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The influence of simultaneous integrated boost, hypofractionation and oncoplastic surgery on cosmetic outcome and PROMs after breast conserving therapy

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Abstract

Introduction: We retrospectively investigated the possible influence of a simultaneous integrated boost (SIB), hypofractionation and oncoplastic surgery on cosmetic outcome in 125 patients with stage I–II breast cancer treated with breast conserving therapy (BCT).
Patients and methods: The boost was given sequentially (55%) or by SIB (45%); fractionation was conventional (83%) or hypofractionated (17%); the surgical technique was a conventional lumpectomy (74%) or an oncoplastic technique (26%). We compared cosmetic results subjectively using a questionnaire independently completed by the patient and by the physician and objectively with the BCCT.core software. Independent-samples T-tests were used to compare outcome in different groups. Patients also completed the EORTC QLQ C30 and BR23.
Results: Univariate analyses indicated no significant differences of the cosmetic results ($P \leq 0.05$) for the type of boost or fractionation. However, the conventional lumpectomy group scored significantly better than the oncoplastic group in the BCCT.core evaluation, without a significant difference in the subjective cosmetic evaluation. Quality of life outcome was in favour of SIB, hypofractionation and conventional surgery.
Conclusion: Our study indicates that the current RT techniques seem to be safe for cosmetic outcome and quality of life. Further investigation is needed to verify the possible negative influence of oncoplastic surgery on the cosmetic outcome and the quality of life as this technique is especially indicated for patients with an unfavourable tumour/breast volume ratio.

Keywords: Simultaneous integrated boost (SIB); Hypofractionation; Oncoplastic surgery; Cosmetic results; Quality of life (QOL); Breast conserving therapy

Introduction

The most common form of cancer for women is breast cancer. Each year, approximately 300 000 women with stages I and II breast cancer undergo breast-conserving therapy (BCT) worldwide, including radiation therapy (RT).[1,2] BCT offers identical disease control and survival rates compared to modified radical mastectomy.[1–4] The addition of a higher (boost) dose to the primary tumour bed after 50 Gy to the whole breast significantly reduces the local recurrence rate and is therefore especially indicated for patients with a higher risk of local recurrence.[5] However, this additional boost dose, as well as larger excision volumes and younger age, lead to poorer cosmetic outcome.[6,7]

In RT, several improvements have been gradually introduced over the last ten years: the sequential boost where the additional dose is delivered after completion of whole breast RT has been replaced by a simultaneous integrated boost (SIB) where the boost dose is given on a daily base

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simultaneously with whole breast RT and hypofractionation, where a radiobiologically equivalent dose is given in less fractions (and thereby a shorter overall treatment duration) is progressively replacing conventional fractionation. These changes lead to a shorter treatment period without compromising effectiveness or safety and possibly even decreasing the risk of acute and late radiation toxicity, and thus lowering the burden of treatment to the patient.[5,8–12] During the same period, breast conserving surgery progressed from conventional lumpectomy, where the removal of the primary tumour was based on a direct approach removing the tumour with a margin with or without closure of the lumpectomy cavity, to oncoplastic surgery, where the breast is remodelled and carefully closed by mobilising tissue in addition to resection of the tumour. With this procedure better cosmetic results can be achieved for technically challenging cases based on tumour location and the ratio of tumour to breast volume.[13,14] Combined with the improvements in diagnostic procedures and risk-adapted systemic therapy, today an excellent long-term prognosis has become feasible for most breast cancer patients.[15]

In Institute Verbeeten, a regional hospital for radiation oncology, the treatment policy evolved as follows:

1 In 2007: the sequential boost was replaced by the SIB technique.
2 In 2009, hypofractionation was incrementally introduced.
3 After its introduction in the referring hospitals in 2009, the use of oncoplastic surgery increased from 2011 onwards.

In this retrospective study we investigated the possible influence of the above-mentioned changes on the cosmetic outcome and on the quality of life (QOL) using patient reported outcome measures (PROM) questionnaires in patients undergoing BCT.

Materials and methods

Patient population

In this study, 125 eligible patients were included. They underwent breast conserving surgery in one of the regional hospitals referring their patients to Institute Verbeeten. All patients were treated with postoperative radiation therapy (three-dimensional conformal radiotherapy using 6 and/or 10 MV photon beams) at Institute Verbeeten from July 2004 to May 2012. They all met the following inclusion criteria:

1 Patients of female gender and $\geq$35 years of age.
2 Breast cancer stage Tis, T1 or T2, irrespective of the N stage.
3 Disease-free and alive at the moment of inclusion.
4 Last follow up visit $<$2 years ago.
5 Karnofsky performance status $\geq$70.
6 No breast cancer during pregnancy.

Previous, concurrent or sequential adjuvant systemic treatments were allowed and documented. Date of and type of axillary lymph node surgery was recorded.

Patients were divided in groups according to the characteristics of their surgical and radiation therapy (Table 1):

- The control group (CR): conventional RT fractionation scheme, sequential boost, and conventional lumpectomy.
- The simultaneous boost group (SIB): conventional RT fractionation scheme, simultaneous boost, and conventional lumpectomy.
- The hypofractionated group (HF): hypofractionated RT fractionation scheme, sequential boost, and conventional lumpectomy.
- The oncoplastic surgery conventional fractionation group (OSCF): conventional RT fractionation scheme, simultaneous boost and oncoplastic lumpectomy.
- The oncoplastic surgery hypofractionated group (OSHF): hypofractionated RT fractionation scheme, simultaneous boost and oncoplastic lumpectomy.

The characteristics of patient, tumour, surgery and RT are given in Table 1. The distribution of these variables between the different study groups did not differ significantly, except the significantly higher age in the SIB group compared to the control group and the larger tumour size in the OSCF group compared to the OSHF group. Also a significant increase in the use of clips to mark the tumour cavity was seen over the years. The volume of the boost, was, although not significantly, higher in patients treated with oncoplastic surgery than in conventional lumpectomy groups who underwent conventional irradiation schedules.

Radiation therapy techniques

Irradiation schedules and boosts were given as follows, using a tangential forward-planned IMRT technique for the whole breast volume, supplemented by 2 or 3 fields to deliver the boost dose:

- Conventional fractionation: 50 Gy in 25 fractions to the whole breast.
- Hypofractionation: 42.56 Gy in 16 fractions to the whole breast.
- Sequential boost: 16 Gy in 8 fractions to the primary tumour bed.
- SIB: 13.72 Gy to the primary tumour bed integrated in the total of 28 fractions.
- Hypofractionated SIB: 13.30 Gy to the primary tumour bed integrated in the total of 21 fractions.