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# Immediate breast reconstruction with prostheses after conservative treatment plus intraoperative radiotherapy. Long term esthetic and oncological outcomes

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ABSTRACT

Electron intraoperative radiotherapy (ELIOT) has been introduced for breast conservative treatment (BCT) with promising oncological outcome. Thus, immediate breast reconstruction with prosthesis after BCT became possible due to minimal radiation effect on local tissue from ELIOT. We reported oncological and esthetical results of 29 BCT patients who had immediate implant reconstruction plus 21 Gy-ELIOT as the sole radiation treatment. All patients had prosthesis in ipsilateral breast and had simultaneous contralateral augmentation for symmetrical procedure. The average age was 52.3 years. There were stage Ia thirteen cases, stage Ib seven cases, stage IIa six cases and stage IIIb one case and two cases of intraepithelial neoplasia. From 54.2 (36–88) months follow up, the capsular contracture grading in the reconstructed breast from ELIOT-side is comparable with non-irradiated contralateral side. There was one patient who developed local recurrence (LR) and later on dead with breast related event (LR = 0.76% per year). There was no primary ipsilateral carcinomas and distant metastasis.



## Background

Breast conservative treatment (BCT) has been verified as a gold standard treatment for patients with small breast tumors.[1–3] Regardless to the additional axillary procedure, BCT itself has to be conventionally followed by external radiation therapy, which can cause acute and late local side effects. Therefore, implant related reconstruction in this group of patients remains controversial in view of unfavorable outcome, higher complications and capsular contraction rate.[4–11]

The oncological benefit and safety of ELIOT have been described with promising results.[12–19] Since 1999, more than 2000 patients had received electron intraoperative radiotherapy (ELIOT) at European Institute of Oncology (EIO) which broadens its clinical applications.[20–25] In 2006, Rietjens et al., reported a satisfactory short term result at 6 months after implant reconstruction for BCT plus ELIOT.[26] With an electron linear accelerator, the radiation dose is delivered only to the glandular tissue around the tumor bed, therefore avoiding the radiation of skin, subcutaneous tissue and pectoral muscle and overcoming the adverse radiation effects of external conventional radiotherapy.

In this study, we inclusively and systemically described the long term outcome of BCT with full-dose 21 Gy-ELIOT plus immediate implant reconstruction procedures. Hence, the advantage is the possibility of implement of implant reconstruction for BCT and avoiding unsatisfactory results due to conventional external radiation while maintaining the maximum oncologic benefit of ELIOT to these specific patients.

## Methods

We enrolled unilateral breast cancer candidates for BCT and received 21 Gy-ELIOT as the sole radiation treatment. Eligibility criteria included patients aged between 35 and 75 years, affected by a unicentric breast invasive carcinoma with a maximum diameter of 25 mm. Exclusion criteria were locally advanced tumors (T3 and T4), the presence of a contralateral synchronous or metachronous tumor, non invasive neoplasia (including Paget disease), other breast malignancies apart from carcinoma, multifocality or multicentricity of the disease, previous surgical biopsy and previous oncological history. At the beginning of our experience, we enrolled all patients within a trial protocol to access the

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oncological safety of the procedure. Afterward, we became familiar with the procedure and we achieved the promising preliminary results so we recruited also patients with in situ cancer lesion. A breast thickness of more than 3 cm from the skin to the tumor is considered a technical contraindication, since it is impossible to deliver energy of more than 9 MeV with the present ELIOT machines. No particular tumor locations are excluded, but the close proximity of the tumor to the skin, pectoral major muscle and axillary region are considered relative contraindications.[21] Neither previous preoperative radiation nor post operative radiotherapy was given. All of the study populations were immediately reconstructed with prosthesis related procedures. The prosthetic associated complications and overall esthetic score were systematically evaluated.

Every patient has given inform consent and this study was conducted under the institutional review board approval. All patients who underwent simultaneous contralateral breast augmentation or prosthesis substitution had proposed for the procedure by themselves. We systemically explained the pros and cons of each procedure to them individually also with the breast surgeons and the medical oncologists.

From September 2003 to September 2007, we recruited 29 patients who were planned for BCT and ELIOT with prosthesis reconstruction. Their average age was 52.3(37–66) years. There were twenty patients with bilateral prosthetic augmentation and nine patients with bilateral prosthetic substitution due to previous cosmetic augmentation. In the latter group, the prosthesis which they have been inserted subglandularly for the cosmetic augmentation was removed and we inserted new prosthesis submuscularly for breast reconstruction and contralateral symmetrical procedure. In this group the previous cosmetic breast augmentation was performed in an average of 14.2 (3–30) months before these oncoplastic procedures. The textured silicone cohesive gel implants were used in all cases.

The pathological T staging of tumors were; pT1 twenty-two cases, pT2 five cases and pTis 2 cases (one Ductal Intraepithelial Neoplasia and one Lobular Intraepithelial Neoplasia). The pathological N staging of tumors were pN0 twenty cases, pN1 eight cases and pN3 1 case. For axillary procedures, there were twenty-three patients who had sentinel node dissection and six patients who had axillary node dissection. None of them received neoadjuvant therapy but six patients received adjuvant chemotherapy.

The average volumes of prosthesis were 195.8 (100–335) cc. and 177.0 (80–325) cc. for the ipsilateral-ELIOT and the contralateral healthy breasts, respectively. In average, there was an 18.8 cc implant volume difference between the healthy and the disease breasts where quadrantectomy was performed.

The patient characteristics are demonstrated in Table 1.

### *Surgical technique*

The quadrantectomy was performed through a periareolar incision or radial incision, and axillary procedure was performed either through the same incision or a separate one. The tumor was confirmed with histological free margins and the nodal procedure was up to the absence or presence of nodal metastasis.

The glandular tissue nearby the defect was undermined over the pectoralis major muscle and a lead disk and aluminum disk were positioned on the surface of the pectoralis major muscle to prevent muscular and chest wall irradiation. Before delivering ELIOT, the glandular flaps were temporarily approximated to close the quadrantectomy defect (clinical target of irradiation) and the skin was

**Table 1**
Patient characteristics.

| Patient code | Age | FU (month) | Pathological TMN staging[a] | | | Location | | Axillary procedure | Event |
|---|---|---|---|---|---|---|---|---|---|
| *Augmentation* | | | | | | | | | |
| 1 | 57 | 84 | $T_1$ | $N_0$ | $M_0$ | L | SM | SNB | – |
| 2 | 44 | 76 | $T_1$ | $N_{1a}$ | $M_0$ | R | SL | AND | – |
| 3 | 66 | 69 | $T_{1b}$ | $N_0$ | $M_0$ | L | IM | SNB | – |
| 4 | 53 | 16 | $T_2$ | $N_0$ | $M_0$ | L | SM | SNB | LR[b] |
| 5 | 57 | 65 | $T_1$ | $N_0$ | $M_0$ | L | IL | SNB | – |
| 6 | 49 | 64 | $T_{1c}$ | $N_{1mi}$ | $M_0$ | L | IL | SNB | – |
| 7 | 37 | 59 | $T_{is}$ | $N_0$ | $M_0$ | R | SM | SNB | – |
| 8 | 58 | 57 | $T_{1c}$ | $N_0$ | $M_0$ | R | SM | SNB | – |
| 9 | 46 | 55 | $T_{1c}$ | $N_0$ | $M_0$ | R | SL | SNB | – |
| 10 | 52 | 54 | $T_{1c}$ | $N_{1a}$ | $M_0$ | L | IL | AND | – |
| 11 | 56 | 54 | $T_2$ | $N_{3a}$ | $M_0$ | L | SL | AND | – |
| 12 | 57 | 53 | $T_2$ | $N_0$ | $M_0$ | L | SL | SNB | – |
| 13 | 48 | 50 | $T_{1c}$ | $N_{1mi}$ | $M_0$ | L | SM | AND | – |
| 14 | 49 | 49 | $T_{1b}$ | $N_0$ | $M_0$ | R | SL | SNB | – |
| 15 | 44 | 48 | $T_1$ | $N_0$ | $M_0$ | L | IM | SNB | – |
| 16 | 53 | 36 | $T_{1a}$ | $N_0$ | $M_0$ | L | SL | SNB | – |
| 17 | 54 | 38 | $T_{1c}$ | $N_0$ | $M_0$ | R | SL | SNB | – |
| 18 | 52 | 41 | $T_{1b}$ | $N_0$ | $M_0$ | R | SM | SNB | – |
| 19 | 49 | 40 | $T_2$ | $N_0$ | $M_0$ | L | SL | SNB | – |
| 20 | 42 | 41 | $T_{1b}$ | $N_{1mi}$ | $M_0$ | L | IM | SNB | – |
| *Substitution* | | | | | | | | | |
| 1 | 62 | 88 | $T_{1c}$ | $N_{1mi}$ | $M_0$ | R | SM | SNB | – |
| 2 | 48 | 85 | $T_{1c}$ | $N_0$ | $M_0$ | L | SL | SNB | – |
| 3 | 61 | 60 | $T_{1c}$ | $N_0$ | $M_0$ | R | SL | SNB | – |
| 4 | 46 | 46 | $T_{1c}$ | $N_{1mi}$ | $M_0$ | R | SL | AND | – |
| 5 | 62 | 36 | $T_2$ | $N_0$ | $M_0$ | L | SL | SNB | – |
| 6 | 61 | 38 | $T_{1b}$ | $N_{0iso}$ | $M_0$ | R | SM | SNB | – |
| 7 | 48 | 38 | $T_{is}$ | $N_0$ | $M_0$ | R | SL | SNB | – |
| 8 | 56 | 41 | $T_{1c}$ | $N_0$ | $M_0$ | L | IM | SNB | – |
| 9 | 50 | 43 | $T_{1b}$ | $N_{1mi}$ | $M_0$ | R | SM | AND | – |

[a] Abbreviations: 1mi = Micrometastasis, S = Superior, I = Inferior, M = Medial, L = Lateral, SNB = Sentinel node biopsy, AND = Axillary node dissection, IS = In situ, LR = Local recurrence.
[b] Infraclavicular recurrence, death at 16 months after surgery.