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Original Article

Gynecological brachytherapy hybrid training: The Tata Memorial Centre and BrachyAcademy experience

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ABSTRACT

PURPOSE: The lack of training is a significant barrier to practicing brachytherapy (BT). Tata Memorial Centre, alongside international BT experts and BrachyAcademy, developed a hybrid gynecological BT training module. This study outlines the preparation, organization, and execution of the 2022–2023 Mumbai training, evaluates its effectiveness, and highlights areas for improvement.

MATERIALS AND METHODS: Participants were radiation oncologists (RO) and medical physicists (MP) with experience in gynecological BT aiming to transition to image-guided brachytherapy (IGBT). The training covered cervical, endometrial, vaginal, vulvar, periurethral cancers, and pelvic reirradiation. The hybrid course included online pre and postcourse homework assignments, a live workshop with hands-on training, a 6-month online follow-up, and a 12-month opportunity to share the transition experience.

RESULTS: The December 2022 Mumbai live workshop spanned 2.5 days, attracting 39 participants from 8 countries (Asia, Africa, Australia/Oceania). Feedback rated the course 9/10, with 78% fully meeting expectations. Forty-four percent suggested extending hands-on training. At the 6-month follow-up, response rates were low (33% RO, 11% MP). Among responding RO, 70% reported practice changes after attending the course, 40% implemented IGBT concepts in clinical practice, and 50% increased confidence in image-guided procedures. Overall, 45% of respondent sites could strengthen their intracavitary/interstitial program, while others faced limitations due to lack of access to advanced BT applicators.

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CONCLUSION: The hybrid gynecological BT training concept was successfully executed. Areas for improvement include extending hands-on training and enhancing participant engagement post-course. Structured steps beyond training may be needed to improve the utilization of advanced brachytherapy for gynecological cancers.

Keywords: Education; Hybrid training; Hands-on training; Image-guided brachytherapy; Gynecological cancers; Cervical cancer

Introduction

Image-guided Brachytherapy (IGBT) plays an important role in the treatment of gynecological cancers and improving local control in locally advanced cervical cancer (LACC) (1,2) resulting in the upgrading of international societies' guidelines (3–5). However, IGBT is not yet optimally utilized in the management of these cancers (6,7). According to surveys among radiation oncologists (RO) and medical physicists (MP) in India, the USA, and Europe, the lack of training is one of the biggest barriers to practicing standard intracavitary or more advanced intracavitary/interstitial (IC/IS) brachytherapy (BT) and to achieve confidence and independence in performing procedures (8–13). More than half of European and Indian ROs responding to the surveys named the need for access to a skills lab (that includes hands-on or simulated training) and online modules as preferable teaching methods in BT (11,13).

Multiple international initiatives are presently in place for training practitioners in gynecological brachytherapy: ESTRO, AROI-ESTRO, ABS schools (14,15); simulation trainings based on mannequins (16–22) or cadavers (23,24); clinical workshops organized in hospitals by the industry – Elekta BrachyAcademy and Varian Medical Systems (13–15,25); live or online contouring workshops, including the FALCON project of ESTRO (14,26,27). The COVID-19 pandemic has transformed BT teaching methods, leading teachers and practitioners to accelerate the adoption of new technologies and strengthen the role of online training (28,29).

Institutions like Tata Memorial Centre in India have extensive clinical, research, educational, and training experience in gynecological brachytherapy (30). In order to develop the existing educational partnership between Tata Memorial Centre and BrachyAcademy in brachytherapy training, we planned the expansion of training from cervix brachytherapy to brachytherapy for all gynecological subsites (endometrial, vaginal, vulvar, periurethral cancers, and reirradiation). This included in-person and online training elements to assess if it could enhance practitioner confidence and transition to IGBT. In 2022, we developed a hybrid training module for the BrachyAcademy gynecological brachytherapy course, combining pre and postcourse online contouring and treatment planning homework with the live workshop. Due to the high demand for BT training in India and other low- and middle-income countries, we planned to increase the number of participants for the workshop from 20 to 40 people without compromising on the hands-on experience. Additionally, we introduced follow-up online training modules with the course faculty to support the transition of the participants to advanced brachytherapy.

This paper describes the preparation, execution, and evaluation of the hybrid gynecological brachytherapy training course organized in Mumbai in 2022-23. The purpose of the paper is to share our experience with the gynecological brachytherapy community, discuss teaching methods and outcomes, and identify potential areas for future improvement.

Methods and materials

The gynecological BT training course in Mumbai was developed by the team of ROs, MPs, and BT technologists at the Tata Memorial Centre, along with international brachytherapy experts (ROs and MPs) and BrachyAcademy. Participants included ROs and MPs with clinical experience in gynecological brachytherapy (at least, with 2D imaging) intending to transition towards IGBT and enhance their knowledge and skills for reirradiation. A precourse survey was sent to the attendees to understand their existing experience, level of confidence in gynecological brachytherapy, and the status of BT practice in their centers.

The hybrid course comprised the following components: online precourse homework, a live workshop, online postcourse homework, an interactive follow-up module at 6 months after the workshop, and, finally, an opportunity to present and share the transition experience at 12 months after the workshop.

The live 2.5-day workshop includes lectures, multiple procedural videos of advanced brachytherapy, hands-on procedural training using 3D printed hybrid IC/IS applicators on mannequins, hands-on training on target delineation and treatment planning using demo workstations, and structured discussions with the course faculty.

To assess participant's knowledge of image-guided adaptive brachytherapy (IGABT) concept and treatment planning in cervical cancer, participants were required to complete online homework before and after the live workshop. The homework involved target delineation for ROs and treatment planning (TP) for MPs using a LACC clinical case. The Elekta's ProKnow software was used to distribute the homework, with each participant receiving an anonymous username to access the clinical case. RO participants submitted homework using representative sections of the clinical contours along with volumetric indices for Gross Tumour Volume (GTV), High-Risk Clinical Target Volume (CTV_{HR}), and Intermediate-Risk Clinical Target Volume (CTV_{IR}). The contours provided by participants were analyzed by 2 clinical experts, and performance scores ranging from 1 to 4 were assigned to all participants for GTV, CTV_{HR}, and CTV_{IR} delineation. During the workshop, clinical experts discussed both the homework case and a live case for target delineation. The results of the postcourse homework were summarized by the faculty during a follow-up call. Similarly, MP participants returned the treatment planning homework based on predefined target contours. The physics TP homework was analyzed by workshop physics experts. During the workshop, MP participants received a live case for applicator reconstruction and treatment planning. The summary of TP for all MPs was prepared for the homework case, and during the feedback session, information about the principles of treatment planning was provided to the RO and MP team. No formal scoring was performed for MPs for the live practice session, but feedback was provided for the treatment planning process.

The live workshop was divided into 7 sessions (Fig. 1a). Teaching methods used during the workshop are summarized in Fig. 1b. Topics of the lectures corresponding to each session are listed in Table 2. Most of the lectures were provided on-site, except for those that were delivered online by 2 international teachers.

Observation of live patient cases in the operating room was not possible due to COVID-19 limitations and the number of the workshop participants (including 30 ROs), as well as the difficulty in performing diverse BT applications and executing treatment for different gynecological cancers within the workshop days. Therefore, the organizing team and other participating faculty prepared high-resolution video recordings of the procedures which included: 1) Combined IC/IS BT in LACC with a) Venezia applicator with interstitial needles including the use of intraoperative ultrasound, b) Venezia applicator with vaginal cap, c) procedure for removal of Venezia applicator; 2) IS BT in recurrent endometrial cancer with Martinez Universal Perineal Interstitial Template (MUPIT); 3) IS BT in vulvar cancer with free-hand needles placement. The procedural videos, ranging from 15 to 35 minutes duration, were demonstrated after the presentation of the corresponding clinical cases, including patient and tumor information, initial findings, external beam radiation therapy (EBRT) and chemotherapy treatment information, and findings at the time of BT. This was followed by structured time for the discussion of each case, practical nuances and tips and tricks by all experts. International participating faculty included examples of their own techniques in standard as well as challenging cases.

For the ROs' hands-on training, we purchased 10 pelvic models, available at https://www.gaumard.com/s504-100. Tata Memorial Centre had prepared 3D printed dummy intracavitary and interstitial applicators (Venezia and MUPIT prototype; 10 prototypes each), while Elekta provided Venezia, Geneva and Rotte-Y applicators for live demonstration. A total of 10 identical hands-on stations with all supportive equipment needed for applicator placement were organized; 3 participants and 1 teacher were assigned to each station (Fig 2).

To train skills in commissioning IC/IS applicators and MUPIT, 2 hands-on parallel training sessions for the MPs were organized in a separate room. Six laptops (5 for the participants and one for the faculty) with the Oncentra Brachy treatment planning station (TPS) were provided for this training. Commissioning phantoms for hands-on practice during the live workshop were prepared using 3D printing.

For hands-on training on target delineation and treatment planning, parallel sessions were organized in separate rooms for RO and MP participants. Sixteen laptops with Oncentra Brachy TPS were prepared for RO training (15 laptops for the participants and 1 laptop for the faculty). The TP session for MPs was organized in the same room as the training on applicator commissioning. After the hands-on training, a joint session was conducted for ROs and MPs to discuss the consensus contours and the outcome of treatment planning.

The postcourse questionnaire included a combination of qualitative and quantitative questions, which could be answered by yes/no or ranked on a Likert scale, or a 1 to 10 scale. Likert scale (very good – good – neutral – poor – very poor) was used to evaluate general impression of the course, logistics, and content. Scale of 1 to 10 (where 10 is the highest score) was used to rate the course. Additionally, participants were asked to provide free-form comments regarding which learning objectives were met/not met, suggestions to improve the course, and topics that could be addressed in future courses.

Completion of the postcourse questionnaire was mandatory before distributing course attendance certificates and presentations of the lectures in PDF format. The procedural videos were not distributed based on privacy regulations.

To assist participants in transitioning to advanced brachytherapy practice and understand their current situation, we organized a short online survey and a follow-up call 6 months after the live workshop. The follow-up survey consisted of questions regarding changes in the GYN

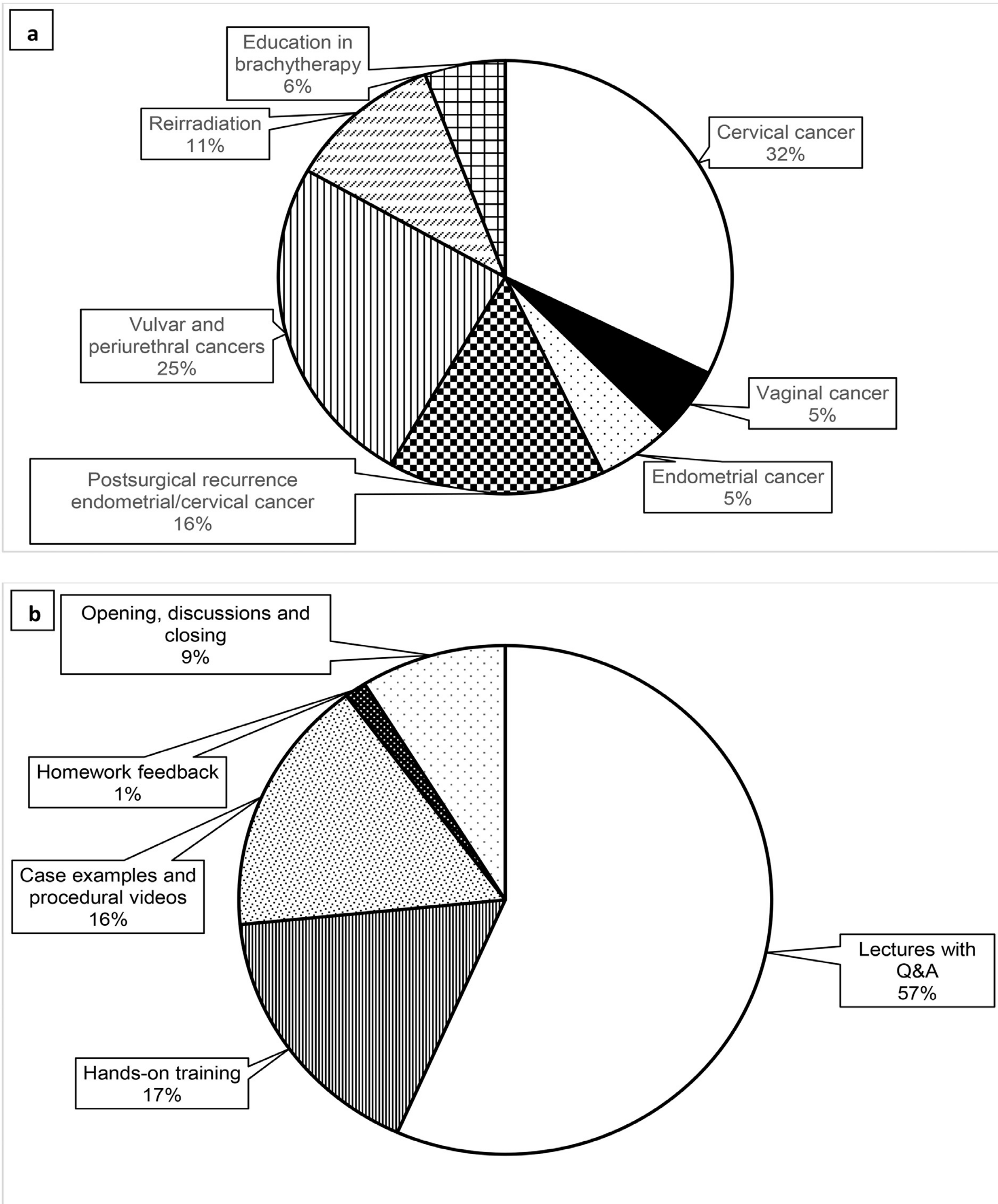

Fig. 1. Proportion of time allocated during the live workshop for (a) content topics and (b) teaching methods.

BT practice since the completion of the course, adoption of the MRI/CT target concept for LACC, and transition to IC/IS BT.

Finally, centers wishing to share their transition experience were given an opportunity to present during the recently concluded workshop in 2024.

Results

The live gynecological brachytherapy workshop in Mumbai was conducted over 19 hours (excluding time for breaks) in 2 and a half consecutive days in December 2022, with a total of 39 participants (30 ROs, 9 MPs). Partici-

Fig. 2. Hands-on training showing (a) organization of the room with hands-on stations and (b) applicator placement process.

Table 1
Precourse survey with the answers received.

Questions	Answers (%) from 37 participants (28 RO + 9 MP)
No. of years practicing BT?	<1yr – 22; 2-5 yrs – 37; >5 yrs – 41
No. of cervical BT treatments in your center?	0–5/wk – 49; 6-10/wk – 16; 11-15/wk – 11; >15/wk – 22; No answer – 2
Type of imaging is used/will be used for GYN BT in your center?*	CT – 100; US – 30; X-ray – 30; MRI – 24
How do you prescribe dose for GYN BT?	Point A-based – 41; Volume-based – 16; Both – 43
Confidence with T&R?	No – 11; Slight – 22; Moderate – 22; Full – 23; No answer – 22
Confidence with T&O?	No – 3; Slight – 3; Moderate – 35; Full – 51; No answer – 8
Confidence with IC/IS BT?	No – 35; Slight – 30; Moderate – 8; Full – 8; No answer – 19
Confidence with MUPIT?	No – 32; Slight – 22; Moderate – 24; Full – 8; No answer – 14
Confidence with free-hand needles?	No – 38; Slight – 19; Moderate – 0; Full – 3; No answer – 40
Confidence with GTV contouring?	No – 14; Slight – 16; Moderate – 30; Full – 16; No answer – 24
Confidence with CTV_{HR} contouring?	No – 14; Slight – 16; Moderate – 26; Full – 20; No answer – 24
Confidence with I CTV_{IR} contouring?	No – 16; Slight – 11; Moderate – 38; Full – 11; No answer – 24
Confidence with optimizing IC BT plans?	No – 8; Slight – 22; Moderate – 30; Full – 37; No answer – 3
Confidence with optimizing IC/IS BT plans?	No – 22; Slight – 37; Moderate – 14; Full – 11; No answer – 16
Does your center perform reirradiation for GYN cancers?	No – 30; Yes – 70
Confidence with reirradiation?	No – 43; Slight – 24; Moderate – 6; Full – 3; No answer – 24
Does your center perform BT for medically inoperable endometrial cancer?	No – 45; Yes – 49; No answer – 6
Does your center perform BT for vulvar cancer?	Not feasible – 14; Yes – 32; Plan to start – 54
Do you want to participate in the online follow-up session after course?	Yes – 100

RO = Radiation Oncologist; MP = Medical Physicist; BT = Brachytherapy; GYN = Gynecological; CT = Computed Tomography; US = Ultrasound; MRI = Magnetic Resonance Imaging; T&R = Tandem-ring applicator; T&O = Tandem-ovoid applicator; IC = Intracavitary; IS = Interstitial; MUPIT = Martinez Universal Perineal Interstitial Template; GTV = Gross Tumor Volume; CTV_{HR} = High-Risk Clinical Target Volume; CTV_{IR} = Intermediate-Risk Clinical Target Volume.
* = Question with multiple answers allowed.

pants and faculty represented 4 continents (Asia, Europe, Australia/Oceania, Africa) and 11 countries. The summed geographic distribution and corresponding number of participants were: India – 24, Vietnam – 6, New Zealand – 2, Thailand – 2, Indonesia – 2, Malaysia – 1, Philippines – 1, South Africa – 1.

Thirty-seven participants (95%) replied to the precourse survey (Table 1). Although 41% of attendees had more than 5 years of experience in practicing BT, and 33% worked in high-volume centers, their procedural level of confidence was low. For instance, only 8% of responded ROs felt fully confident with IC/IS BT applications in LACC. The percentage of RO participants who felt fully confident in contouring various target volumes were: 21% in delineating GTV, 25% for CTV_{HR}, 14% for CTV_{IR}. We noticed that the ROs were more confident with tandem-ovoid than tandem-ring applicators (50% vs. 21% of responders with full confidence), and not confident with MUPIT and free-hand needles. Four out of 9 participating MPs claimed full confidence with IC plans optimization, and only 1 MP was fully confident in IC/IS plan optimization.

For the online precourse homework, we selected a clinical case of a LACC patient, with International Federation of Gynecology and Obstetrics (FIGO) stage IIb, who had a partial response to EBRT. Baseline clinical and imaging details were provided to the participants. The residual disease (GTV-BT) could be differentiated easily, and delineation of CTV_{HR} and CTV_{IR} on this case was considered to represent a standard case scenario in clinical practice. A total of 20 out of 30 (67%) participating ROs completed and returned the precourse homework. Unfortunately, we couldn't use ProKnow to assess the homework due to a software limitation as it doesn't accept para-axial MRI images for analysis. As a result, participants had to send screenshots of GTV, CTV_{HR} and CTV_{IR} contouring results from their treatment planning systems in axial and sagittal orientations, along with the corresponding volumes in cc. Consequently, a simultaneous overlay presentation of all contours was not possible, and quantitative analysis was limited.

Upon evaluating the homework contours, it was observed that 43% of participants overcontoured the GTV, whereas undercontouring was observed in 28.5%, and only 28.5% had optimal contouring of GTV (deviation from master contours -7 to +16 cc). For CTV_{HR}, the trend was more towards overcontouring (38% participants, deviation from master contours -20 to +14 cc), and in a small proportion of participants, the CTV_{HR} contour was considered suboptimal due to the omission of the normal-looking cervix. For CTV_{IR}, overcontouring was common with a deviation ranging from -20 to +100 cc compared to the master contour. Deviations in GTV, CTV_{HR} and CTV_{IR} delineation are summarized in Fig 3 (a-c).

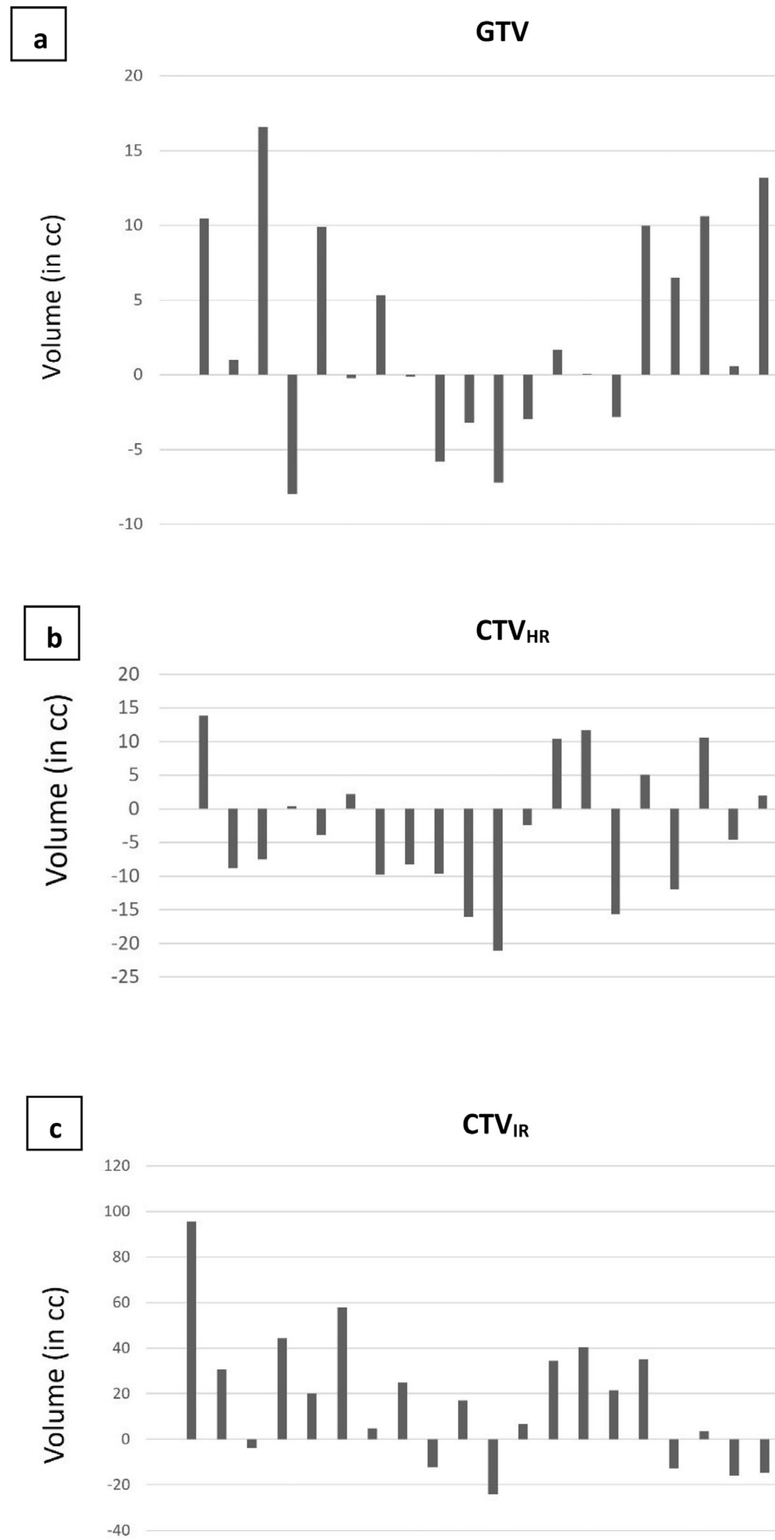

Fig. 3. Deviations of GTV (a), CTV_{HR} (b), and CTV_{IR} (c) delineations observed in the precourse homework. The zero line on the X-axis corresponds to the master contour done by the faculty. Vertical bars represent the deviation of contours in the precourse homework of 20 ROs. Bars below X-axis represent undercontouring comparing to the master contour, while bars above X-axis represent overcontouring.

The treatment planning homework by MPs was also evaluated. Participants managed to meet the dose objectives; however, in the vast majority of cases, this was done through the violation of TP principles (7 out of 9 MPs). This was associated with reducing the intrauterine contribution (n = 4; 19-29%), reducing ring loading (n = 5; 11-21%), or overloading interstitial needles (n = 5; 37–66%) beyond the permissible limits.

Out of the 39 participants, 36 (92%) replied to the postcourse questionnaire. The participants rated the training course as very high with the score of 9 on a scale from 1 to 10. We received a "yes" response to the question "Did the training course meet your expectations?" from 78% of responders, "partly" from 14% responders, "no" from 0 responders, and no answer from 8%. Participant responses to the quantitative questions of the postcourse questionnaire are summarized in Table 2. Participants evaluated the point "Sufficient time for training of practical skills" with only 47% indicating "very good", 31% "good", 17% "neutral", and 3% "poor" answers. Sixteen participants (44% of the responders) suggested in free-form comments to have more time for hands-on training. In the first version of such a hands-on course, the percentage of the time dedicated to hands-on training was perceived as small (17% of the total time) comparing to the lectures (57%, Fig. 1b).

At 6 months after the live workshop, a follow-up survey was conducted, with representatives from only 11 out of the 25 participating sites responding: 10 ROs and 1 MP. Participant responses are summarized in Table 3. Amongst the responding ROs, 70% reported that after attending the course, their clinical practice changed, 40% were able to implement concepts of IGBT in their clinical practice, and 50% had increased confidence in doing image-guided procedures. Overall, 45% of respondent sites could strengthen their IC/IS program, while other sites were unable to do so, mostly due to lack of access to advanced BT applicators.

Four teams which attended the hybrid training shared their postcourse transition experiences with participants of the next course in January 2024. Team A underwent a transition from point-A-based BT to CT-based IGABT in cervical cancer and started to learn Transrectal Ultrasound (TRUS) guidance. Team B began IGBT for cervical, vaginal, and endometrial cancers (including IC/IS technique). Team C reported an increase in the yearly number of LACC patients treated by IGABT. Team D improved confidence in applicator choice, needle insertion, target volume delineation, and target coverage. The presenters noted the main challenges during the transition to advanced BT: increased treatment costs, anesthesia, patient transport to MRI, MR imaging protocols, applicator and needle reconstruction, and complication management. Overall, all presenting teams were optimistic about the results, mentioning improvements in workflow, strengthened teamwork, and expressing a willingness to further develop brachytherapy in their hospitals.

Discussion

The postcourse participant feedback confirms that hands-on training remains a critical aspect in brachytherapy education. During the live workshop, we conducted hands-on training on applicator insertion for 30 ROs using mannequins and 3D printed IC and IS applicators. The development and integration of 3D printed applicators and templates represent one of the most significant advancements in BT delivery in the last 20 years (31). There is a potential to use 3D printed applicators in simulation training, which was successfully demonstrated in our study and may be of value to provide trainees with an immersive experience.

Another improvement component of the hands-on training is the availability of pelvic gynecological mannequins compatible with multimodality imaging and allowing placement of IS needles. There are prototypes made by clinical teams (21,32,33), and commercially available phantoms (22). For our live workshop, we obtained pelvic models from Gaumard, which were used during previous GYN BT hands-on trainings (16,17). While the phantom allows ease of vaginal and cervical visualization, uterine sound, and standard Fletcher-type applicator placement, we realized that the Gaumard pelvic phantom is not designed to place commercial IC/IS tandem-ring applicators alone or with needles. Therefore, we had to adapt the printing of 3D applicators to suit the specifications of the Gaumard model. However, it could allow placement of only selected parallel and divergent needles through the Venezia ring due to interference of a plastic ring in its design that's positioned superior to the level of the cervix. An alternative phantom, e.g., VIOMERSE (22) could possibly be more appropriate for commercial applicators as it allows the successful implantation of the Geneva applicator with IS needles. Additionally, the VIOMERSE phantom comes with the benefit of multi-imaging compatibility, although, according to our initial experience, it is not yet optimized for TRUS guidance.

Target delineation is one of the most critical steps and is associated with the largest uncertainty (34). This was also observed in the precourse homework. However, we noticed that the uncertainty with delineation reduced during and after the course, emphasizing the need for more hands-on training with live cases. Such a step needs continued engagement both from the faculty and course participants. Our design of the contouring and TP homework was in line with findings in the literature (27): discussion of baseline contouring prior to the program, showing and discussing master contours, and recontouring after the program intervention. The majority of studies evaluated the short-term impact of contouring courses on performance; no long-term impact was evaluated (27). Therefore, we asked the participants to do a recontouring exercise 5 months after the workshop. A phase III randomized trial invested into assessing high vs. low frequency expert feedback during

Table 2
Responses of the workshop participants to quantitative questions in postcourse questionnaire.

Question group	Parts of the training course and evaluation results	% of participants responded "very good"	% of participants responded "good"	% of participants responded "neutral"
General impression	Scope of the topics covered	89	11	0
	Presentation content is clear	75	25	0
	Length of the training	50	39	11
	Sufficient time for training of practical skills	47	31	17
Logistics	Required information received on time	94	6	0
	Organization of the course	78	22	0
Course content	Session 1 Cervical cancer			
	Lectures: Imaging; Point A; Target concept MRI-based IGABT; Applicator selection; Applicator commissioning and QA; TP recommendations; Clinical outcome and morbidity; CT/Ultrasound-based IGABT	60	35	5
	Homework feedback	59	31	10
	Case examples and procedural videos	74	26	0
	Hands-on training 1: IC/IS applicator insertion (RO) or IC/IS applicator commissioning (MP)	69	31	0
	Hands-on training 2: Target delineation (RO) or IC/IS applicator reconstruction and TP (MP)	56	41	3
	Session 2 Vaginal cancer			
	Lectures: Target concept; Treatment planning	64	35	1
	Case examples	62	38	0
	Session 3 Endometrial cancer			
	Lectures: Postoperative RT (indications, applicator selection, QA); BT for medically inoperable cancer(target delineation, prescription, outcomes); Planning principles	72	27	1
	Case examples	68	32	0
	Session 4 Postsurgical recurrence: endometrial/cervical cancer			
	Lectures: Guidelines for target evaluation; Applicator selection; Target delineation and TP	61	37	2
	Case examples and procedural video	69	31	0
	Hands-on training 3: Rotte Y/ MUPIT insertion (RO) or MUPIT commissioning and reconstruction (MP)	67	25	8
	Session 5 Vulvar and periurethral cancers			
	Lectures: Patient selection and techniques; Applicator reconstruction; Target delineation and TP; Dose-response correlation with morbidity; Second cancer in pelvic region; HPV-related second cancer	53	43	4
	Case examples and procedural video	64	36	0
	Session 6 Reirradiation with BT for GYN cancers			

(*continued on next page*)

Table 2 (*continued*)

Question group	Parts of the training course and evaluation results	% of participants responded "very good"	% of participants responded "good"	% of participants responded "neutral"
	Lectures: Evidence and rationale for irradiation; Patient selection; OAR tolerance; Dose accumulation for multicourse irradiation; Outcomes; Ongoing collaborating initiatives	66	33	1
	Session 7 Education in BT			
	Lectures: Results of GEC-ESTRO European and Indian surveys; BT learning curve; Transition to advanced techniques	61	39	0

IGABT = Image-Guided Adaptive Brachytherapy; QA = Quality Assurance; TP = Treatment Planning; RO = Radiation Oncologist; MP = Medical Physicist; RT = Radiation Therapy; HPV = Human Papillomavirus; OAR = Organ At Risk.

Table 3
Responses of the workshop participants to the follow-up survey.

Questions	Answers (N) from the 11 participants who responded (10 ROs, 1 MP)
Any change in clinical BT practice for your GYN patients since attending the course?	Yes, for the majority (>75%) of patients– 1 Yes, for 51–75% of patients – 2 (including 1 MP) Yes, for 26–50% of patients – 2 Yes, for up to 25% of patients – 3 No change – 3
Did you implement CT/MRI-based target concepts in your clinical practice for cervical BT?	Yes – 4 No – 1 I was already using it, and my confidence increased – 6 (including 1 MP) I was already used it but no change in my clinical practice – 0
Was your team able to transition to performing IC/IS BT since attending the course?	Yes, we could strengthen our existing program for IC/IS BT – 5 (including 1 MP) Yes, we could initiate IC/IS BT – 0 No, we were not able to transition as we do not have advanced BT applicators – 5 No, I yet do not feel confident to perform IC/IS BT procedure - 1

RO = Radiation Oncologist; MP = Medical Physicist; BT = Brachytherapy; GYN = Gynecological; CT = Computed Tomography; MRI = Magnetic Resonance Imaging; IC/IS = Combined intracavitary/interstitial.

repetitive procedures demonstrated a clear impact on medical students' learning curve for clinical procedural skill acquisition (36). A prospective study in learning curve assessment of trainees at the Tata Memorial Centre also demonstrates the need for repetition and consistency to improve scores of postprocedural skills like target delineation and treatment planning (37).

Despite 100% interest from the participants in the course follow-up (according to the precourse survey, Table 1), the level of engagement after the live workshop was low; only a few ROs completed the postcourse homework and attended the follow-up call. Similar observations have previously been reported (14,35). Among the highly motivated participants who completed the postcourse homework and responded to the precourse survey, 40% reported implementing image-guided brachytherapy after the completion of the course. Nevertheless, the extent to which participants who did not respond to the follow-up questionnaire transitioned to the image-guided brachytherapy remains unknown. In the future, structured methods, including a delay in certification for individual skill sets, should be considered after completing repeat tasks as it is likely to improve participant engagement.

Although the overall workshop evaluation was good, we found several points that could be improved in future courses. Looking at the time distribution between course topics (Fig. 1a), we realized that the sessions on vaginal, vulvar and periurethral cancers consumed 30% of the workshop time, whereas the session dedicated to cervical cancer was relatively short (32%), compared to the frequency of its occurrence in clinical practice. This differential structuring was initially done due to availability of another full course of 3.5 days for cervical cancer in India. However, considering the high incidence and burden of cervical cancer and the need for consistent training, the time allocation for cervical cancer modules was increased for the course in 2024.

The participants of the workshop suggested the allocation of more time for hands-on training, including target delineation which we also improved in the next version of the course in 2024. An additional practical step in the course could be to involve participants in follow-up sessions for "evaluating the target volume" where participants are given precontoured structures with some missing elements, and they are asked to identify those misses. Critical to such an initiative could be the provision of pretraining reading materials. With these measures, we hope to improve the perception of the "length of the training" (for this workshop, we received 50% "very good", 39% "good", 11% "neutral" scores, as shown in Table 2), as well as to improve the participant performance after the course. From the scorings for the feedback section, we observed that participants would appreciate a further detailed session on homework assessment and treatment planning in future courses, and this was also integrated into the recent workshop in 2024.

Separate from the training enhancement needs, 1 hindrance in transitioning to advanced brachytherapy is the availability of advanced IC/IS applicators and incurring the recurring costs of procedures and consumables for the healthcare system. Most patients in India with cervical cancer come from lower socioeconomic strata and are supported through government reimbursement packages for brachytherapy. The low reimbursement rates for brachytherapy in the current packages also make the cost investment into advanced brachytherapy infrastructure less lucrative (25). Further studies on the cost structuring of brachytherapy applicators and consumables are needed to improve the access to these applicators in most centers that are keen to make a transition.

Conclusion

We successfully implemented the hybrid concept of gynecological brachytherapy training. Forty percent of responded radiation oncologists made the transition to image-guided brachytherapy within 6 months after the live workshop. We identified potential areas for improvement that will be investigated for its training efficiency in future courses. Structured steps beyond training may be needed to improve the utilization of advanced brachytherapy for gynecological cancers.

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