and 12 patients (55%) with stage T2N0M0 breast cancer according to TNM classification. Intraoperative diagnosis of breast carcinoma was performed in 4 patients (18%) by pathohistological examination of the excised tumour, while the preoperative diagnosis of carcinoma was confirmed by frozen section examination in 18 patients (82%). Histological analysis showed that among 22 patients included in this study, 10 of them (45%) presented ductal carcinoma in situ, while 11 patients (50%) had invasive ductal carcinoma. There were no patients with lobular carcinoma in situ, but 1 patient (4,5%) presented an invasive type of lobular carcinoma. All patients with invasive cancer components underwent a sentinel lymph node biopsy, and all patients had an intraoperatively negative imprint cytology examination result. Clinically, 4 (18%) of the evaluated patients presented the complication of Baker grade II capsular contracture, and 2 (9%) patients Baker grade III capsular contracture. There were no patients



**Figure 3:** Axial T2-weighted turbo spin-echo fat suppressed image shows left breast single lumen implant with length of free fluid approximately 6.5 mm in a patient who underwent radiotherapy.



**Figure 4:** Axial TIRM water suppressed silicone image shows normal right single lumen implant. The capsule is seen a dark ring around the implant.

with Baker grades I or IV capsular contracture. None of the evaluated patients presented contracture to such a degree that would have required substitution of the implant, nor was any protrusion observed. No patients presented flap necrosis, implant loss, wound infection, haematoma, or seroma requiring surgical evacuation. There were no signs of extracapsular rupture or intracapsular rupture. The mean postoperative hospital stay was 5 days (range 3 - 7 days). During the follow-up period, with a median of 2 years, there was no evidence of local or distant disease relapse. Seven patients (32%) received adjuvant chemotherapy and 6 patients (27%) received adjuvant radiotherapy. Capsule formation requiring capsulotomy was also not observed. Based on MRI examination, 9 patients (41%) presented signs of capsular contracture manifested as an anteroposterior to mediolateral ratio less than 2 (Figure 1). This correlates with 6 patients (27%) who presented clinical findings of Baker grade II and III contracture. Only one patient clinically considered to be Baker II did not present an anteroposterior to mediolateral ratio less than 2, but the patient did present a fibrous capsule thickness of 1.8 mm, and a lot of radial folds, as well as a significant length of peri-implant fluid (more than 4 mm) (Figure 2). All patients who underwent radiotherapy (6 patients) had an anteroposterior to mediolateral ratio less than 2 and manifested capsular contracture clinically (Baker grade II and III).

Student's t-test detected a significant difference between mean fibrous capsule thickness around the implant between patients that underwent radiotherapy and those who did not ( $1.60 \pm 0.37$  mm versus  $0.89 \pm 0.17$  mm,  $t=5.44$ ;  $p < 0.05$ ). There was also a significant difference between the mean value of maximum length of free fluid around the implant according to Student's t-test ( $3.78 \pm 0.62$  mm in the group that underwent radiotherapy versus  $2.93 \pm 0.32$  mm

in the group that did not,  $t=3.84$ ;  $p < 0.05$ , Figure 3). Patients with radiotherapy presented a mean value of latissimus dorsi muscle flap thickness of 5 mm, while in those without radiotherapy 5.8 mm. However, the difference between mean thickness values of the reconstructed muscle between tested groups was not statistically significant (data not shown). No patients had signs of capsular rupture or significant implant dishomogeneity.

## Discussion

Breast conserving therapy is avoided in cases of primary breast cancer based on the size or the distribution of the tumour, or if breast conserving therapy would have a poor cosmetic outcome or local recurrence [10]. Some studies suggest that autologous tissue reconstruction provides better cosmetic results when compared to implant use, especially if it is deemed necessary to use radiotherapy [11,12]. The use of implants has advantages such as simplicity, shorter operation time and hospital stay, no extra scars, and no donor site morbidity. The main disadvantages of breast reconstruction with prosthesis include the risk of failure due to infection, rupture, extrusion, capsular contracture, the inability to withstand radiotherapy, and limited cosmetic results in comparison to autologous flaps [11]. The latissimus dorsi musculocutaneous flap is a popular method for breast reconstruction along with the transverse rectus abdominis musculocutaneous flap [13]. In selected patients, the latissimus dorsi myocutaneous flap provides adequate coverage of the prosthesis, and the skin island of the latissimus muscle flap can be incorporated into the defect after nipple-areola complex removal. This creates a tension-free muscular pocket, and provides adequate tissue coverage for the silicone implant [2,14,15]. The combined technique for reconstruction used in this study allowed for immediate breast volume replacement in patients who were not good candidates for more complex procedures and allowed for final adjustments during the postoperative period with minimal morbidity. The muscular flap provides a stable soft-tissue cover for the silicone implant, and protection against implant exposure in wound healing complications. In addition, the pocket exhibited little tension on the underlying silicone implant, allowing natural expansion without tension, and avoiding secondary upper pole fullness [1-3]. Another advantage of this combined method of breast reconstruction is also seen in this study, as none of the patients had signs of extracapsular or intracapsular implant rupture. The results of this study demonstrate that breast reconstruction with silicone implant and latissimus dorsi myocutaneous flap is a simple and consistent technique that has an important place among the main breast reconstruction procedures available at the moment. The success of the procedure depends on patient selection that is coordinated with the oncology surgeon, and on careful intraoperative and postoperative management. SSM and IBR for operable breast cancer is associated with a high level of patient satisfaction and low morbidity [4,5]. Evaluation of complications and cosmetic outcome is complex because of the significant variation in the sequencing of radiotherapy, the administration of systemic therapy, the duration of follow-up, and the techniques of radiation delivery [6]. For this purpose, a large clinical trial and longer follow-up periods are necessary for conclusions to be drawn that have adequate statistical power. The most common complication of SSM is skin flap necrosis because the skin envelope blood supply can become compromised during dissection [6], but none of our patients experienced this complication. IBR using prosthesis offers the best aesthetic results if postmastectomy radiotherapy is not needed. If radiotherapy is indicated, then delayed reconstruction

is preferable to avoid potential aesthetic and radiation delivery problems [12]. Postmastectomy radiotherapy causes fibrosis and increases the incidence of capsular contracture, as seen in this study. MRI findings of capsular contracture according to our study do not correlate well with clinical findings using the Baker scale. MRI has been reported as a sensitive and specific method in the detection of capsular contracture. As can be seen in this study, MRI revealed incipient capsular contracture in three patients that was not seen clinically using the Baker scale. MRI depicts the capsule as a dark ring-like structure where thickness may vary (Figure 4). A formed capsule will contract the implant in cases where capsular fibrosis occurs. As a result of pressure, the sensation of tension will begin. The implant can assume an abnormal shape [9]. The MRI examinations confirm our conclusion that patients who undergo radiotherapy are more likely to develop capsular fibrosis and contracture compared to patients that do not undergo radiotherapy. These results can be explained considering an increased chronic inflammatory response during radiotherapy. Our further study, related to the follow-up of patients with breast cancer reconstruction, along with standard MRI techniques, will encompass silicone selective sequences as well. An outlined procedure should produce more accurate and objective information related to the development of capsular fibrosis and contracture.

## Conclusion

This study shows that patients with IBR who undergo radiotherapy have more undesirable parameters. We consider that immediate reconstruction has better results if the operation is performed without additional radiotherapy. The Baker scale is not sufficient in determining the appearance of capsular contracture after SSM and IBR. Therefore, we emphasise that MRI can be a method for the analysis of breast reconstruction, especially for the detection of postoperative complications (such as capsular contracture), and when clinical signs are not evident (Baker scale I). From a radiological point of view, the challenge remains to expand our study further, investigate a larger number of patients in order to precisely define the parameters that describe each phase of contracture. Such knowledge will enable us to more accurately advise surgeons on their plans for further treatment of capsular contracture.

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