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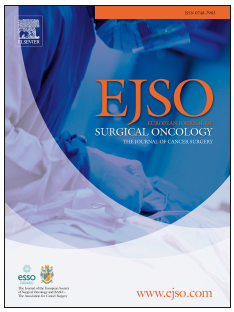

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PII: S0748-7983(18)30039-8

DOI: 10.1016/j.ejso.2018.01.010

Reference: YEJSO 4824

To appear in: *European Journal of Surgical Oncology*

Received Date: 15 October 2017

Revised Date: 11 December 2017

Accepted Date: 2 January 2018

Please cite this article as: Aristei C, Kaidar-Person O, Tagliaferri L, Arenas M, Coles CE, Offersen BV, Frezza G, Leonardi MC, Valentini V, Bourgier C, Poortmans PM, The Assisi Think Tank Meeting and Survey of post MAstectomy Radiation Therapy after breast reconstruction: The ATTM- SMART report, *European Journal of Surgical Oncology* (2018), doi: 10.1016/j.ejso.2018.01.010.

The Assisi Think Tank Meeting and Survey of post MAstectomy Radiation Therapy after breast reconstruction: The ATTM- SMART report

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Abstract

Purpose: To describe the current European practice on post-mastectomy radiation therapy (PMRT) in relation to breast reconstruction.

Methods: A 21-item questionnaire was distributed online via Survey Monkey. Items referred to 1. general topics (country, centre, years of experience in breast cancer); 2. clinical decision making; 3. RT techniques and dosimetry; 4. dose fractionation.

Results: 283 responses were received from 19 countries. Most responders worked in public health services and in academic institutions and had 5-20 years experience. Although many indicated they were consulted about the timing and type of breast reconstructive surgery, final decisions were most often made by surgeons. Immediate reconstruction with expander followed by RT and subsequently permanent reconstruction with prosthesis was recommended by 61.6% of responders. Most (48.4%) adviced a boost only when margins were close or involved with an another 17.7% recommending it in the presence of high-risk features (T3-T4, lympho-vascular involvement). Intensity modulated RT was rarely used by about two-thirds of responders, except when with 3D technique the dose constraints were not achieved or when regional lymph nodes were included. Almost 60% of responders did not use bolus/tissue equivalent material (TEM). The main indication for bolus/TEM use was skin involvement. The majority of responders used 1.8 - 2 Gy per fraction.

Conclusions: The present survey highlighted controversial areas in clinical practice, confirming the uncertainties about the scheduling of PMRT and breast reconstruction.

Keywords: Breast cancer, Breast reconstruction, Post-mastectomy radiotherapy, Survey

Introduction

The "Assisi Think Tank Meeting" (ATTM) on Breast Cancer, endorsed by the European Society for Radiotherapy & Oncology (ESTRO) was held in Italy on 5th - 7th February 2016 to identify major clinical challenges in breast cancer radiation therapy (RT) and to propose clinical trials to address them [1]. After in-depth discussions, the participating radiation oncologists, who were all experts in the field of breast cancer, identified three major clinical challenges, one of which was post-mastectomy RT (PMRT) after breast reconstruction.

Breast reconstruction after mastectomy has changed significantly in the past decade, with application of skin- and nipple-sparing procedures combined with flap- or implant-based reconstruction techniques in single- or multi-step procedures. In one of the many one-step, so-called "immediate" procedures, reconstruction is performed during the mastectomy operating session. In multi-step procedures, a temporary expander is inserted and later replaced by a permanent prosthesis alone or combined with a flap in a subsequent operation. Implants are generally partially/fully muscle covered, but may be subcutaneous as well, of different sizes and diverse materials like saline, water soluble polyvinylpyrrolidone-based gel or silicone. To improve cosmesis, additive oncoplastic techniques like lipofilling may be used for further adjustments to shape and consistency. Decision-making among these options is linked to feasibility, the patient's physical characteristics and the surgeon's skill and expertise. When obtaining informed consent the physician should bear in mind that the patient's perception of the proposed strategy may be influenced by external factors, like relatives' views, environmental pressure from articles and debates in the mass media and so forth.

Parallel to these significant changes in surgical techniques, indications for PMRT have expanded following the publication of level I evidence by the Early Breast Cancer Trialists' Collaborative Group (EBCTCG). They clearly demonstrated better disease free and overall survival after PMRT to the chest wall and regional nodes in patients with diseased axillary lymph nodes, irrespective of how many were involved and whether or not adjuvant systemic therapy was administered [2]. The EBCTCG analysis also suggested that PMRT reduced loco-regional and overall recurrence rates in selected patients with node-negative disease after limited axillary surgery [3].

The evidence in favour of PMRT and the growing popularity of immediate breast reconstruction led to many open questions about their optimal combination. In fact, while the trials in the EBCTCG meta-analysis included only patients without immediate reconstruction, data about PMRT in the setting of breast reconstruction mainly comes from retrospective studies that focused on the surgical and aesthetic effects rather than oncological outcomes and radiation techniques [4,5]. Difficulties in

irradiating a reconstructed breast may lead to sub-optimal coverage of target volumes, particularly when draining nodes need to be treated together with the chest wall, or sub-optimal sparing of the organs at risk, such as lungs and heart [6,7]. Finally, in PMRT uncertainties are found in target volume definitions, dose and fractionation schedules, whether or not to administer a boost or to use bolus material and in technical options such as deflating the tissue expander before PMRT [8-12].

Assuming that the lack of standardization in PMRT after breast reconstruction is reflected in different practice patterns, the present survey (The Assisi Think Tank Meeting - Survey of post MAstectomy Radiation Therapy, ATTM-SMART) focused on PMRT after reconstruction in order to provide a picture of current practice across European RT centres.

Methods

The Questionnaire

The ATTM Expert Board Members (named CA, OKP, CB, PMPP), who explored the issues of PMRT, designed a questionnaire, which was reviewed by all ATTM participants and subsequently revised in accordance with their comments.

Items in the questionnaire referred to diverse aspects of PMRT clinical practice. The first 3 questions addressed general topics such as country, centre, and years of experience in RT for breast cancer. Eight questions (Q4, Q5, Q6, Q8, Q9, Q10, Q11, Q18) referred to clinical decision-making. Seven (Q7, Q12, Q13, Q14, Q15, Q16, Q17) inquired about RT techniques and dosimetry and the last 3 (Q19, Q20, Q21) inquired about dose fractionation schedules.

The ATTM-PMRT questionnaire was distributed online via Survey Monkey. “SurveyMonkey", an online survey development cloud-based software, provides customised surveys and data analysis, sample selection, bias elimination, and data representation tools. Each ATTM participant was requested to answer the questionnaire and forward it, directly or via scientific societies, to colleagues who were active in the field of breast cancer, whether they were working in university or general hospital RT centres or cancer centres that were or not specifically dedicated to breast cancer. We requested one single response from each RT centre. Survey participation was voluntary with no financial incentives for responders and anonymous responses were received between November 2016 and January 2017. This survey study did not require Ethical Approval as it was non-interventional and no patients or patient data were involved.

Statistical analysis

Descriptive statistics (rates, percentages) were calculated by means of automatic "surveymonkey" tools and used to present survey results.

Results

We received 283 completed questionnaires from 19 countries. The percentage of responding centres ranged from 0.7% to 67% of the total number of RT centres in each country [13]. The percentage impact of each responding centre upon the overall survey results ranged from 0.4% to 47% (Table 1).

All responders answered all 21 questions in the survey. Most centres were part of National Health Services; only 8.8% were private care centres. The majority of responders (63%) belonged to academic institutions while 26% worked in non-teaching hospitals. The expertise of responding radiation/clinical oncologists (from now on referred to as radiation oncologists) ranged from under 5 years for 7.8% to over 20 years for 33.9% (Table 2).

Clinical decision-making

A majority (59.4%) of radiation oncologists were consulted about the timing and type of breast reconstructive surgery. However, 79% stated that breast, reconstructive or plastic surgeons made the final decision on whether the reconstruction should be immediate or delayed. Approximately 80% of radiation oncologists agreed that the target volumes were well enough defined after immediate reconstruction to apply consistently in daily practice.

Reconstruction with expander followed by RT and subsequently permanent reconstruction with prosthesis was recommended by 61.8% of radiation oncologists and was indeed applied by 63.2% in clinical practice.

In cases of chest-wall irradiation, 48.4% of radiation oncologists recommended a boost only when margins were close or involved, independently of whether disease was single- or multi- focal. An additional 17.7% recommended it in the presence of other high-risk features (T3-T4, lympho-vascular involvement). The same indications for boost were maintained by 68.5% of radiation oncologists after skin or nipple sparing mastectomy and by 43% after modified radical mastectomy followed by immediate reconstruction. A quarter of the radiation oncologists reported that a boost

was never used in the setting of PMRT, regardless of the surgical procedure. An additional 13% declared they never applied a boost in the setting of immediate breast reconstruction.
Only a very small minority of radiation oncologists selected pre-mastectomy RT as an option.
Table 3 reports all results.

PMRT technique and dosimetry

The greatest challenge in PMRT planning after immediate reconstruction was, according to 60% of responders, achieving satisfactory coverage of target volumes without compromising the dose to the organs at risk (e.g. lungs, heart, contralateral breast).This target was not reached in 30% of cases. Approximately, two-thirds of responders did not use intensity modulated radiation therapy (IMRT) for PMRT after reconstruction, unless the 3D-treatment planning did not meet the dose constraints or the regional lymph nodes needed to be irradiated.
One-third of radiation oncologists indicated that metal ports on expanders were never used by their referring surgeons. When metal ports were present, approximately one-third of responders used specific algorithms for treatment planning.
In the setting of PMRT with or without immediate reconstruction, 64.3% and 55.8%, respectively, of responders did not use bolus/tissue equivalent material (TEM). The main indication for bolus/TEM use was skin involvement by the cancer. If applied, bolus/TEM was used daily for the entire treatment by 41.3% of radiation oncologists, while others indicated various bolus application protocols. The bolus/TEM thickness also varied, for example when 6MV photons were used the bolus/TEM thickness was 5mm in almost 50% of patients.
Table 4 reports all results.

Dose fractionation schedules

Most radiation oncologists used daily schedules of 1.8 - 2 Gy per fraction for PMRT with or without reconstruction, whether or not regional nodes required irradiation. Moderate hypofractionation was used by under 25% of responders (Table 5).

Discussion

The ATTM-SMART is the first European survey to summarise approaches to PMRT in the setting of breast reconstruction. Replies to the present survey highlighted controversial areas in clinical practice, flanking published data that are derived from single-centre research interests. The divergent picture is probably due to a lack of national or international guidelines for issues addressed by our survey.

The most controversial issues were the timing and the type of reconstructive surgery, two topics on which some data are available [14-23]. Even though the radiation oncologist was involved in the multi-disciplinary discussion in the majority of the cases, the final decision was made by the surgeon who usually opted for immediate reconstruction with expander followed by RT and a permanent reconstruction with prosthesis in a second procedure. This approach is becoming prevalent in current practice [10,24].

According to survey results breast reconstruction with autologous tissue was less popular. Despite offering the advantage of less risk of expander/prosthesis-related complications, this procedure is time-consuming and highly technical and optimal conditions for performing it may not always be available in surgical units. On the other hand, performing reconstruction in the same surgical session as mastectomy undoubtedly offers several advantages: patients maintain their body image without risking the psychological trauma of breast amputation; they maintain a relatively unperturbed quality of life; excellent/good cosmetic outcomes and a high grade of satisfaction are achieved in most patients; a second costly and risky operation is avoided, the success of which might be jeopardized because the breast tissue had been irradiated between the two operations. Under 20% of present responders adopted the Memorial Sloan Kettering Cancer Centre approach i.e. mastectomy with positioning of a tissue expander to be gradually inflated during adjuvant chemotherapy and replacement with a definitive prosthesis before starting PMRT [20,25]. This approach was apparently not very popular because of the logistical difficulties in organising and timing its three different steps. Furthermore, recent data showed no advantages in terms of toxicity and adverse side effects [26-30]. Delayed reconstruction with autologous tissue or prosthesis was preferred by almost 70% of responders, suggesting patient-related factors or the surgeon's personal preference may have played major roles in decision-making.

The issue of boost administration in PMRT has received little attention. The present survey showed a boost was given only to patients with tumours at high risk of relapse, probably because it was expected to impact negatively on toxicity and cosmetic outcome [10]. In line with our findings, Thomas et al [11] found that 33% of US responders never gave a boost dose while Chen et al. reported that 40% of responders never used a boost, with significant differences emerging between

physicians from both Americas and from Europe in boost prescription (72% *vs* 17% responders, $p < 0.001$) [10].

Appropriate target volume coverage associated with sparing of organs at risk is the main objective of radiation treatment planning. In the present survey, since most responders reached these goals with no difficulty, IMRT was rarely needed and was used only when a 3D-treatment plan did not meet the dose constraints, when volumes or geometries were particularly complex or when the regional lymph nodes needed to be irradiated. IMRT may not be selected for PMRT delivery because it delivers low-dose irradiation to a high volume of healthy tissues, including the lungs and the contralateral breast, a disadvantage which needs to be weighed against its benefits.

The few reports about metal ports on expanders diverged on their impact on dose distribution [31-38], explaining why almost half of the radiation oncologists did not change treatment planning when metal ports were present. For example, in some studies, they did not use high-energy photons or specific algorithms for the metal material [33-35,38], probably because they provide at best only an estimate. Specific algorithms still need to be assessed in treatment planning projects and subsequently be included in educational programmes on breast cancer radiation oncology.

Due to concerns about toxicity [39,40], bolus/TEM was not commonly used in the present survey and its schedule varied greatly among the radiation oncologists who opted for it. Skin involvement was the main factor determining bolus/TEM use. As in the present investigation, the UK survey reported that a large majority of responders did not use bolus [41], confirming data from Chen's report, which found that 71% of European physicians did not use it compared with 38% in both Americas [10]. Thomas et al. also found that 48% of US radiation oncologists did not use bolus after mastectomy [11].

The present survey showed fractionation schedules of 1.8-2.0 Gy daily were the most frequently used for PMRT with or without reconstruction, whether or not regional nodes were included. This diverges from clinical practice in the Netherlands [41] and UK survey findings [42] which reported that hypofractionation was used by the majority of radiation oncologists. Hypofractionation was not generally recommended in the guidelines for PMRT in the reconstructed breast as randomized clinical trials had mainly been conducted after breast conserving surgery [43-45]. Therefore radiation oncologists seem wary about extrapolating results to the PMRT setting even though the schedule of 40 Gy in 15 fractions, as used in the START B trial [45], was associated with a non-inferior loco-regional recurrence rate, at least equal overall survival and a gentler effect on normal tissue (explained by a lower EQD2 dose) [46,47]. Moreover, in a phase II prospective study Khan et al. showed hypofractionation was safe in PMRT [48].

We were unable to estimate a participation rate in the present survey, as we do not know how many centres or radiation oncologists received our questionnaire. Response rates were, however, low in other surveys that were conducted in this field [8-11]. For example, Chen et al. [10] analysed replies from 358 radiation oncologists out of the 4753 (7.5%) who were invited to participate, with 60% coming from the Americas and the rest from various countries worldwide, while Thomas et al. [11] reported a low 19.2% response rate in the USA. These data highlighted the challenge in conducting these non-sponsored surveys. On the other hand, Royal College consultants replied in almost 75% of UK centres [41] and the EORTC survey on nodal RT achieved a 95% reply rate [49]. Consequently, involvement of a national professional or research organisation seems to be a crucial factor in contributing to the success of a survey initiative.

Conclusions

The results of the present survey indicated that treatment approaches varied across Europe. Due to the controversial issues that have emerged, our opinion is that PMRT combined with breast reconstruction should be included in prospective trials like the new Danish trial [50]. The survey showed that radiation oncologists play a key role in pre-surgery clinical meetings that plan breast reconstructions, even though decision-making belongs to the surgeon and is probably based on his/her assessment of feasibility, the patient's physical characteristics and wishes, and his/her own skill and expertise. It is recommended that surgeons and radiation oncologists develop shared views on risks and priorities, so as to offer breast cancer patients best outcomes in terms of disease control, toxicity, cosmesis and quality of life after reconstruction.

Acknowledgements. The authors thank all the other ATTM Expert European Board members: Bruno Cutuli, Pierfrancesco Franco, Domenico Genovesi, Vladislav Grinberg, Diclehan Kilic, Vassilis Kouloulias, Lorenzo Livi, Stefano Maria Magrini, Fabio Marazzi, Icro Meattini, Angel Montero Luis, Isabella Palumbo, Elisabetta Perrucci, Ugur Selek, Daniela Smaniotto, Fabrizio Stracci, Vincenzo Tombolini, Lurdes Trigo, Cristiana Vidali.

Conflict of Interest. The authors declare that they have no conflict of interest.
Dr Charlotte Coles is supported by the Cambridge National Institute of Health Research Biomedical Research Centre.

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Table 1. Details of responders to the survey on post-mastectomy radiation therapy and breast reconstruction

Q1. Where do you work?

Responders' countries	**N° of centres in each country*°**	**N° of responders**	**Estimated percentage of responding centres over the total number in the country**	**Percentage of responders over the total number in the survey**
Italy	197	132	67%	47%
United Kingdom	84	37	44%	13%
Turkey	163	28	17%	10%
Spain	118	25	21%	9%
France	228	20	9%	7%
Netherlands	21	14	67%	5%
Israel	11	6	55%	2%
Belgium	39	4	10%	1.4%
Denmark	7	2	29%	0.7%
Germany	299	2	0.7%	0.7%
Poland	38	2	5%	0.7%
Portugal	26	2	8%	0.7%
Czech Republic	38	1	3%	0.4%
Ireland	13	1	8%	0.4%
Macedonia	-	1	-	0.4%
Slovakia	15	1	7%	0.4%
Slovenia	2	1	50%	0.4%
Switzerland	42	1	2%	0.4%
Sweden	22	1	5%	0.4%
Not stated		2		0.7%

*IAEA DIRAC (Directory or Radiotherapy Centres) in https://dirac.iaea.org/ p. https://dirac.iaea.org/ (updated)

°The number of Centres in each country that received the questionnaire is unknown

Table 2. Survey responders' workplaces and experience

Q2. What type of institution/hospital/department do you work in?	**Responders (number)**	**Responders (%)**
University institution/hospital/department	152	53.7%
Satellite institution/hospital/department, university affiliated	26	9.2%
Community institution/hospital/department, not university affiliated	74	26.1%
Private institution/hospital/department, not university affiliated	25	8.8%
Comprehensive cancer center/ Private institution university affiliated	6	2.1%
Q3. How many years have you been practicing as a radiation oncologist?	**Responders (number)**	**Responders (%)**
< 5 years	22	7.8%
5-10 years	58	20.5%
10-20 years	107	37.8%
>20 years	96	33.9%

Table 3. Clinical decision-making, according to survey responders

Q4. In candidates for mastectomy and possible immediate or delayed reconstruction, is the radiation oncologist in your institution consulted on the timing and type of reconstructive surgery?	**Responders (number)**	**Responders (%)**
Yes, in most cases	168	59.4%
Rarely	63	22.3%
No, patients are presented only after surgery	52	18.4%
Q5. In your opinion, who most often influences reconstruction timing (immediate vs delayed)?	**Responders (number)**	**Responders (%)**
The breast/plastic surgeon	219	77.4%
The patient	14	4.9%
The radiation oncologist	24	8.5%
The medical oncologist	2	0.7%
Multidisciplinary discussion	23	8.1%
Availability to treatment	1	0.35%
Q6. As a radiation oncologist, are the target volumes after immediate reconstruction sufficiently defined to apply consistently in daily practice?	**Responders (number)**	**Responders (%)**
Yes	191	67.5%
No	92	32.5%
Q8. Which sequence do you generally recommend for mastectomy candidates? More than 1 answer is possible: select the ones that are most used in your department on a case-by-case basis.	**Responders (number)**	**Responders (%)**
Mastectomy > RT > Delayed reconstruction (autologous)	124	43.8%
Mastectomy > RT > Delayed reconstruction (prosthesis)	80	28.3%
Mastectomy > Immediate expander > RT > Definitive reconstruction (prosthesis)	175	61.8%
Mastectomy > Immediate autologous reconstruction > RT	60	21.2%
Mastectomy > Immediate reconstruction (prosthesis) > RT	57	20.1%

Mastectomy > Immediate expander > Chemotherapy > Definitive reconstruction (prosthesis) > RT	52	18.4%
RT > Mastectomy and reconstruction (autologous)	10	3.5%
RT > Mastectomy and reconstruction (prosthesis)	5	1.8%
Varies significantly between cases (and/or treating physicians)	37	13.1%
Q9. Which sequence does your Institution perform most often for mastectomy candidates? More than 1 answer is possible: select the ones that are most used in your department on a case-by-case basis.	**Responders (number)**	**Responders (%)**
Mastectomy > RT > Delayed reconstruction (autologous)	95	33.6%
Mastectomy > RT > Delayed reconstruction (prosthesis)	65	23%
Mastectomy > Immediate expander > RT > Definitive reconstruction (prosthesis)	179	63.2%
Mastectomy > Immediate autologous reconstruction > RT	49	17.3%
Mastectomy > Immediate reconstruction (prosthesis) > RT	68	24.0%
Mastectomy > Immediate expander > Chemotherapy > Definitive reconstruction (prosthesis) > RT	49	17.3%
RT > Mastectomy and reconstruction (autologous)	9	3.2%
RT > Mastectomy and reconstruction (prosthesis)	1	0.3%
Varies significantly between cases (and/or treating physicians)	29	10.2%
Q10. For chest wall irradiation (mastectomy without immediate reconstruction), which of the following is an indication for boost at your institution?		
All/most patients are planned for scar boost (and other high risk regions)	6	2.12%
Cases with high risk features such as T3-T4, lymphovascular involvement, close/involved margins	50	17.7%
Only high risk regions in T4 tumours	16	5.6%
A boost is indicated only for close and/or involved margins	137	48.4%
Do not boost	74	26.1%
Q11. Following the question before, does an immediate reconstruction change the indication for delivering a boost?		
No. I keep the same indication	122	43.1%
Yes. I boost only the patients at the highest risk, e.g. cases of unexpectedly involved margins and/or very small boost volume	52	18.4
Yes. I do not boost after reconstruction	37	13.1%
No. I never boost	72	25.4%

Q18. Assuming an indication exists for PMRT, which radiation do you use to boost the skin/nipple, after skin sparing or nipple sparing mastectomy?	**Responders (number)**	**Responders (%)**
No boost, unless special indications (like involved margins or skin involvement)	194	68.5%
Boost with electronsQ18.	60	21.2%
Boost with photons	29	10.2%

Abbreviations: RT = radiotherapy; PMRT = post-mastectomy radiotherapy

Table 4. Technical and dosimetric aspects of post-mastectomy radiation therapy and breast reconstruction

Q7. When planning PMRT, how often do you find target volume(s) and breast shape after immediate reconstruction create difficulties in achieving adequate coverage, whilst respecting dose constraints to organs at risk?	**Responders (number)**	**Responders (%)**
Never	22	7.8%
Less than 30% of the cases	170	60.1%
About 30-50% of the cases	73	25.8%
More than 50% of the cases	18	6.4%
Q12.Do you use IMRT after immediate reconstruction?	**Responders (number)**	**Responders (%)**
Yes, as in many of my patients without immediate reconstruction	48	17%
Yes, in nearly all cases, i.e. much more than in patients without reconstruction	15	5.3%
Yes, but only when the reconstructed breast and regional lymph nodes (without the internal mammary nodes) need irradiation	5	1.8%
Yes but only when the reconstructed breast and the regional lymph nodes (with the internal mammary nodes) need irradiation	31	10.9%
Yes, but rarely, only for complex volumes/geometry or when the 3D plan does not meet the dose constraints	119	42.0%
No, IMRT is never used and/or is not available for these indications in my institution	65	23.0%
Q13. When the expander contains metal ports, do you use specific algorithms for the metal material and/or higher photon energies for dosimetry?	**Responders (number)**	**Responders (%)**
Yes	102	36.0%
No	90	32%
Not applicable – surgeons never use expanders containing metal ports as they know they affect dosimetry	91	32.1%
Q14. Does your Institution use TEM after mastectomy without immediate reconstruction?	**Responders (number)**	**Responders (%)**
Yes. Bolus to the entire chest wall	91	31.2%
Yes. Bolus to the scar only	15	5.3%
No, unless skin is involved	158	55.8%
Never, even if skin is involved	19	6.7%

Q15. Does your Institution use TEM after mastectomy with immediate reconstruction?	**Responders (number)**	**Responders (%)**
Yes. Bolus to the entire chest wall	45	15.9%
Yes. Bolus to the scar only	9	3.2%
No, unless skin is involved	182	64.4%
Never, even if skin is involved	47	16.6%
Q16. Which bolus/TEM schedule do you use after mastectomy with or without immediate reconstruction?	**Responders (number)**	**Responders (%)**
Daily for entire treatment	117	41.3%
Alternate days for entire treatment	13	4.6%
Daily for the first half of treatment (e.g. first 12-13 days out of 25)	40	14.1%
Varies from patient to patient, depending on the treatment plan	52	18.4%
Varies from patient to patient, depending on the acute skin reaction	17	6.0%
Other schedules	44	15.5%
Q17. Which bolus/TEM thickness do you use (for 6 MV)?	**Responders (number)**	**Responders (%)**
3 mm	6	2.1%
5 mm	138	48.8%
10 mm	61	21.5%
15 mm	3	1.1%
Varies with cases	49	17.3%
Not applicable	26	9.2%

Abbreviations: PMRT = post-mastectomy radiotherapy; IMRT = intensity modulated radiotherapy; TEM = tissue equivalent material

Abbreviations: PMRT = post-mastectomy radiotherapy; SIB = simultaneous integrated boost

Table 5. Dose fractionation schedules in post-mastectomy radiation therapy and breast reconstruction

Q19. Excluding the boost dose, which schedule does your Institution use for PMRT without reconstruction?	**Responders (number)**	**Responders (%)**
Conventional fractionation (1.8–2.1Gy per fraction, over 25-28 fractions)	183	64.7%
Hypo-fractionation (2.5–3.0Gy per fraction, over 13-16 fractions)	66	23.3%
Accelerated, b.i.d. fractionation (1.5Gy per fraction to a dose of > 45Gy)	0	0.0%
Two of the above fractionations schedules, depending on the case	22	7.8%
All of the above fractionations schemes, depending on the case	4	1.4%
Other schedules	8	2.8%
Q20. Excluding the boost dose, which schedule does your Institution use for PMRT after immediate reconstruction <u>without</u> regional nodal irradiation?	**Responders (number)**	**Responders (%)**
Conventional fractionation (1.8-2.1Gy per fraction, over 25–28 fractions)	191	67.5%
Hypo-fractionation (2.5-3.0Gy per fraction, over 13–16 fractions)	65	23.0%
Accelerated, b.i.d. fractionation (1.5Gy per fraction to a dose of > 45Gy)	0	0.0%
Two of the above fractionations schedules, depending on the case	14	4.9%
All of the above fractionations schemes, depending on the case	4	1.4%
Other : No PMRT for node negative 2.25Gy x 21 fractions 2.3Gy x 20 fractions, 4 fractions/week 2.66Gy x 16 fractions SIB: 2.66Gy x 21 fractions to boost volume and 2.17Gy x 21 fractions to chest wall 2.66Gy x 23 fractions to boost volume and 2.03Gy x 23 fractions to chest wall	9	3.2%
Q21. Excluding the boost dose, which schedule does your Institution use for PMRT after immediate reconstruction <u>with</u> regional nodal irradiation?	**Responders (number)**	**Responders (%)**
Conventional fractionation (1.8-2.1Gy per fraction, over 25-28 fractions)	204	72%
Hypo-fractionation (2.5-3.0Gy per fraction, over 13–16 fractions)	57	20.1%
Accelerated, b.i.d. fractionation (1.5Gy per fraction to a dose of > 45Gy)	0	0.0%
Two of the above fractionations schedules, depending on the case	13	4.6%
All of the above fractionations schemes, depending on the case	2	0.7%
Other schedules (please specify in the field below): 2.25Gy x 21 fractions 2.3Gy x 20 fractions, 4 fractions/week 2.66Gy x 16 fractions	7	2.5%