Documentație pentru fizicieni medicali

Tehnica 3DCRT

Radioterapia tridimensională conformațională (3D-CRT) este tehnica standard promovată de IAEA atât în țările dezvoltate, cât și în cele aflate în curs de dezvoltare. Motivul este acela că există destule dovezi științifice care să susțină că prognosticul pentru pacienții tratați prin 3D-CRT este mai bun decât pentru cei tratați prin radioterapia 2D. Radioterapia conformațională este cea mai utilă formă de tratament pentru tumorile care sunt localizate în apropierea organelor și structurilor importante din corpul uman. Acest lucru se datorează faptului că tratamentul evită deteriorarea prin radiații a țesuturilor sănătoase ale corpului și organelor din zona supusă terapiei. Aceasta poate fi utilizată pentru a trata:

- Cancerul de prostată;
- Cancerul de duct alimentar (cancer esofagian);
- Cancerul pulmonar;
- Cancerul de vezică urinară;
- Cancerul pancreatic;
- Cancerul la ficat;
- Cancerele de cap și gât;
- Tumorile cerebrale;

În acest document raportăm o serie de articole științifice noi, publicate în literatura de specialitate, referitoare la folosirea tehnicii 3DCRT ca metodă de tratament în terapia cancerului. Aceste articole vor fi puse la dispoziția studenților pe canalele de comunicare on-line (platform Teams, site-ul proiectului).

Documentul este organizat în felul următor:

1. datele de identificare a articolelor (autori, titlu, anul apariției, volum, pagina de început și sfârșit/numărul articolului, adresa DOI.
2. abstractul articolului

3. concluziile articolului

Imaginile și textele prezentate pot fi subiectul unor acorduri de copyrights și sunt prezentate doar în scop ilustrativ și didactic.

Lista articolelor propuse

Articol 1

1. Annie Xiao, Jessica Jutzy, Greg Hubert, Meghan Edens, Maxine Washington, Yasmin Hasan, Steven J. Chmura, Hania A. Al-Hallaq,
   A study of the dosimetric impact of daily setup variations measured with cone-beam CT on three-dimensional conformal radiotherapy for early-stage breast cancer delivered in the prone position
   Radiation oncology physics, J Appl Clin Med Phys 2020; 21:12:146–154,
   doi: 10.1002/acm2.13080

Abstract

Purpose: To evaluate the dosimetric impact of daily positioning variations measured with cone-beam computed tomography (CBCT) on whole-breast radiotherapy patients treated in the prone position.Methods: Daily CBCT was prospectively acquired for 30 consecutive patients positioned prone. Treatment for early-stage (≤II) breast cancer was prescribed with standard dose (50 Gy/25 fractions) or hypofractionation (42.56 Gy/16 fractions) for 13 and 17 patients, respectively. Systematic and random errors were calculated from the translational CBCT shifts and used to determine population-based setup margins. Mean translations (±one standard deviation) for each patient were used to simulate the dosimetric impact on targets (PTV_eval and lumpectomy cavity), heart, and lung. Paired Student's t tests at $\alpha = 0.01$ were used to compare dose metrics after correction for multiple testing ($P < 0.002$). Significant correlation coefficients were used to identify associations ($P < 0.01$).

Results: Of 597 total fractions, 20 ± 13% required patient rotation. Mean translations were 0.29 ± 0.27 cm, 0.41 ± 0.34 cm, and 0.48 ± 0.33 cm in the anterior–posterior, superior–inferior, and lateral directions leading to calculated setup margins of 0.63, 0.88, and 1.10 cm, respectively. Average three-dimensional (3D) shifts correlated with the

maximum distance of breast tissue from the sternum (r = 0.62) but not with body-mass index. Simulated shifts showed significant, but minor, changes in dose metrics for PTV_eval, lung, and heart. For left-sided treatments (n = 18), mean heart dose increased from 109 ± 75 cGy to 148 ± 115 cGy. Shifts from the original plan caused PTV_eval hotspots (V105%) to increase by 5.2% ± 3.8%, which correlated with the total MU of wedged fields (r = 0.59). No significant change in V95% to the cavity was found. Conclusions: Large translational variations that occur when positioning prone breast patients had small but significant dosimetric effects on 3DCRT plans. Daily CBCT may still be necessary to correct for rotational variations that occur in 20% of treatments. To maintain planned dose metrics, unintended beam shifts toward the heart and the contribution of wedged fields should be minimized.

KEY WORDS

breast cancer, cone-beam CT, prone positioning, setup margins, whole-breast radiotherapy

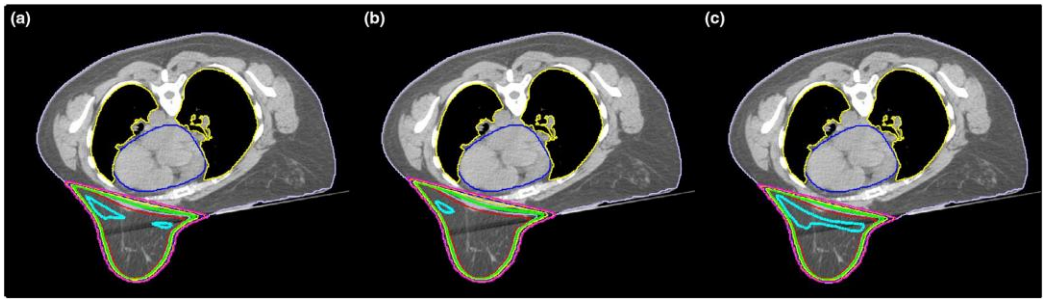

Fig. 3. Isodose lines of 95% (green) and 105% (cyan) overlaid on an axial computed tomography image demonstrate the (a) intended dose and dose for simulated shifts of the patient (b) by 0.48 cm anteriorly toward the beam isocenter (c) and by 0.35 cm posteriorly away from the beam isocenter (M = −0.06 cm, STD = 0.42 cm). Dose to the heart increases from 0.86 to 1.1 Gy when the patient is shifted anteriorly (b) while the volume of V105% increases from 11.2% to 16.4% when the patient is shifted posteriorly (c).

Our work demonstrates that in 3DCRT WBRT plans without intensity modulation, setup variations caused small but significant dosimetric changes although further gains could be achieved by minimizing anterior shifts of the patient toward the beam to limit increases to the heart dose and by reducing the total monitor units of wedged fields to limit increases in target hotspots. While these results appear to downplay the importance of daily CBCT for reproducing the planned dose to targets, forgoing CBCT may have occasionally delivered higher than planned dose to the heart and would have risked treating patients with uncorrected postural rotations/deformations in 20 ± 13% of fractions. Based on the results of our study, daily CBCT is recommended for prone positioning for 3DCRT plans.

Articol 2

2. Dler Khalid Ismael, Fezaa Shalal Neda, Ansam Qassim Gadhban, Wasif O. Khatab Alobaidi,
   Conformity and Homogeneity Indices for Brain Cancer Patients Using 3DCRT Technique
   NeuroQuantology , January 2022, Volume 20, Issue 1, Page 41-48,
   doi: 10.14704/nq.2022.20.1.NQ22006

Abstract

Background: 3D conformal radiotherapy 3DCRT technique are used to treat patients with brain cancer.

Goal: this study aims to compare conformity and homogeneity indices for eight patients of brain cancer by using three-dimension conformal radiotherapy (3DCRT) technique on planning target volume (PTV) located in brain.

Methods: Comparative study of Conformity and Homogeneity indices for ten brain cancer patients during period from October 2019 to March 2020 that carried out at ZCC (Zhianawa Cancer Center) in Sulaimany-Iraq. 3DECRT technique was applied to get the heist dosage to the target volume (tumor) and lowest dose to the healthy structures around the tumor. By using Linear Accelerator machine- LINAC, Elekta synergy type with

6MV photon beam. SPSS-version 22 was applied for analyzing and caring out the data measurements.

Results: It has been observed from the results, in both techniques the highest conformity and homogeneity indices have the acceptable values, in this study with 3D-CRT plan technique showed that the mean conformity and homogeneity indices were (0.1999 ± 0.03, 0.9457 ± 0.05) respectively. The mean dose values for organs at risk spinal cord and brain stem were (41.98 ± 2.23, 26.01 ± 16.62) respectively, for ten right and left parotid glands were (23.52 ± 3.99, 23.34 ± 3.93) respectively. In both plans, the average dose values for all organs at risk mentioned above were less than tolerance radiation doses.

Conclusion: This study also supports that indices of homogeneity and conformity are important tools for improving the long-term quality of life of brain cancer patients using 3DCRT technology.

Key Words: Treatment-planning Techniques, Dose Volume, Organs at Risk, Brain Cancer.

Figure 1. Linear Accelerator (LINAC)

Concluzii

We can see that from the results: CI and HI of ten brain cancer patients who worked in this paper within the framework of RTOG recommendations; the best value of this two indices was (1.0518 and 0.1558) respectively, in the case of the best target volume (PTV) coverage. It can be concluded that the matching and homogeneity indices are necessary tools to assess the adequacy of a treatment plan, but not a sufficient factor to optimally

evaluate a radiotherapy plan. To be able to evaluate and estimation acceptance of some treatment plan methods into daily practice, further experience and data as max., min, and average dose values for required size, In addition to covering healthy organ tissues should be taken into account. For other assessment tools (DVH, isodose assay etc.).

Articol 3

3. Abinaya Rajasekar, Alicia Moggré, Andrew Cousins, Steven Marsh,
Optimising the use of EPIgray for 3DCRT breast treatments
Physical and Engineering Sciences in Medicine (2020) 43:1077–1085
https://doi.org/10.1007/s13246-020-00904-0

Abstract

EPIgray is an in-vivo dosimetry system which uses electronic portal images to calculate dose delivered to a point of interest (POI) and the percentage dose difference (%DDiff) from expected dose. For 3D conformal radiotherapy (3DCRT) of breasts, a small shift between patient position on treatment compared to the planning CT is often clinically accepted. However due to the use of the planning CT in the EPIgray back-projection algorithm, acceptable shifts can have undue impact on EPIgray dose so it does not reflect true POI dose. At our centre ± 5.0% %DDiff tolerance is used for all treatment sites, however for breast treatments this effect causes false positive (FP) results, which may mean an actual treatment error is not detected.

Patient position can be better represented within EPIgray using a contour correction (CC) method, increasing dose calculation accuracy. A custom breast-lung phantom was developed to validate use of CC, then EPIgray data of 30 breast patients were retrospectively analysed with CC. %DDiff before and after CC identified a FP rate. A process to determine optimal EPIgray tolerances for breast 3DCRT to reduce incidence of FP results is presented, based on analysis of factors influencing %DDiff and a receiver operator characteristic curve analysis of the retrospective study data. This process determined that a reduced tolerance of ± 3.5% would optimise utility of the EPIgray results, but this would require additional clinical resources to investigate the

correspondingly increased rate of false negative results. Choice of tolerance requires consideration of workload and aims of the IVD program.

Keywords Epigray · In-vivo dosimetry · Transit dosimetry · Radiation therapy

Concluzii

The initial part of this study investigated measurement agreement between CC EPIgray and other established dosimeters. CC within EPIgray enabled the removal of patient and panel setup errors as a factor influencing the EPIgray dose reconstruction. Routinely used and calibrated detectors were used to justify the use of CC to better represent the treatment conditions within EPIgray for more accurate dose reconstruction. Translational patient shifts of up to ± 2.0 cm in all orthogonal translational directions were validated by comparison to film and IC dosimetric systems. While the post CC EPIgray %DDiff reflects the %DDiff provided by other dosimetry systems for shifts of up to ± 2.0 cm, it is recommended that the distance required for CC be noted. Shifts in patient contour which are clinically unacceptable, should automatically be considered an error regardless of whether or not the %DDiff is within the ± 5.0% tolerance. Any error greater than the clinically acceptable amount should be flagged and reported to the treatment team. The minimum experimental uncertainties associated with EPIgray reconstruction were determined as a basis for setting tolerances. By considering 3DCRT breast treatment specific parameters, EPID calibration uncertainties, acceptable setup errors on treatment and operator related uncertainties, the minimum uncertainty associated with EPIgray provided %DDiff was found to be ± 3.3%. ROC curve analysis was performed to produce a result of ± 3.5%, providing independent support for this value.

Clinical EPIgray experience has revealed that FNs do exist. There were fields which were outside the ± 5.0% tolerance post CC which may still represent a dosimetrically accurate treatment. Dosimetrically accurate fields which are failed by EPIgray occur due to two main reasons: (i) Inaccurate EPID image acquisition and/or (ii) the imposed ± 5.0% tolerance does not cover the entire range of patients and the variation of various clinical parameters that are seen in the clinical setting. In contrast, decreasing the tolerance from ± 5.0% to ± 3.5% to minimise the FP as indicated by ROC analysis would result in an

increasing number of dosimetrically accurate treatments being reported as inaccurate, even though no notable errors in treatment calculation or delivery have occurred. One of the primary purposes of this study was to identify an appropriate level of tolerance such that EPIgray could be more sensitive at identifying treatments which have been delivered suboptimally. The reduction in investigation tolerance reduced the number of FP by a factor of two, from 20 to 10. The feasibility of having an investigation tolerance at the determined optimal tolerance of 3.5% was considered using the pre- and post-CC results of the 255 fields of the retrospective study. However, in considering the most optimal tolerance for the clinic, the investigation rates of the tolerances should also be considered. With the implementation of the ± 3.5% investigation tolerance, the investigation rate increases from 10.5 to 33%. The increased workload to conduct these investigations should be balanced with the benefits from a reduction in FP results when deciding whether implementing a reduced investigation tolerance is justified. The robustness of EPIgray as an IVD system will increase with decreased investigation tolerance however the impact of the time required for investigating these results should be considered.

Articol 4

4. Anabela G. Dias, Diana F. S. Pinto, Maria F. Borges, Maria H. Pereira, João A. M. Santos, Luís T. Cunha, Joana Lencart

Optimization of skin dose using in-vivo MOSFET dosemeasurements in bolus/non-bolus fraction ratio: A VMAT and a 3DCRT study

Radiation oncology physics, J Appl Clin Med Phys 2019; 20:2: 63–70
doi: 10.1002/acm2.12525

Abstract

In-phantom and in-vivo three dimensional conformal radiation therapy (3DCRT) and volumetric modulated arc therapy (VMAT) skin doses, measured with and without bolus in a female anthropomorphic phantom RANDO and in patients, were compared against treatment planning system calculated values. A thorough characterization of the metal oxide semiconductor field effect transistor measurement system was performed prior to

the measurements in phantoms and patients. Patients with clinical indication for postoperative external radiotherapy were selected. Skin dose showed higher values with 3DCRT technique compared with VMAT. The increase in skin dose due to the use of bolus was quantified. It was observed that, in the case of VMAT, the bolus effect on the skin dose was considerable when compared with 3DCRT. From the point of view of treatment time, bolus cost, and positioning reproducibility, the use of bolus in these situations can be optimized.

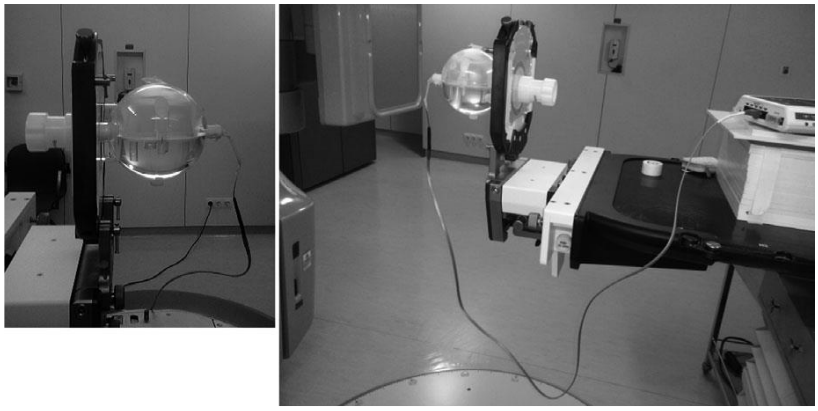

Fig. 2. Angular dependence measurement setup, with Lucy 3D qualityassurance phantom.

Concluzii

From the measurements made in the female anthropomorphic phantom RANDO, considering the treatment plan performed in the TPS, and without any correction factors, there was some discrepancy between the measured and the calculated values by the TPS, with more evidence for plan without bolus. However, this difference was within the ±20% error range, the value referred in the AAPM-TG 53 for the TPS calculation imprecision in the buildup region. These measurements also demonstrate that the surface dose increased in the presence of the bolus when considering VMAT and 3DCRT. This increased surface dose is clearly higher in the VMAT technique. Since the treatment plan is very similar to that performed for treatment of patients with breast carcinoma, measurements using the RANDO phantom seem to indicate an easy and straightforward method of verifying surface dose (in-vivo) applicable in actual clinical situations. It should

be noted that this method may be used in patients with other pathologies, always taking into account the associated error.

Articol 5

5. Bastiaan G. Wortman, MD, Cathalijne C.B. Post, MD, Melanie E. Powell, MD, PhD,y Pearly Khaw, MD, PhD,Anthony Fyles, MD, PhD,x Romerai D'Amico, MD, PhD,k Christine Haie-Meder, MD, PhD, Ina M. Jurgenliemk-Schulz, MD, PhD, Mary McCormack, MD, PhD, Viet Do, MD, PhD, Dionyssios Katsaros, MD, PhD, Paul Bessette, MD, PhD,Marie Helene Baron, MD, PhD, Remi A. Nout, MD, PhD, Karen Whitmarsh, MD, PhD, Linda Mileshkin, MD, PhD, Ludy C.H.W. Lutgens, MD, PhD, Henry C. Kitchener, MD, PhD, Susan Brooks, MD, PhD, Hans W. Nijman, MD, PhD, Eleftheria Astreinidou, PhD, Hein Putter, PhD, Carien L. Creutzberg, MD, PhD and Stephanie M. de Boer, MD, PhD
   Radiation Therapy Techniques and Treatment- Related Toxicity in the PORTEC-3 Trial: Comparison of 3-Dimensional Conformal Radiation Therapy Versus Intensity-Modulated Radiation Therapy
   Int J Radiation Oncol Biol Phys, Vol. 112, No. 2, pp. 390–399, 2022, https://doi.org/10.1016/j.ijrobp.2021.09.042

Abstract

Purpose: Radiation therapy techniques have developed from 3-dimensional conformal radiation therapy (3DCRT) to intensity modulated radiation therapy (IMRT), with better sparing of the surrounding normal tissues. The current analysis aimed to investigate whether IMRT, compared to 3DCRT, resulted in fewer adverse events (AEs) and patient-reported symptoms in the randomized PORTEC-3 trial for high-risk endometrial cancer.
Methods and Materials: Data on AEs and patient-reported quality of life (QoL) of the PORTEC-3 trial were available for analysis. Physician-reported AEs were graded using Common Terminology Criteria for Adverse Events v3.0. QoL was assessed by the European Organisation for Research and Treatment of Cancer QLQC30, CX24, and OV28

questionnaires. Data were compared between 3DCRT and IMRT. A P value of ≤ .01 was considered statistically significant due to the risk of multiple testing.

For QoL, combined scores 1 to 2 ("not at all" and "a little") versus 3 to 4 ("quite a bit" and "very much") were compared between the techniques. Results: Of 658 evaluable patients, 559 received 3DCRT and 99 IMRT. Median follow-up was 74.6 months. During treatment no significant differences were observed, with a trend for more grade ≥3 AEs, mostly hematologic and gastrointestinal, after 3DCRT (37.7% vs 26.3%, P = .03). During follow-up, 15.4% (vs 4%) had grade ≥2 diarrhea, and 26.1% (vs 13.1%) had grade ≥2 hematologic AEs after 3DCRT (vs IMRT) (both P < .01). Among 574 (87%) patients evaluable for QoL, 494 received 3DCRT and 80 IMRT. During treatment, 37.5% (vs 28.6%) reported diarrhea after 3DCRT (vs IMRT) (P = .125); 22.1% (versus 10.0%) bowel urgency (P = 0039), and 18.2% and 8.6% abdominal cramps (P = .058). Other QoL scores showed no differences. Conclusions: IMRT resulted in fewer grade ≥3 AEs during treatment and significantly lower rates of grade ≥2 diarrhea and hematologic AEs during follow-up. Trends toward fewer patient-reported bowel urgency and abdominal cramps were observed after IMRT compared to 3DCRT.

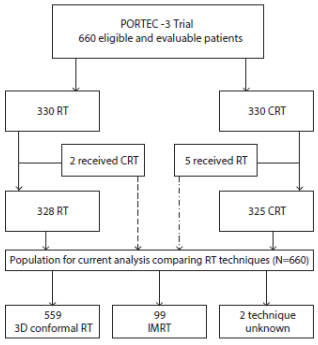

Fig. 1. Flowchart of the PORTEC-3 trial. *Abbreviations*: CRT = chemoradiation therapy; IMRT = intensity modulated radiation therapy; RT = radiation therapy.

Table 1 Patient characteristics

	PORTEC-3 population by technique (n = 658)			PORTEC-3 population by arm (n = 660)	
	IMRT (n = 99)	Conformal RT (n = 559)	*P value*	CRT (n = 327)	RT (n = 333)
Age at randomization, y					
Median	62.2 (56.1-68.1)	62.9 (56.5-68.0)	.24	61.9 (55.9-68.1)	62.5 (56.5-68.0)
<60	34 (34.3%)	232 (41.5%)	-	127 (38.8%)	141 (42.3%)
60-69	48 (48.5%)	224 (40.1%)	-	142 (43.4%)	130 (39.0%)
≥70	17 (17.2%)	103 (18.4%)	-	58 (17.7%)	62 (18.6%)
WHO					
0-1	95 (96.9%)	550 (98.7%)	0.18	320 (98.5%)	327 (98.5%)
2	3 (3.1%)	7 (1.3%)	-	5 (1.5%)	5 (1.5%)
Unknown	1	2		2	1
Comorbidity					
Diabetes	8 (8.1%)	73 (13.1%)	.33	45 (13.8%)	36 (10.8%)
Hypertension	36 (36.4%)	184 (33.0%)	.49	115 (35.2%)	105 (31.6%)
Cardiovascular	10 (10.2%)	39 (7.0%)	.50	29 (9.0%)	20 (6.0%)
FIGO					
Ia	10 (10.1%)	67 (12.0%)	.30	39 (11.9%)	39 (11.7%)
Ib	13 (13.1%)	103 (18.4%)	-	58 (17.7%)	59 (17.7%)
II	28 (28.3%)	142 (25.4%)	-	79 (24.2%)	91 (27.3%)
III	48 (48.5%)	247 (44.2%)	-	151 (46.2%)	144 (43.2%)
Histology					
Endometrioid	72 (72.7%)	398 (71.2%)	.27	234 (70.9%)	237 (71.8%)
Serous	13 (13.1%)	92 (16.5%)	-	53 (16.1%)	52 (15.8%)
Clear cell	8 (8.1%)	53 (9.5%)	-	29 (8.7%)	33 (10.0%)
Other	6 (6.1%)	16 (2.9%)	-	14 (4.3%)	8 (2.4%)
Type of surgery					
TAH-BSO	29 (29.3%)	164 (29.3%)	.96	96 (29.4%)	98 (29.4%)
TAH-BSO with LND/ full staging	39 (39.4%)	234 (41.9%)	-	140 (42.8%)	133 (39.9%)
TLH-BSO	14 (14.1%)	72 (12.9%)	-	44 (13.5%)	43 (12.9%)
TLH-BSO with LND/full staging	17 (17.2%)	89 (15.9%)	-	47 (14.4%)	59 (17.7%)
Treatment					
Chemoradiation arm	53 (53.5%)	273 (48.8%)	0.69	327 (100%)	-
Radiation therapy arm	46 (46.5%)	286 (51.2%)	-	-	333 (100%)
Brachytherapy boost	48 (48.5%)	261 (46.7%)	0.73	149 (45.6%)	160 (48.0%)
Radiation therapy technique					
IMRT	99 (100%)	-	-	53 (16.2%)	46 (13.8%)
Conformal RT	-	559 (100%)	-	273 (83.5%)	286 (85.9%)

Abbreviations: CRT = chemoradiation therapy; IMRT = intensity modulated radiation therapy; LND = lymph node dissection; RT = radiation therapy; TAH-BSO = total abdominal hysterectomy and bilateral salpingo-oophorectomy; TLH = total laparoscopic hysterectomy.

Concluzii

Within the PORTEC-3 trial, IMRT resulted in fewer grade ≥3 AEs during treatment and significantly lower rates of grade ≥2 AEs, specifically diarrhea and hematologic AEs, during follow-up as compared to 3D-conformal radiation therapy. Trends toward fewer

patient-reported bowel symptoms were observed after IMRT. Intensity-modulated techniques such as IMRT or VMAT should be the standard techniques for women receiving adjuvant radiation therapy for high-risk EC.

Articol 6

6. Todd F. Atwood, Narottam Lamichhane, Krisha Howell, Stephanie E. Weiss, Louise Bird, Charles Pearson, Michael C. Joiner, Michael M. Dominello, Jay Burmeister
Three discipline collaborative radiation therapy (3DCRT) special debate: A physicist's time is better spent in direct patient/provider interaction than in the patient's chart
J Appl Clin Med Phys. 2022;23:e13559. wileyonlinelibrary.com/journal/acm2 1 of 6
https://doi.org/10.1002/acm2.13559

Abstract

Radiation oncology is a highly multidisciplinary medical specialty, drawing significantly from three scientific disciplines—medicine, physics, and biology. As a result, discussion of controversies or changes in practice within radiation oncology involves input from all three disciplines. For this reason, significant effort has been expended recently to foster collaborative multidisciplinary research in radiation oncology, with substantial demonstrated benefit. In light of these results, we have adopted this "team-science" approach to the traditional debates featured in this journal. This article is part of a series of special debates entitled "three discipline collaborative radiation therapy (3DCRT)", in which each debate team has included three multidisciplinary team members, with the hope that this format would be both engaging for the readership and foster further collaboration in the science and clinical practice of radiation oncology. All 3DCRT debates thus far have included a radiation oncologist, medical physicist, and radiobiologist on each team. For this debate, we break that trend and include a patient representative along with a radiation oncologist and medical physicist on each team. We hope this patient perspective adds a valuable new aspect to our debate format and encourages the continued inclusion of patient perspectives in future clinical discussions.

Concluzii

- Medical physicists have historically contributed to patient care in radiation oncology primarily through the implementation and oversight of technology and comprehensive quality and safety programs. In addition, our dynamic healthcare environment continuously pressures the medical profession to redefine its contribution and value. So where can a more unfettered medical physicist provide "top of the license" contributions to the quality of patient care? One recent effort has been to cultivate increased engagement of the medical physicist with the patient for the intended result of maximizing the patient's understanding of their treatment and improving the overall healthcare experience.
- As the field of radiation oncology has evolved, so has the role of the medical physicist. While the primary function of the medical physicist in radiation oncology has always centered around the design and delivery of safe and efficacious therapy, the day-to-day responsibilities of medical physicists have consistently adapted to provide patients with the highest level of care. To assure the continued value of the medical physicist in the changing healthcare landscape, the American Association of Physicists in Medicine (AAPM) created a new initiative, called "Medical Physics 3.0"(https://www.aapm.org/ MedPhys30/), which aims to "redefine and reinvigorate the role of physics in modern medicine."
- Ensuring that all patients have the information they need to understand and feel comfortable with their care is a necessity for the field of radiation oncology. Medical physicists are ideally positioned to help address some of these concerns by leading efforts to demystify the radiation therapy process for patients. Using their comprehensive knowledge of the technology involved in radiation oncology and the specifics of each patient's treatment plan, medical physicists could ensure that all patient questions and concerns related to the technical aspects of their care are adequately addressed. Additionally, research has shown that education assists with patient enlistment in their own care, which can lead to improved adherence to treatment regimens. Traditionally, medical physicists have had some patient contact, but these interactions have typically been limited to brief clinical

encounters or meetings with technologically savvy and inquisitive patients. Recently, more comprehensive patient-facing roles have been explored to evaluate the potential of further integrating medical physicists into direct patient care.

- In addition to improving the patient experience, patient-facing roles for medical physicists would also strengthen clinical collaborations with radiation oncologists. Effective communication and teamwork have traditionally been assumed to be skills of expert individual practitioners, and formal training and assessment in these areas has been largely absent. By expanding the direct patient care team to include medical physicists, opportunities for shared decision-making would arise and communications bridging the technical and medical aspects of patient care would increase. This approach works to create a well-understood plan of care, which greatly reduces the chances of errors becoming consequential and injuring patients, and expresses a culture of strong, clear, and visible attention to safety
- The field of radiation oncology is interdisciplinary and requires a lot of teamwork. In the midst of this teamwork, the physicist plays a vital role in maintaining patient safety and quality of care. This delicate balance of teamwork in radiation oncology requires each division to prioritize and focus on their expertise. The smooth workflow of the radiation therapy department is facilitated by each team member carrying out their required work with diligence. A safety gate of this entire workflow is the division of physics, and a major focus of routine radiation oncology physics work is chart review. The process of chart review occurs within various steps of a clinical physics workflow such as pretreatment initial chart review, weekly chart review, and end of treatment chart review.
- The motivation behind the physicist being involved in direct patient care is noteworthy. The responsibilities of clinical physicists are evolving in the current era. However, adding direct patient care is another responsibility of a clinical physicist also comes with many challenges. For a radiation oncology department, and specifically for the division of physics, the allotment of staff is based on various factors within the department and guidance from professional societies. As such, the number of physicists required for a radiation therapy department is guided by

the number of treatments, radiation oncologists, machines, special procedures, and many other clinical factors. The value a medical physicist has in patient care is evident in expectations built into the current patient relations and clinic flow. It, however, is not often executed in a manner to build the patient's education and trust. Yet, these elements are highly crucial. In a review of more than 8,000 patient satisfaction surveys, albeit missing a medical physicist component question, patient satisfaction was greatest with regard to their perceived provider relationships. Beyond that, there exists a uniqueness to the relationship between a medical physicist and patient, some of which cannot be supplemented. We need to look no further than the standard procedure for HDR remote afterloader major medical emergencies.

- Clinically trained pathologists and radiologists best serve patients solely through direct peer-to-peer interaction. So too do medical physicists. The collaborative division of expertise in a functioning department of radiation oncology is akin to the clinical division of expertise that is enhanced by bringing these experts together in multi-disciplinary conferences. This promotes seamless throughput of patient care without compromising patient safety. We agree that patient awareness of the type of treatment and the methodology of treatment they are receiving is of utmost importance. However, this is not necessarily best achieved with direct physicist–patient interaction. Patient-related information sharing can be accomplished by electronic means, or printed materials provided by the patient's established clinical care team. This method is not only more efficient and cost-effective but potentially less overwhelming for the patient.
- The foundation of medicine is its underlying research. Medical physics research plays an important role in shaping the field of radiation oncology. Thus, we believe that the MedPhys 3.0 initiative may be best achieved by extending medical physics research into contemporary fields of medicine in lieu of directing physics efforts in direct patient interaction.

Articol 7

7. Joseph J. Foy, Serpil K. Dogan, Poonam Yadav, Bharat B. Mittal, Indra J. Das
Transferability of patients for radiation treatment between unmatched machines
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Abstract

Purpose: The feasibility of transferring patients between unmatched machines for a limited number of treatment fractions was investigated for threedimensional conformal radiation therapy (3DCRT) and volumetric modulated arc therapy (VMAT) treatments. **Methods:** Eighty patient-plans were evaluated on two unmatched linacs: Elekta Versa HD and Elekta Infinity. Plans were equally divided into pelvis 3DCRT, prostate VMAT, brain VMAT, and lung VMAT plans.While maintaining the number of monitor units (MUs), plans were recalculated on the machine not originally used for treatment. Relative differences in dose were calculated between machines for the target volume and organs at risk (OARs). Differences in mean dose were assessed with paired *t*-tests ($p < 0.05$). The number of interchangeable fractions allowable before surpassing a cumulative ±5% difference in dose was determined. Additionally, patient-specific quality assurance (PSQA) measurements using ArcCHECK for both machines were compared with distributions calculated on the machine originally used for treatment using gradient compensation (GC) with 2%/2-mm criteria.

Results: Interchanging the two machines for pelvic 3DCRT and VMAT (prostate, brain, and lung) plans resulted in an average change in target mean dose of 0.9%, −0.5%, 0.6%, 0.5%, respectively. Based on the differences in dose to the prescription point when changing machines,statistically,nearly one-fourth of the prescribed fractions could be transferred between linacs for 3DCRT plans.While all of the rescribed fractions could typically be transferred among prostate VMAT plans, a rather large number of treatment fractions,31% and 38%, could be transferred among brain and lung VMAT plans, respectively, without exceeding a ±5% change in the prescribed dose for two Elekta

machines. Additionally, the OAR dosage was not affected within the given criterion with change of machine.

Conclusions: Despite small differences in calculated dose, transferring patients between two unmatched Elekta machines with similar multileaf collimator (MLC)-head for target coverage and minimum changes in OAR dose is possible for a limited number of fractions (≤3) to improve clinical flexibility and institutional throughput along with patient satisfaction. A similar study could be carried out for other machines for operational throughput.

Concluzii

Transferring patients between linacs may be necessary in the case of a machine malfunction to prevent disturbing a patient's intended course of treatment. For 3DCRT and VMAT prostate, brain, and lung plans, clinically unmatched Elekta linacs with the same MLC head (providing nearly identical PDD and profiles) demonstrated adequate agreement in the delivered doses to the PTV,OARs, and the description point. Differences in the dose to the prescription point indicated that patients can be transferred between two linacs for at least three treatment fractions; however, the differences in the dose due to this transfer should be assessed and documented for each patient. Additionally, calculated and measured dose distributions among VMAT plans reflected good agreement with no systematic differences in the GC passing rate between two machines. These findings may aid clinicians in the scheduling of patients and provide some flexibility in patient treatment when a transfer between unmatched linacs is necessary. While the values presented here may not apply to the general medical physics community with many combinations of different linacs, the methods outlined in this study could be implemented a priori to determine how many fractions can be transferred between unmatched linacs without significantly degrading treatment plan quality and institutional dosimetric criterion.