Clinical Experience with the Contura™ Breast Brachytherapy Catheter to Deliver Accelerated Partial Breast Irradiation: Setting a Higher Standard for APBI

K.M., Tokita[1],

Address Reprints:
K.M., Tokita, M.D.
Department of Radiation Oncology

Key Words: Contura™ MLB, MammoSite®, Balloon brachytherapy, partial breast irradiation, breast cancer,

Purpose: We reviewed our institution's clinical experience managing patients with the Contura™ Multi-Lumen Balloon (MLB) breast brachytherapy catheter to deliver accelerated partial breast irradiation (APBI).

Materials and Methods: ___ patients underwent breast conserving therapy and received adjuvant radiation using the Contura™ catheter (34 Gy in 3.4 Gy fractions). A total of 19 _— patients had stage 0, ___34 had stage I and __12_ had stage II breast cancer. Median follow-up was ___ 17months (range, __1-_38_).

Results: No local, regional or distant recurrences have been observed. The percentage of patients with excellent/good cosmetic results at 24 (n=__), 36 (n=__) and 48 months (n=__) was , ___, _____, respectively. No major toxicities (0% grade III) have been documented. The rate of clinically significant seromas was ___% and clinically visible telengiectasias was __. No symptomatic cases of fat necrosis were reported.

The median skin dose (% of prescribed dose [PD]) was _80.44__ (range, __26 to _120.1_). The median dose to 95% of the planning target volume for evaluation (PTV_EVAL) was __93.54_% (range, 72.5__to__112.1).

Conclusion: APBI using the Contura™ MLB catheter produced similar loco-regional control, cosmesis and toxicity rates to other forms of APBI with similar lengths of follow-up. Improved dosimetric standards for the delivery of APBI were achieved in all patients.

Introduction

Accelerated partial breast irradiation (APBI) is being explored as an option to deliver adjuvant radiation therapy (RT) after lumpectomy in selected patients treated with breast conserving therapy BCT (1). Most of the results with APBI (primarily phase I/II studies and more recently, some phase III data) continue to demonstrate excellent 5 and 10-year rates of cancer control in the breast along with acceptable cosmetic results (2;3). Multi-catheter interstitial brachytherapy (MIB) is the APBI technique that has provided the largest group of cases with the most extensive follow up establishing the adequacy of this concept (4;5)

Newer forms of APBI have been developed in an effort to reduce the complexity of the original brachytherapy procedure and also to improve its reproducibility and 'acceptability' to patients. One such device (the MammoSite® applicator-Hologic Inc, Bedford, Massachusetts) was the technique developed to address these difficult issues (6). The first phase I/II clinical study using the device in 43 patients receiving APBI as their sole treatment (7) demonstrated the device was safe and well tolerated, resulting in its clearance by the FDA in May of 2002. Five-year results are now available in these initial patients and 83% of them have achieved good-to-excellent cosmetic results with no local recurrences observed to date (median follow-up -66 months (8). Since then, arger studies have confirmed the advantages and efficacy of the device and technique.

Unfortunately, a major limitation of the original MammoSite® to deliver APBI relates to its simple, single lumen design as well as the fixed relationship between the geometry of the balloon placement and the ultimate dose delivered. The Contura™ MLB (SenoRx, Inc., Aliso Viejo, California) was constructed to provide additional, practical

options to allow more idealized dosimetric goals. The Contura has 4 additional lumens (each off-set 5 mm from the single central lumen) designed such that dose shaping is now possible. Published dosimetric data have already demonstrated the device's ability to significantly reduce both skin and rib doses as well as improving upon other treatment restrictions (i.e., sub-optimal conformance). Preliminary experiences employing the new device have revealed its excellent early tolerance and a spectrum of toxicities that are as good or better than those observed with the original single-lumen MammoSite device. This study examines 4-year clinical efficacy (i.e., loco-regional control, cosmeis and toxicity) using the Contura applicator at our institution to deliver APBI.

Materials & Methods

This retrospective analysis has been given an exempt determination granted under 45 CFR 46 101(b) (4) by the Western Institutional Review Board. All cases were treated from through ___Follow-up was complete through _____ 2011..

Patient Selection & Eligibility Criteria

Results on several of the patients reported in this analysis have been previously reported.(ref) Most pitients were selected for treatment with APBI at the discretion of the treating physicians and preference (once determined to be eligible) of the patient. Guidelines for the treatment of patients with APBI off-protocol by either the American Society of Breast Surgeons (ASBS) and/or the American Brachytherapy Society were followed at the time of patient consultation (10). No patients were enrolled on any specific IRB approved protocol. for the use of APBI.

Treatment Planning Procedure

All patients referred for APBI underwent a CT scan (with the Contura™ MLB in place) in order to assess appropriateness for treatment and for treatment planning purposes. Adequate tissue to balloon conformance was confirmed under ultrasound guidance.. Any additional fluid was added to the balloon if necessary at hat time. The final determination as to adequate balloon-to-tissue conformance was made by CT scan examination prior to any treatment planning., The rotational orientation of the Contura™ catheter was documented at the time of the planning CT so that prior to each fraction, the proper orientation could be accurately reproduced.

Target Volume Definitions

The NSABP B39-RTOG 0413 protocol guidelines were followed for treatment planning purposes: The planning target volume for evaluation (PTV_EVAL) = clinical target volume (CTV) = planning target volume (PTV). Per the protocol, the PTV_EVAL was delineated as the breast tissue volume bounded by the uniform expansion of the balloon radius in all dimensions by 10 mm less the balloon volume and was limited to 5 mm from the skin surface and by the posterior breast tissue extent (the chest wall and pectoralis muscles were not to be included).

Contura™ MLB Placement Technique and Final Treatment Planning

Typically, the Contura™ MLB was positioned with the closed cavity placement technique in all (?) patients. The radioactive source location, precise number of lumens, exact number of positions and the dwell times were at the discretion of the treating physician and were established by high dose rate (HDR) CT based 3D treatment planning (_____?) to produce the most optimal conformal plan in accordance with all volume definitions and dose requirements. The final treatment plan chosen for each patient was based upon an analysis of the volumetric dose including dose-volume histogram (DVH) analyses of the PTV_EVAL and all other important critical normal tissues

Final Determination of Appropriateness for Treatment

The appropriateness for treatment was based on the ability to achieve the pre-defined idealized dosimetric goals. Once these goals were achieved, a patient's treatment was typically initiated within 1 to 5 day window from the acquisition of the planning CT scan. The Contura balloon remained inflated throughout the entire treatment course. Patient positioning, balloon inflation and proper balloon rotation/orientation was

confirmed (validated) prior to each and every treatment delivery. A total dose of 34 Gy was prescribed to the PTV_EVAL such that the dosimetric requirements of optimal target coverage, dose homogeneity and reduced skin dose were met. Two fractions were delivered per day, each of 3.4 Gy, separated by at least six hours, and were given in five consecutive working days

Validating Quality Assurance of the Dose Distribution

As a rule, dose volume histogram analyses of target coverage were always performed in each case to confirm that a minimum of ≥ 90% of the PD covered ≥ 90% of the PTV_EVAL (per the NSABP B-39/RTOG 0413 criteria). Also, the maximum skin dose was reduced to as low as achievable while satisfying all dose parameters and not exceeding 145% of the PD. The maximum rib dose was reduced to as low as achievable while satisfying all dose parameters to not exceed 200% of the PD (if possible). Finally (and just as critical) the volume of breast tissue receiving 150% (V150) of the PD was reduced to as low as achievable while satisfying all dose parameters, but could not to exceed 50 cc. Similarly, the volume of breast tissue receiving 200% (V200) of the PD was reduced to as low as achievable while satisfying all dose parameters, but could not to exceed 10 cc. Typically, the majproty dosimetric plans easily met and improved upon these minimal guidelines set by the phase III trial. As a result, more optimal radiation dose-volume goals and standards were attempted and achieved in almost all cases.

Follow-up Evaluations & Procedures

All patients were closely followed (physical examination, clinical outcome, cosmetic and toxicity assessment) at 3-6 month intervals by their radiation oncologist

and/or surgeon. Baseline mammography was typically performed 6-12 months after the completion of brachytherapy. All follow-up was complete through May 1, 2011.

Cosmetic Evaluation

The cosmetic outcome was evaluated in each patient using the published Harvard Criteria. Briefly, an excellent cosmetic result score was assigned when the treated breast looked essentially the same as the contralateral breast (as it relates primarily to the radiation effects). A good cosmetic score was assigned for minimal but identifiable radiation effects on the treated breast. A fair score meant that the radiation effects were readily observable and significant. Finally, a poor score was used for severe sequelae of breast tissue secondary to radiation effects.

Results

Table I provides a comprehensive analysis of all pertinent patient, tumor and treatment related characteristics of the study population. The median follow-up time in surviving patients was ___ months (range, __-__) with a mean of ___months. No patients were lost to follow-up. As described in previous publications (Table II), the median skin dose (% of prescribed dose [PD]) was ___80.44_ (range, __26_to__120.1_) and the median dose to 95% of the planning target volume for evaluation (PTV_EVAL) was a __93.54_% (range, _72.5_to112.1__).

Local Tumor Control, Cosmetic Results and Toxicity Evaluations

Table III presents a complete listing of all clinical outcomes, cosmetic results/evaluations and treatment related toxicities for all ___65 patients. The percentage of patients with excellent/good cosmetic results at 24 (n=__), 36 (n=__) and 48 months (n=__), was ___, ___ and _____%, respectively. No major grade IIII toxicities were identified (e.g,., no large areas of telegiectasias, no significant skin retraction impacting cosmesis, no non-healing wound infections requiring surgical corrections and no symptomatic seromas requiring surgical resection).. The overall seroma rate was ___% and only ___% of patients exhibited clinically visible telengiectasia.

Finally, no local or regional recurrences have been observed to date. Only _0_ patients have died of their disease.

Discussion

In the current study, we comprehensively reviewed our single institution's 4 year clinical experience managing patients with the Contura™ Multi-Lumen Balloon (MLB) breast brachytherapy catheter to deliver APBI. With a median follow-up of __17_ months, the percentage of patients with an excellent/good cosmetic result was ____. We have observed no local or regional recurrences to date and no major toxicities (0% grade III) developed. Just as crucial, the rate of clinically evident seromas was a mere ___% and only __% of patients were found to develop any telengiectasias. These important findings clearly demonstrate that adjuvant APBI using the Contura™ MLB catheter exhibits similar loco-regional control, cosmetic results and toxicities to other forms of APBI (with similar lengths of follow-up) but with significantly improved dosimetric capabilities.

Improved Dosimetric Capabilities-Setting Higher Standards

It has now been established that important and significant improvements in dosimetric endpoints with the Contura™ MLB catheter compared to single lumen balloon brachytherapy can routinely be achieved (9;11). In all published clinical scenarios that have been investigated (i.e., small breasts, large breasts with eccentrically placed cavities, close skin spacing, close rib spacing or various combinations of any of the above findings), use of multiple lumens and dwell positions can result in profoundly reduced skin doses beyond what are already considered acceptable as per NSABP B39/RTOG 0413 criteria (i.e, < 145% of the PD). As pointed out previously, many of the patients in these studies (approximately 20%) would not have been considered acceptable candidates for APBI (<5 mm skin spacing) without the ability to tailor the dose away from the skin

through the use of the Contura's multiple lumens or without the use of the vacuum lumen. This dose contouring (to maintain an acceptable skin dose) just as importantly did not significantly increase the V150 or V200 or the dose to the ribs (Table III). This is an extremely important point. In order to provide an acceptable long-term outcome related to potential radiation toxicities, all dosinetric endpoints must be met concurrently.

It should also be pointed out that the optimal use of this device has previously demonstrated an ability to set higher dosimetric goals not only for balloon based APBI but for APBI in general. For example, in the NSABP B-39/RTOG 0413 phase III trial, dosimetric guidelines dictate that that 90% of the PTV_EVAL is covered by 90% of the PD. Use of the Contura™ in all cases in this study showed that _92.84__% of the PTV_EVAL could be covered at minimum by 95% of the PD without excessively increasing unwanted hot spots (V150 or V200), skin dose, or rib dose. These are critically important improvements and attest to the value of this technique of APBI in delivering an optimal dose (efficacious) with minimal concerns for long-term toxicities. It must also be remembered that these significantly improved dosimetric endpoints were achieved in many difficult cases such as in patients with minimal skin and rib spacing and/or smaller breasts. Despite over 7 years of excellent clinical results (even with a single-lumen device), it is important for balloon based APBI to continue to improve its therapeutic ratio as demonstrated in this small series.

Improving Cosmetic Results and Toxicities

Previous studies have demonstrated that long-term cosmetic results using balloon based brachytherapy are clearly and directly related to the skin dose. The findings from this series support this conclusion since 100% of patients obtained good-to-excellent

cosmetic results at 4 years and since no significant areas of skin telegiectasia or induration were observed. In addition, these results also demonstrate the lack of development of significant fibrosis and/or retraction. It was theorized that these toxicities could be reduced through the use of multiple lumens because of the ability to concurrently reduce skin and rib doses while not increasing unwanted hot spots. These clinical findings corroborate those previous hypotheses as no grade III toxicities were observed.

Finally, it is also important to note that the rate of clinically significant palpable seromas was only ___%. The rate of seroma formation has been a concern to some investigators in the past but with improved balloon placement techniques and dosimetric capabilities, seroma formation with balloon based brachytherapy Not clinically evident These rates of seroma formation are as low as those seen with surgery alone or surgery followed by standard whole breast irradiation.

Phase III Data and Toxicity Reporting

The limited toxicities demonstrated in this small retrospective analysis have now been confirmed in published toxicity results from the NSABP B39/RTOG 0413 phase III trial. In a recent publication from the phase III trial, 3550 patients enrolled (82..6% of the targeted accrual) were evaluated (12). Toxicity data were made available for 1300 patients randomized to APBI who had received three-dimensional conformal radiation therapy (3D-CRT), with 338 of the latter group in their 3rd year of follow-up in the trial. With a mean time on study of 32.0 months, the authors reported no significant toxicity-related issues in these patients. In fact, the rates of Grade 2 or greater fibrosis-cosmesis and fibrosis-deep connective tissue were <10% for ***all of the methods of radiation***

therapy used in the trial (including balloon based brachytherapy APBI) and the rate of Grade 3 or 4 toxicity was <2%. Although not specifically discussed in the short publication from the ongoing trial (the toxicity data were released early because of concerns for excessive toxicity with 3D-CRT APBI reported in two small, unrelated studies), these findings can be extrapolated to other potential toxicities (i.e., seroma formation with balloon based brachytherapy) which are included in the comprehensive list of potential toxicities closely monitored in the trial.

These important findings emphasize that only large phase III randomized, prospective trials with rigorous QA can circumvent any potential biases that may be introduced from small, single-institution experiences or from subjective and unfounded claims of other APBI techniques without comparable QA evaluations. The continuation of accrual to this phase III trial is critically important so that APBI efficacy, long-term toxicity, and QOL outcomes can be accurately assessed for all three acceptable forms of APBI (3D-CRT, balloon based brachytherapy and MIB) directly evaluated in the trial. It is also critically important to emphasize that toxicity concerns with other newer forms of APBI (devices and/or techniques) cannot and should not be extrapolated from the data from the NSABP B39/RTOG 0413 phase III trial at this time.

Lastly, it is very important to note that the excellent cosmetic results and reduced toxicities reported here were not obtained at the expense of under-dosing the target tissue (e.g., PTV_EVAL). In all cases, coverage of the target volume at risk for possible subclinical disease was as good (or better) than with single-lumen breast brachytherapy. As a result, the excellent 5-year local control rates demonstrated in the ASBS MammoSite Registry trial can be anticipated in these patients (13). These 4-year findings

also support this hypothesis. Of course, further follow-up of these patients will be necessary to establish the long-term stability of these improved outcomes as well as the results of multiple phase III trials that are currently addressing these issues (see Table V).

Conclusions

In this single-institution analysis, adjuvant APBI using the Contura™ MLB catheter provided similar or reduced toxicities, excellent local control and superb cosmesis compared to other forms of APBI with similar follow-up. Compared to standard single-lumen balloon based brachytherapy, potential improvements in dosimetric capabilities (i.e., reduced skin dose, improved PTV_EVAL coverage and normal tissue avoidance) were also realized. These findings demonstrate,that higher standards for radiation coverage of target tissue with APBI can now be routinely achieved and previously encountered toxicities can more easily be reduced and in many cases, completely eliminated.

Reference List

1. Arthur DW, Morris MM, Vicini FA. Breast cancer: new radiation treatment options. *Oncology (Williston.Park)* 2004;18:1621-9.

2. Vicini FA, Antonucci JV, Wallace M, Gilbert S, Goldstein NS, Kestin L et al. Long-term efficacy and patterns of failure after accelerated partial breast irradiation: a molecular assay-based clonality evaluation. *Int.J.Radiat.Oncol.Biol.Phys.* 2007;68:341-6.

3. Arthur DW, Vicini FA. Accelerated partial breast irradiation as a part of breast conservation therapy. *J Clin.Oncol* 2005;23:1726-35.

4. Arthur DW, Winter K, Kuske RR, Bolton J, Rabinovitch R, White J et al. A Phase II Trial of Brachytherapy Alone After Lumpectomy for Select Breast Cancer: Tumor Control And Survival Outcomes of Rtog 95-17. *Int J Radiat Oncol Biol Phys* 2008.

5. Polgar C, Fodor J, Major T, Nemeth G, Lovey K, Orosz Z et al. Breast-Conserving Treatment with Partial or Whole Breast Irradiation for Low-Risk Invasive Breast Carcinoma-5-Year Results of a Randomized Trial. *Int.J.Radiat.Oncol.Biol.Phys.* 2007.

6. Keisch M, Vicini F. Applying innovations in surgical and radiation oncology to breast conservation therapy. *Breast J* 2005;11 Suppl 1:S24-S29.

7. Keisch M, Vicini F, Kuske RR, Hebert M, White J, Quiet C et al. Initial clinical experience with the MammoSite breast brachytherapy applicator in women with early-stage breast cancer treated with breast-conserving therapy. *Int.J Radiat.Oncol.Biol.Phys.* 2003;55:289-93.

8. Benitez PR, Keisch ME, Vicini F, Stolier A, Scroggins T, Walker A et al. Five-year results: the initial clinical trial of MammoSite balloon brachytherapy for partial breast irradiation in early-stage breast cancer. *Am.J.Surg.* 2007;194:456-62.

9. Brown S, McLaughlin M, Pope K, Haile K, Hughes L, Israel PZ. Initial radiation experience evaluating early tolerance and toxicities in patients undergoing accelerated partial breast irradiation using the Contura Multi-Lumen Balloon breast brachytherapy catheter. *Brachytherapy.* 2009;8:227-33.

10. Arthur D, Vicini F, Kuske RR, Wazer D, Nag S. Accelerated partial breast irradiation: An updated report from the American Brachytherapy Society. *Brachytherapy* 2002;1:184-90.

11. Arthur DW, Vicini FA, Todor DA, Julian TB, Lyden MR. Improvements in Critical Dosimetric Endpoints Using the Contura Multilumen Balloon Breast Brachytherapy Catheter to Deliver Accelerated Partial Breast Irradiation: Preliminary Dosimetric Findings of a Phase IV Trial. *Int.J.Radiat.Oncol.Biol.Phys.* 2010.

12. Wolmark N, Curran WJ, Vicini F, White J, Costantino JP, Arthur D et al. Response to "unacceptable cosmesis in a protocol investigating intensity-modulated radiotherapy with active breathing control for accelerated partial-breast irradiation" (Int J Radiat Oncol Biol Phys 2010;76:71-78) and "toxicity of three-dimensional conformal radiotherapy for accelerated partial breast irradiation" Int J Radiat Oncol Biol Phys 2009;75:1290-1296). *Int.J.Radiat.Oncol.Biol.Phys.* 2010;77:317.

13. Vicini F, Beitsch P, Quiet C, Gittleman M, Zannis V, Fine R et al. Five-Year Analysis of Treatment Efficacy and Cosmesis by the American Society of Breast Surgeons Mammosite Breast Brachytherapy Registry Trial in Patients Treated with Accelerated Partial Breast Irradiation. *Int.J.Radiat.Oncol.Biol.Phys.* 2010.

14. Brown S, McLaughlin M, Pope DK, Haile K, Hughes L, Israel PZ et al. A dosimetric comparison of the Contura multilumen balloon breast brachytherapy catheter vs. the single-lumen MammoSite balloon device in patients treated with accelerated partial breast irradiation at a single institution. *Brachytherapy.* 2010.

15. Tokita KM, Cuttino LW, Vicini FA, Arthur DW, Todor DA, Julian TB et al. Optimal application of the Contura multilumen balloon breast brachytherapy catheter vacuum port to deliver accelerated partial breast irradiation. *Brachytherapy.* 2010.

16. Cuttino LW, Todor D, Rosu M, Arthur DW. A Comparison of Skin and Chest Wall Dose Delivered with Multicatheter, Contura Multilumen Balloon, and MammoSite Breast Brachytherapy. *Int.J.Radiat.Oncol.Biol.Phys.* 2010.

17. Israel PZ, Robbins AB, Shroff P, Haile K, Pope DK. Initial surgical experience evaluating early tolerance and toxicities in patients undergoing accelerated partial breast irradiation using the Contura Multi Lumen Balloon breast brachytherapy catheter. *Am.Surg.* 2009;75:1042-9.

18. Wilder RB, Curcio LD, Khanijou RK, Eisner ME, Kakkis JL, Chittenden L et al. Preliminary results with accelerated partial breast irradiation in high-risk breast cancer patients. *Brachytherapy.* 2010;9:171-7.

19. Wilder RB, Curcio LD, Khanijou RK, Eisner ME, Kakkis JL, Chittenden L et al. A Contura catheter offers dosimetric advantages over a MammoSite catheter that increase the applicability of accelerated partial breast irradiation. *Brachytherapy.* 2009;8:373-8.

20. Vaidya JS, Joseph DJ, Tobias JS, Bulsara M, Wenz F, Saunders C et al. Targeted intraoperative radiotherapy versus whole breast radiotherapy for breast cancer (TARGIT-A trial): an international, prospective, randomised, non-inferiority phase 3 trial. *Lancet* 2010;376:91-102.

Table I. Patient, Tumor and Treatment Related Characteristics

Characteristic	#	%
Total # Patients	65	
Median Follow-up (months)	17	
Range (-)	1-38	
Median Age	65	
Range	46-92	
Tumor Size (mm)		
Median	15.6	
Range	2-45	
< 10	16	
≥ 10 < 20	34	
≥ 20	15	
T-stage		
DCIS	19	
T1	36	
T2	10	
ER (+)	51	
PR (+)	43	
Invasive Cancer n=32		
Node (-)	64	
Node (+)	1	
Chemotherapy (yes)	10	
Tamoxifen (yes)	6	
Arimidex (yes)	16	
Femara (yes)	2	
Final Margin (-)		

Table II. Radiation Characteristics of Patients Treated

Characteristic	*Findings*
Skin spacing	
>7 mm	52
>5 ≤7 mm	9
≥2 ≤5 mm	2
Median dose to 95% of (PTV_EVAL)	93.54
Median Skin Dose	2.73 Gy
Median Rib Dose	3.30 Gy
Median V150	25.93 cc
Median V200	9.25 cc

PTV_EVAL: Planning Target Volume for Evaluation

Table III. Clinical Outcomes

Outcome	*Number*	*Percent*
Ipsilateral Breast Tumor Recurrence		
Regional Recurrence		
Distant Failure		
Cosmesis (%Good/Excellent)		
Palpable Seroma		
Clinically Visible Telengiectasia		
Fat Necrosis		
Any Grade III Toxicity		

III. Published Studies Addressing the Use of the Contura MLB.

Series	# *Patients*	*Follow-up*	*Local Control*	*Cosmesis (Good/Excellent)*	*Findings*
Current Study	**41**	**36 months**	**100%**	**98%**	**Longest published follow-up with the Contura MLB**
Brown et al (14)	**33**	**NS**	**NS**	**NS**	**Improved dosimetry versus single lumen MS**
Tokita et al (15)	**32**	**NS**	**NS**	**NS**	**Use of Contura vacuum port improved dosimetry**
Cuttino et al (16)	**45**	**NS**	**NS**	**NS**	**Reduced skin dose with theContura**
Arthur et al (11)	**144**	**NS**	**NS**	**NS**	**Improved Dosimetry ↓SD ↓RD ↑PTV Coverage**
Israel et al (17)	**46**	**12 months**	**100%**	**100%**	**Initial surgical experience with Contura**
Wilder et al (18)		**22 months**		**NS**	**High-risk patients Analyzed**
Wilder et al (19)	**45**	**16**	**NS**	**NS**	**Improved dosimetry versus single lumen MS**
Brown et al (9)	**41**	**12 months**	**100%**	**100%**	**Initial radiation experience with Contura**

MS=MammoSite, NS=Not stated, SD=Skin dose, RD=Rib dose, PTV=Planning target volume

Table IV- Randomized Trials Addressing the use of APBI

Trial	*# of Patients*	*APBI Technique*	*Follow-up (years)*	*Local Recurrence Rates*	
				APBI	*WBI*
NSABP B-39/RTOG 0413 (12)	4300*	Interstitial, 3-D CRT, or MammoSite	NA	NA	NA
Polgar et al(5)	258	Interstitial Implants	5.5	4.7%	3.4%
TARGIT-A (20)	2232	IORT Single fraction 5Gy	4 (n=862), 3 (n=1514)	1.2%	0.95%
European Institute of Oncology ELIOT Trial	1306	IORT Single Fraction 21Gy	NA	NA	NA
Ontario Clinical Oncology Group RAPID Trial	2128*	3-D CRT 3.5Gy X 10	NA	NA	NA
MRC IMPORT Low Trial	1935*	Quadrant RT	NA	NA	NA
University of Florence	520*	IMRT	NA	NA	NA
GEC-ESTRO	1202*	HDR/PDR Brachytherapy	NA	NA	NA

*Targeted Accrual, Currently Enrolling, NA=Not available
Abbreviations: APBI= accelerated partial breast irradiation, WBI= whole-breast irradiation, TARGIT= Targeted Intra-Operative Radiation Therapy, ELIOT= electron intraoperative therapy, RTOG= Radiation Therapy Oncology Group, NSABP= National Surgical Adjuvant Breast and Bowel Project, RAPID= Randomized Trial of Accelerated Partial Breast Irradiation, MRC= Medical Research Council, IMPORT= Intensity Modulated and Partial Organ Radiotherapy, GEC= Groupe Européen de Curiethérapie, ESTRO= European Society for Therapeutic Radiology and Oncology