specific absorption rate (SAR) distribution. The measurement data is obtained with a saline phantom consisting of a tube with elliptical cross section. The tube is inserted into the BSD-2000/3D Sigma60 and a probe inside is moved in 3 spatial dimensions. The probe, a commercial isotropic SAR sensor, is scanned in 2 cm steps for a distance of 20 cm in horizontal and vertical directions and relative SAR values are recorded. Planned and measured data in the central plane of the applicator are compared for the location of the focus to assess the transferability of treatment plans to the treatment machine.

Results: The location of the focus maximum can be determined from the graphs and compared to the location of the maximum from the simulation. For the investigated plans an agreement between simulation and measurement was found with deviations of the focal area between 0 and 2 cm.

Conclusion: Good agreement for the investigated patient plans was found between simulation and measurement. With an automated measurement system higher resolutions and 2D or 3D comparisons would be possible. The method described allows the transferability of a patient treatment plan to the treatment machine to be verified, however it does not check the correct heating of the patient.

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An optimal grid block design for spatially fractionated radiation therapy

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Purpose or Objective: In the present work, we performed model calculations of cell survival to design a Grid block with optimal therapeutic ratio. The optimal Grid block was manufactured and dosimetric characteristics of the Grid were introduced.

Material and Methods: The Geant4 toolkit (Version 9.6.p02) was used to simulate the head of the Varian2100C linear accelerator for a 6 MV photon beam based on the vendor detailed information. The dose distributions of a Grid block with hole-diameters of 0.5 cm, 0.75 cm, 1.0 cm, 1.25 cm, and 1.5 cm with constant center-to-center spacing of 1.8 cm, were calculated separately using the Monte Carlo simulation technique. A dose profile from Monte Carlo simulation, across a single hole of the Grid, has been utilized to calculate therapeutic ratio for different Grid blocks separately. The Hug-Kellerer (H-K) radiobiological model (Equation 1) which is more appropriate at doses higher than 12 Gy was utilized to calculate survival fraction of cell lines under a single hole of the Grid. The values of α/β ratios for tumor cells and normal cells were considered to be 10 Gy and 2.5 Gy, respectively.
Equation 1:

$$\begin{cases} SF = \sum V_i \, e^{(-k_1 D_i + k_2 (1-\exp(-k_3 D_i))} \\ \alpha = k_1 - k_2 . k_3 \qquad \beta = k_2 . k_3^2 . (\ln(2) - 1/2) / (\ln(2))^2 \end{cases}$$

Where the *Vi* represents the relative cell numbers receiving the same dose ranging from *Di* and *Di+1*. The therapeutic advantage of the Grid irradiation was considered in terms of the normal tissue cell survival ratio (Grid/open field ratio) for the same tumor cell survival.

A Grid with optimal TR value was selected to manufacture. Dosimetric characteristics of the Grid were measured using ionization chamber in water phantom and Gafchoromic film dosimeter in Solid WaterTM phantom materials.

Results: The results from the Monte Carlo studies showed that increasing the spacing between the Grid holes with a given hole diameter keep the TR value of the Grid block nearly unchanged (±4%). Moreover, a Grid block with a hole-diameter of 1.0 cm and 1.25 cm may lead to about 19% higher clinical responses relative to the Grids with hole-diameters smaller than 1.0 cm or larger than 1.25 cm. Dosimetric measurements of the optimal Grid were in good agreement (± 5%) using different dosimetry techniques. Table 1 shows comparison between different dosimetric features of the manufactured Grid and the dosimtric features that were predicted by Monte Carlo simulation.
Table 1

	Geant4-Monte Carlo simulation	Ionization chamber dosimetry	Film dosimetry	Max difference
Output factor	0.87	0.85	0.83	-4.6%
Valley-to-Peak ratio	21%	20.4 %	19.8 %	-5.7%
TR (15 Gy to dmax)	1.95	2.00	1.87	-4.1 %
EUD (15 Gy to dmax)	6.14	6.3	6.0	-2.6%

Conclusion: Designed Grid block leads to have an optimal therapeutic ratio for spatially fractionated radiation therapy.

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Individual cases review in KROG-0806 study Phase Ⅲ randomized trial for breast cancer patients

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Purpose or Objective: Korea Radiation Oncology Group (KROG)-0806 study has been the phase Ⅲ randomized trial to investigate the efficacy of internal mammary node(IMN) irradiation in breast cancer patients. Previous dummy run study evaluated protocol compliance of participating institutions. The purpose of this study is to assess the protocol compliance based on individual cases review (ICR).

Material and Methods: For ICR, patients were divided into eight subgroups based on IMN irradiation (non-irradiation (N) vs. Irradiation (R), tumor laterality (left-side (L) vs. right-side (R)) and type of surgery (breast-conserving surgery (B) vs. mastectomy (M)), respectively: NLB, NRB, NLM, NRM, RLB, RRB, RLM and RRM. We extracted 15% among patients enrolled in each subgroup using the SURVEYSELECT procedure with the simple random sample. Then, all participating institutions were requested to upload the following information: planning computed tomography (CT) images, structure sets, and radiation doses as well as the documents containing treatment techniques and all beams' eye views with questionnaire. We performed the comparison of the dose distribution among 8 subgroups. Major and minor violations are determined according to IMN treatment and dose delivered to IMN.

Results: The information of 102 patients was collected. Institutions used the different treatment techniques such as standard tangents (42.2%), partial wide tangent (23.5%), 30/70 photon/electron mix (17.6%), IMN-electron only (4.9%), and reverse hockey stick (11.8%). The IMN average doses in subgroups were as follows: Arm1[NLB(14.9Gy±10.7Gy), NRB(18.5Gy±13.0Gy), NLM(27.7Gy±16.4Gy), NRM(27.5Gy±15.1Gy)] and Arm2[RLB(48.3Gy±4.5Gy), RRB(50.9Gy±4.1Gy), RLM(49.3Gy±4.1Gy), RRM (51.3Gy±3.2Gy)]. The dose differences between Arm1 and Arm2 groups were statistically significant. Dose variations in IMN were much greater in Arm1 than Arm2. In Arm1 group,