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RESEARCH ARTICLE

Practice pattern survey Of breaSt cancer radIoTherapy among Indian Radiation ONcologists (POSITRON)- A Pilot Survey

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Abstract

Introduction: Breast cancer radiotherapy has evolved from conventional fractionation to hypofractionated and ultra-hypofractionated schedules, accelerated further during the COVID-19 pandemic. However, implementing such techniques in India may be limited by financial and technological constraints. Real-world adoption patterns in India remain inadequately documented. This study aimed to evaluate current practice patterns of breast cancer radiotherapy among Indian radiation oncologists, with particular focus on dose fractionation, techniques, and factors influencing clinical decision-making. **Materials and Methods:** A 50-question cross-sectional e-survey was developed using Google Forms and distributed to radiation oncologists via email and academic discussion groups. The questionnaire contained 22 open-ended and 28 multiple-choice questions. Descriptive statistics were used to summarize responses, and exploratory comparisons were performed using Fisher's exact test where appropriate. **Results:** Forty-five eligible responses were analysed out of fifty received responses. Hypofractionation (40 Gy/15#) was the preferred regimen for post-mastectomy RT (69%), whole breast RT (69%), WBRT-DCIS (64%), and regional nodal irradiation (69%). Ultra-hypofractionation (26 Gy/5#) was used by 38%. 3DCRT was the most preferred technique for PMRT and WBRT. DIBH was routinely used by 58% in left-sided breast cancer. Respondents with access to a motion management facility reported adopting lower target mean heart dose thresholds for left-sided cases. Perceived toxicity and cosmetic outcomes were more favourable with hypo-fractionated regimens. **Conclusion:** This pilot survey provides a preliminary snapshot of contemporary breast radiotherapy practices among a limited cohort of Indian radiation oncologists. Moderate hypofractionation is widely adopted, while ultra-hypofractionation remains selectively used. Larger, nationally representative surveys are required to define definitive practice patterns.

Keywords: Breast cancer- Practice survey- Radiotherapy- Hypofractionation- Radiation oncologist

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Introduction

Breast cancer is the most common cancer in India, accounting for about 28.2% of all female cancers [1]. The survival rate in India remains suboptimal due to factors such as younger age at presentation, advanced stage at diagnosis, and delayed initiation of definitive treatment [2]. The 5-year observed survival rates were 81%, 65.5%, and 18.3% for localised, regional, and advanced disease, respectively, according to data from 11 population-based cancer registries in India from 2012 to 2015 [3]. Adjuvant radiotherapy (RT) plays a crucial role in breast cancer management in both post-mastectomy and post-breast-conservative surgery (BCS) settings, contributing to significant reductions in local recurrence and breast cancer–specific mortality [4, 5].

Breast cancer radiotherapy has undergone substantial evolution in both treatment techniques and dose

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fractionation schedules [6]. Advances in radiotherapy delivery have focused on improving local control, reducing treatment-related toxicity, enhancing cosmetic outcomes, and improving patient compliance. The low alpha/beta ratio of breast tissue has driven interest in hypofractionated radiotherapy, which has demonstrated equivalent or improved oncologic and cosmetic outcomes, along with improved patient convenience due to shorter overall treatment duration [7-10]. The recent trend of employing ultra-hypofractionation significantly reduces hospital visits while reporting similar local control and toxicity [11, 12]. The COVID-19 pandemic also accelerated the integration of ultra-hypofractionated schedules into clinical practice, primarily to minimize patient-healthcare worker contact and optimize resource utilization [13].

However, employing newer techniques will require training, physicians' experience, and the availability of technology at the treating hospital. Several breast cancer practice pattern surveys have been conducted in the past, specifically addressing the COVID-19 pandemic [14]; however, post-pandemic practice pattern data from the Indian subcontinent remain limited. The publication of the UK FAST Forward and the recent COVID-19 pandemic facilitated the rapid adoption of ultra-hypofractionated radiotherapy [11, 12]. The uptake of newer techniques varies widely across geographical regions and healthcare systems, and financial reimbursement structures may further influence the choice of dose fractionation [15]. Practice pattern surveys offer valuable insights into the adoption of radiotherapy techniques and the factors influencing these trends, particularly the rapid adaptation during the COVID-19 pandemic. An international practice pattern survey by Oladeru et al. 2023 reported the early adoption of hypofractionation by advanced centres in high-income countries, while low and middle-income countries struggled to implement it due to limited access to technology and training [14]. Mehrotra et al. provide an assessment of the present situation and roadblocks in the diagnosis and treatment of breast cancer in India, like limited funding, resources, and delayed diagnosis [16]. Understanding the perspective of radiation oncologists is therefore essential to contextualize the adoption of contemporary radiotherapy approaches. Accordingly, the primary objective of this study is to provide a snapshot of current practice patterns related to dose fractionation in breast cancer radiotherapy in India and explore factors associated with variation in practice. This study aimed to evaluate current practice patterns of breast cancer radiotherapy among Indian radiation oncologists, with particular focus on dose fractionation, techniques, and factors influencing clinical decision-making.

Materials and Methods

This was a cross-sectional electronic questionnaire-based survey conducted among radiation oncologists practicing in the Indian subcontinent. The study was conducted between March and August 2025. The first three months were dedicated to survey dissemination and data collection, followed by data analysis and manuscript preparation in the next three months. A structured questionnaire was developed using Google Forms (Google, Mountain View, California), and the link was circulated among radiation oncologists via email and academic discussion groups. These platforms were estimated to collectively include about 1200 radiation oncologists. As participation was voluntary and the survey was disseminated across multiple platforms, an exact denominator could not be determined, and a formal response rate could not be calculated. The survey was open-access, voluntary, and without incentives. Google Forms settings were utilized to prevent duplicate responses from the same user account.

The questionnaire comprised 50 items, including 22 open-ended questions and 28 multiple-choice questions (MCQs). The questionnaire has six sections: a) general section (12 questions), b) dose fractionation schedule (16 questions), c) treatment technique (7 questions), d) locoregional lymph node irradiation (6 questions), e) organs at risk (OAR) delineation (3 questions), and f) Toxicity and Miscellaneous (6 questions). Electronic informed consent for participation and publication of anonymized responses was incorporated into the survey interface.

Individual radiation oncologists' responses were analysed individually, and any response with more than 10% unanswered open-ended questions was excluded. Five responses were excluded based on this criterion.

Statistical Analysis

The survey responses were extracted in a spreadsheet. Descriptive statistics were used to summarize individual responses. Given the small sample size and sparse data across comparison groups, exploratory comparisons were performed using Fisher's exact test. Percentages are rounded off to the nearest whole number due to limited sample size.

The survey conduct and reporting were aligned with the CHERRIES guidelines for internet based surveys.

Results

Of the 50 responses received, 45 were eligible for analysis after excluding five responses with incomplete data (>10% unanswered open-ended questions). The median age of the respondents was 36 years (28-60 years). The median overall clinical experience was 8 years (minimum 1 year, maximum 32 years). Median experience in treating breast cancer patients was 7 years (minimum 1 year, maximum 32 years).

Responses were received from 13 states across India. Most respondents practised in metropolitan cities (58%), followed by non-metropolitan cities (33%). The most common practice setting was medical colleges (42%). The majority of respondents (96%, 43/45) reported working in centres providing comprehensive cancer care. Most respondents (82%, 37/45) treated all patients requiring radiotherapy, while 18% (8/45) limited their practice to breast and selected subsites.

Table 1. Preferred Dose Fractionation Regimen for Breast Cancer

	40Gy/15#	50Gy/25#	42.5Gy/16#	26Gy/5#	34Gy/10#	38.5Gy/10#	Others
PMRT (n=45)	31 (69%)	7 (16%)	5 (11%)	2 (4%)	-	-	-
WBRT (n=45)	31 (69%)	-	9 (20 %)	3 (7 %)	-	-	2 (4%)
WBRT- DCIS (n=45)	29 (64%)	13 (29%)	2 (5%)	1 (2%)	-	-	-
RNI (n=45)	31 (69%)	10 (22%)	4 (9%)	-	-	-	-
APBI (n=11)	-	-	-	2 (18%)	6 (55%)	3 (27%)	-

Gy- Gray, PMRT- Post Mastectomy Radiotherapy, WBRT- Whole Breast Radiotherapy, WBRT-DCIS- Whole Breast Radiotherapy after breast conservative surgery in Ductal Carcinoma in Situ, RNI- Regional Nodal Irradiation, APBI- Accelerated Partial Breast Irradiation

Table 2. Preferred Techniques for Breast Cancer Radiotherapy

	Technique	Most preferred (%)	Employed depending on the case (%)	Least preferred (%)	Do not use this regimen (%)
PMRT(n=45)	3DCRT	28 (62)	13 (29)	3 (7)	1 (2)
	IMRT	13 (29)	27 (60)	3 (7)	2 (4)
	VMAT	4 (9)	21 (47)	10 (22)	10 (22)
WBRT(n=45)	3DCRT	25 (56)	13 (29)	5 (11)	2 (4)
	IMRT	16 (36)	25 (56)	2 (4)	2 (4)
	VMAT	7 (16)	19 (42)	10 (22)	9 (20)

PMRT- Post-Mastectomy Radiotherapy, WBRT- Whole Breast Radiotherapy, 3DCRT- Three-dimensional Conformal Radiotherapy, IMRT- Intensity Modulated Radiotherapy, VMAT- Volumetric Modulated Arc Therapy

91% (41/45) of respondents had access to Linear accelerators (LINACS) at their facility, and others had a telecobalt unit. Motion management facilities were available at 49% (22/45) of centres, while 49% (22/45) had access to a high-dose-rate brachytherapy system.

Approximately 51% (23/45) of respondents reported treating up to five breast cancer patients per week, while 27% (12/45) treated more than ten patients per week.

Opinion On Dose Fractionation Schedule

The most preferred regimen for post-mastectomy radiotherapy (PMRT), whole breast radiotherapy (WBRT), WBRT post breast conservative surgery for Ductal carcinoma in situ (WBRT-DCIS), and Regional nodal irradiation (RNI; irradiation of axilla, supraclavicular and internal mammary nodes) was 40 Gy in 15 fractions over 3 weeks (69%, 69%, 64% and 69% for PMRT, WBRT, WBRT-DCIS, and RNI, respectively) (Table 1).

The conventional fractionation regimen (50 Gy in 25 fractions) was the second most commonly preferred regimen in PMRT, WBRT-DCIS, and RNI, while no respondents reported routine use of conventional fractionation for WBRT. Conventional fractionation was not used by 64% (29/45) of the respondents in their routine clinical practice. Among those who did (n = 16), PMRT was the most common indication (81%, 13/16).

The most common schedule for tumour bed boost after WBRT was 12 Gy in 4 fractions (29%), followed by 10 Gy in 5 fractions (15%). Tumor bed boost was selectively omitted by 53% of the respondents.

Ultra-hypofractionation was used by 38% (17/45) of respondents, most commonly employing a schedule of 26 Gy in 5 fractions. The median duration of experience with ultra-hypofractionation among these respondents was 3 years. Only 24% (11) of respondents used APBI (Accelerated Partial Breast Irradiation) in their daily practice. Among them, 88% (9/11) reported treating less than 10% of patients with APBI. The most common dose fractionation schedule followed for APBI was 34 Gy in 10 fractions (54%, 6/11).

Opinion on Radiotherapy Technique

The preferred technique for PMRT and WBRT was 3-dimensional conformal radiotherapy (3DCRT) (Table 2). For APBI, variable responses were received regarding external beam radiotherapy (EBRT) techniques; however, for balloon catheter brachytherapy, 45% of (5/11) APBI users reported not using the technique, while 27% (3/11) considered it the least preferred technique. For APBI using interstitial brachytherapy, 18% (2/11) of participants did not use the technique, and 18% (2/11) considered it the least preferred.

For right-sided breast cancer, 80% of respondents did not routinely use respiratory gating or deep inspiration breath hold (DIBH). In contrast, for left-sided breast cancer, 58% routinely used DIBH, 20% used it selectively, and 22% did not use it (Table 3).

Opinion On Loco Regional Nodal Radiotherapy

For axillary radiotherapy, 36% of respondents reported treating 10–50% of patients, while 24% treated fewer than 10% of patients. For internal mammary nodal (IMN) irradiation, 49% treated fewer than 10% of patients, and 42% treated 10–50% of patients. For supraclavicular nodal RT, 100 % of respondents agreed on node-positive criteria (any node positive / 4 or more nodes positive), and 73% (33/45) considered inadequate axillary dissection as an indication. For indication of IMN irradiation, the frequency of response in descending order was undissected axilla (80%), inadequate axillary dissection (78%), extra nodal

Table 3. Opinion on Cardiac Sparing in Breast Cancer Radiotherapy

		Less than or equal to 2 Gy	Greater than 2 Gy and less than or equal to 5 Gy	Greater than 5 Gy and less than or equal to 10 Gy	Greater than 10 Gy	Routinely use Gating/ DIBH	Use gating/ DIBH based on the case	Do not use gating/DIBH
Right-sided breast cancer	Use of gating/ DIBH	-	-	-	-	1 (2%)	8 (18%)	36 (80%)
	Target heart mean dose	17 (38%)	18 (40%)	6 (13%)	4 (9%)	-	-	-
Left-sided breast cancer	Use of gating/ DIBH	-	-	-	-	26 (58%)	9 (20%)	10 (22%)
	Target heart mean dose	3 (7%)	21 (46%)	18 (40%)	3 (7%)			

Gy- Gray, DIBH- Deep Inspiration Breath Hold

Table 4. Opinion on Toxicity and Cosmetic Profile of Breast Cancer Radiotherapy

	Response of participants→	Highest	Moderate	Lowest	Not seen at all	Do not practice this schedule
Grade 3 or more toxicity	Conventional fractionation	9 (20%)	11 (25%)	10 (22%)	5 (11%)	10 (22%)
	Hypo fractionation	3 (7%)	12 (27%)	22 (49%)	7 (15%)	1 (2%)
	Ultra hypofractionation	9 (20%)	6 (7%)	10 (22%)	5 (11%)	15 (33%)
	APBI	1 (2%)	9 (20%)	8 (18%)	6 (13%)	21 (47%)
Grade 2 or worse cosmetic	Conventional fractionation	10 (22%)	11 (24%)	11 (24%)	3 (7%)	10 (22%)
Outcome	Hypo fractionation	2 (4%)	17 (38%)	20 (44%)	5 (5%)	1 (2%)
	Ultra hypofractionation	9 (20%)	10 (22%)	6 (7%)	5 (11%)	15 (33%)
	APBI	2 (4%)	10 (22%)	6 (%)	6 (7%)	21 (47%)

APBI- Accelerated Partial Breast Irradiation

extension (75%), high axillary nodal burden (53%), and node-positive axilla (18%). For IMN irradiation, universal agreement was observed for clinically or radiologically positive nodes, followed by high axillary nodal burden (40%). Regional nodal irradiation(RNI) was practised by 20% of the respondents at their respective institutes.

Opinion on Perceived Toxicity Profile and Cosmetic Outcome

Most respondents (71%, 32/45) reported observing less than 5% incidence of grade 3 or higher toxicity in their practice, while only 7% reported grade 3 rates exceeding 15%. For grade 2 or worse cosmetic outcomes, 47% and 31% of respondents reported incidences below 5% and 5–10%, respectively.

Hypofractionated regimens were perceived by respondents to be associated with the lowest rates of grade 3 toxicity and grade 2 or worse cosmetic outcomes (49%, 22/45) (Table 4).

Exploratory Comparison with Personal and Socio-Geographical Parameters

Respondents practicing in metropolitan areas more frequently reported access to motion management facilities compared to those practicing in non-metropolitan areas (62% vs. 32%; exploratory comparison using Fisher's exact test, $p = 0.049$). In contrast, the availability of motion management facilities was similar between academic and non-academic centres (47% vs. 54%; Fisher's exact test, $p = 0.72$).

The availability of motion management facilities did not appear to influence the proportion of respondents preferring respiratory gating or deep inspiration breath hold (DIBH) for either right- or left-sided breast cancer, nor did it affect the proportion of respondents preferring hypofractionated dose schedules.

However, respondents with access to motion management facilities more commonly reported practicing lower target mean heart dose thresholds for left-sided breast cancer, with 73% reporting a target mean heart dose of less than 5 Gy compared to 27% reporting a target mean heart dose of 5 Gy or higher (exploratory comparison using Fisher's exact test, $p = 0.032$).

Overall, age, years of experience, practice location, and availability of motion management facilities did not show meaningful differences in the distribution of dose fractionation schedules or radiotherapy techniques among respondents.

Discussion

The POSITRON study gives a preliminary snapshot of the real-world practice choice for breast cancer radiotherapy among Indian radiation oncologists. Given the limited sample size and voluntary participation, the findings should not be interpreted as representative of national practice patterns but rather as an overview of prevailing trends within the respondent cohort. The hypofractionation regimen of 40 Gy in 15 fractions emerged as the preferred regimen in WBRT, PMRT, WBRT-DCIS, and RNI, with more than 60% of respondents in each group. This reflects a shift from earlier Indian

practice pattern surveys, which reported conventional fractionation as the preferred approach [17]. The current preference mirrors the widespread endorsement of moderate hypofractionation as an international standard established by robust data from the UK START trials [8-10]. An international practice pattern survey also supports the preference of moderate hypofractionation in the pre-pandemic era [14]. The practice survey published in 2010 targeting Indian radiation oncologists reported no preference for hypofractionation for breast conservative therapy [17].

Although many participants have used ultra-hypofractionation in their practice (38%), it is not the preferred regimen of choice across all treatment settings, with rates of 4%, 7%, and 2% for PMRT, WBRT, and WBRT-DCIS, respectively. The slow adoption may be due to concerns regarding long-term toxicity and the desire for long-term data on ultra-hypofractionation in the Indian population.

A study on the adoption of ultra-hypofractionation at the University of Texas MD Anderson Cancer Centre reported a rapid increase in the adoption of the ultra-hypofractionation regimen, from 4.3% in March-April 2020 to 45.5% in July-August 2020, indicating a shift in practice, owing to recent data, especially in the light of the COVID-19 pandemic [18]. Our study's preferred dose fractionation for ultra-hypofractionation is 26 Gy in 5 fractions, which aligns with the international adoption of this regimen following the publication of the UK Fast Forward data [12]. While the FAST-Forward trial included node-positive patients, the present survey did not specifically assess whether ultra-hypofractionation was routinely applied to nodal volumes, which remains an area of clinical caution. The latest 10-year update of the trial presented in ESTRO 2025 has reported a similar ipsilateral breast tumour relapse and toxicity profile. This data can aid the adoption of the 26 Gy in 5 fractions regimen among Indian radiation oncologists.

3DCRT is the most preferred technique for WBRT and PMRT. This may be due to the availability of long-term data and the routine use of 3DCRT in hypofractionation trials, the reliance on tangential field planning, less stringent planning and quality assurance requirements, and a reduced chance of target miss due to the use of skin flash. The selective use of IMRT and VMAT may reflect caution related to limited long-term outcome data, concerns regarding dosimetric robustness in the setting of breast motion, and relatively higher low-dose spill to the surrounding normal tissues.

Our study reports significantly higher motion management facilities in metropolitan areas, reflecting a disparity in the availability of modern technology across all centres. However, the availability of better technology did not significantly affect preference for motion management in left or right-sided breast cancer or choice of hypofractionated regimen, suggesting the interplay of other factors in decision making process. Importantly, respondents with access to motion management facilities reported practicing lower mean heart dose thresholds for left-sided breast cancer, highlighting the role of technology availability in cardiac sparing and long-term morbidity reduction.

Toxicity and cosmetic outcomes were other important findings in this study. Most participants responded to lower rates of grade 3 toxicity and grade 2 or worse cosmetic outcome with hypofractionation, aligning with published clinical data [8-10]. However, these findings represent clinician-reported perceptions rather than prospectively audited or patient-reported outcomes. This agreement reflects the diminished apprehension of the late effects of hypofractionation. However, ultra-hypofractionation and APBI were perceived with more caution, reflecting the need for further validation and long-term outcome reporting in Indian settings.

Several limitations exist in this study, including a smaller sample size compared to approximately 5000 radiation oncologists in the country, limited representation from only 13 states, inadequate representation of rural and semi-urban regions, and potential response bias due to voluntary participation. The predominance of respondents from metropolitan areas and comprehensive cancer centres suggests a selection bias toward better-resourced institutions, potentially overestimating the adoption of advanced techniques such as DIBH. Additionally, the survey reflects practice trends at a single point in time and did not capture clinical variables such as reconstruction status, tumour biology, use of ultra-hypofractionation for nodal irradiation or node positive patients, or surgery-driven boost decisions.

Despite the limitations, the POSITRON study reflects the evolving practice scenario in India and provides a useful benchmark for comparison with international samples. This can also help future policy making for training and resource deployment for equitable availability of technology, thereby improving the quality of care for breast cancer patients across all country regions. Prospective, multi-institutional studies in India focusing on ultra-hypofractionation, cardiac sparing, and patient-reported outcomes will be essential to guide national standards and ensure equitable access to modern breast radiotherapy nationwide.

In conclusion, this pilot survey highlights that hypofractionated radiotherapy and the 3DCRT technique are preferred among a limited cohort of Indian radiation oncologists, with a consensus on low rates of grade 3 toxicity and grade 2 or worse cosmetic outcomes. While ultra-hypofractionation is being practised, it is not yet the preferred schedule among radiation oncologists, owing to limited data in the Indian population. Prospective, multi-institutional studies in India focusing on ultra-hypofractionation, cardiac sparing, and patient-reported outcomes will be essential to guide national standards and ensure equitable access to modern breast radiotherapy nationwide.

Declarations

Clinical trial registration

Not applicable

Conflict of Interest Statement

The Authors declare no conflict of Interest

Availability of data and material

The data sets used and/or analyzed during the current study are available from the corresponding authors upon reasonable request.

Code availability

The custom code was used.

Authors' contributions

Mandira Saha Mallik; Concept and design, Administrative support, Provision of study materials, Collection and assembly of data, Data analysis and interpretation, Manuscript writing, Final approval of manuscript, accountable for all part of the work. Arindam Chaudhury; Concept and design, Administrative support, Provision of study materials, Collection and assembly of data, Data analysis and interpretation, Manuscript writing, Final approval of manuscript, accountable for all part of the work. Arnab Kumar Ghosh; Concept and design, Administrative support, Provision of study materials, Collection and assembly of data, Data analysis and interpretation, Manuscript writing, Final approval of manuscript, accountable for all part of the work. Adhiraj Dandapat; Administrative support, Provision of study materials, Collection and assembly of data, Data analysis and interpretation, Manuscript writing, Final approval of manuscript, accountable for all part of the work. Sanjay Santhyavu; Administrative support, Provision of study materials, Collection and assembly of data, Data analysis and interpretation, Manuscript writing, Final approval of manuscript, accountable for all part of the work. Sanskriti Poddar; Administrative support, Provision of study materials, Collection and assembly of data, Data analysis and interpretation, Manuscript writing, Final approval of manuscript, accountable for all part of the work. Suman Dhabal; Administrative support, Provision of study materials, Collection and assembly of data, Data analysis and interpretation, Manuscript writing, Final approval of manuscript, accountable for all part of the work. Adrija Ghosh; Administrative support, Provision of study materials, Collection and assembly of data, Data analysis and interpretation, Manuscript writing, Final approval of manuscript, accountable for all part of the work. Stela Dhar; Administrative support, Provision of study materials, Collection and assembly of data, Data analysis and interpretation, Manuscript writing, Final approval of manuscript, accountable for all part of the work. Janmenjoy Mondal; Concept and design, Provision of study materials, Collection and assembly of data, Data analysis and interpretation, Manuscript writing, Final approval of manuscript, accountable for all part of the work.

Ethics approval

Approval for this study was obtained from our institution's Institutional Ethics Committee (Institutional Ethics Committee, All India Institute of Medical Sciences, Kalyani).

Consent to participate/consent for publication

The consent for publication of the data from the questionnaire was present in the e-questionnaire sent to participants.

Originality Declaration for Figures

Not applicable.

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Declaration on generative AI and AI-assisted technologies in the writing process

Generative AI was not used for the preparation of this manuscript.

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