Inter-fractional variation in Fletcher-Suit applicator geometry

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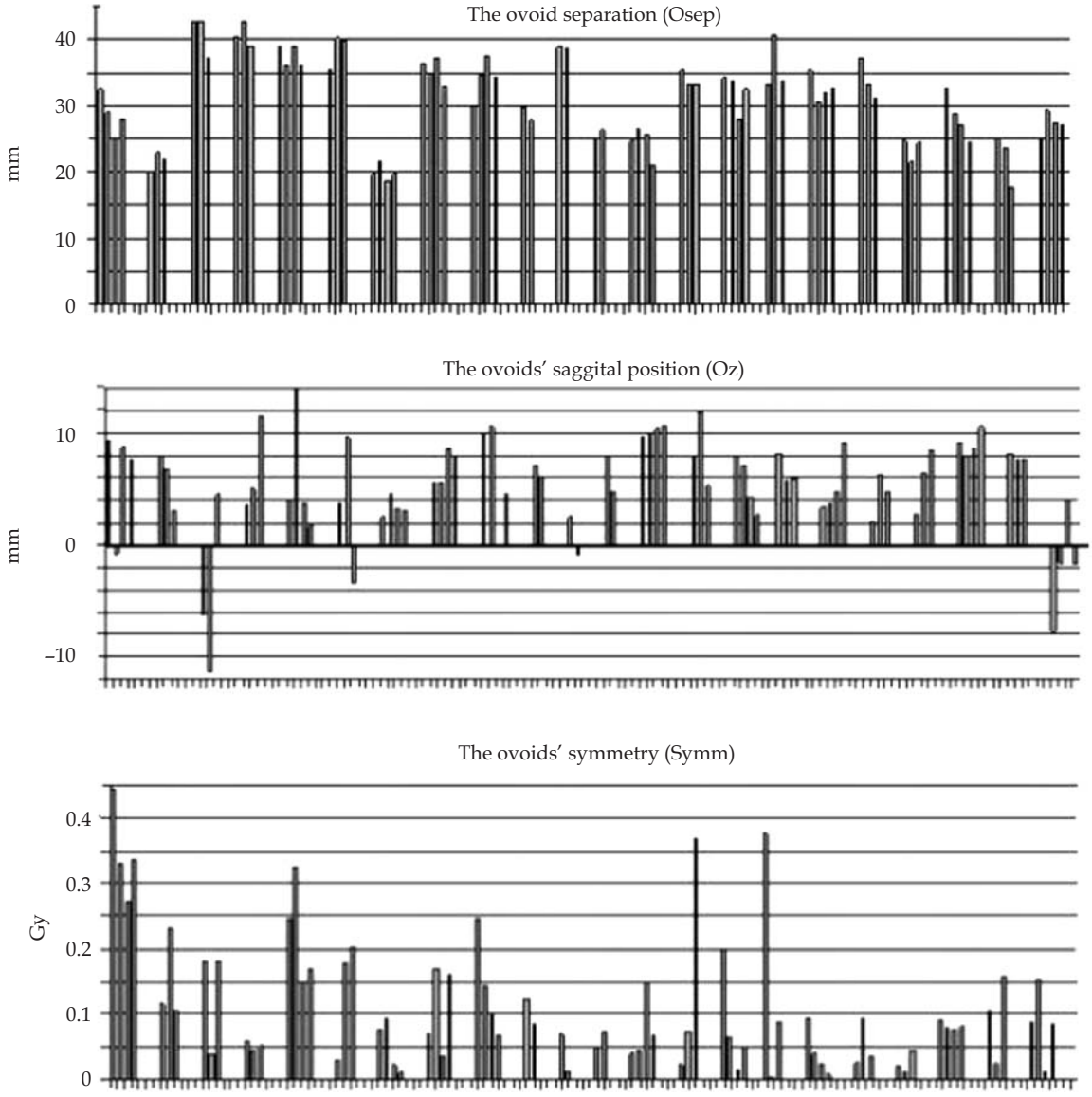
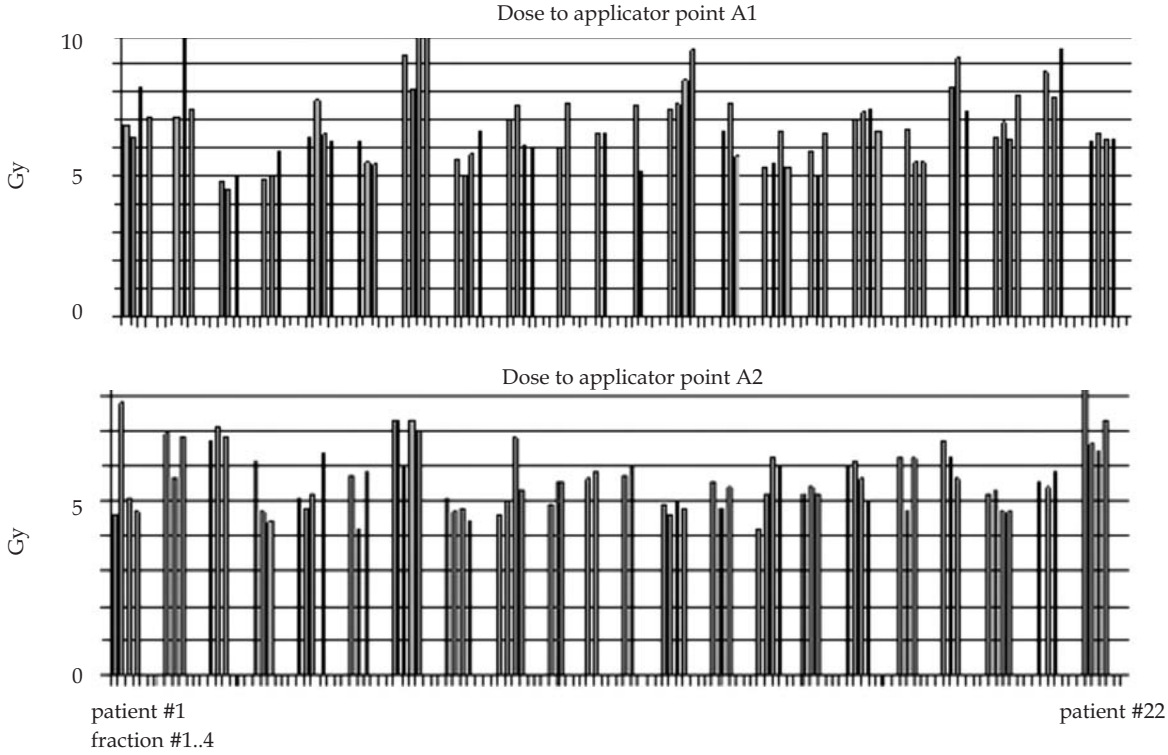
Purpose: The fixation mechanism of Fletcher-Suit (FS) applicator allow independent positioning of the tandem and ovoids, adapting to different anatomical and pathological situations resulting in various geometrical arrangements. The aim of the study was to evaluate the inter-fractional variation in applicator geometry in course of multiple treatrments and the infuence on sagittal dose distribution.

Material and methods: We considered 73 FS applicator geometries in course of definitive treatments of 22 patients. The majority of the patients received four treatment fractions with one fraction per week schedule. All insertions were performed by the same gynaecologist using the Fletcher-Suit applicator (Nucletron) with 15 degrees tandem. Oval ovoid spacers of same form and dimensions (round or D-profile) were applied for each treatment fraction. We prepared the treatment plans with the PLATO Brachytherapy Treatment Planning System v13.7 (Nucletron). We normalized the dose distributions to ICRU AL and AR reference points. We administered 7 Gy dose per fraction. For the accurate comparison of sagittal dose distribution of different FS applicator arrangements, we defined the coordinate system fixed to the tandem. We computed three quantities influencing primarily the dose distribution, such as: lateral separation of the left and right lateral symm ovoids (Osep), the sagittal position of the ovoids with respect





of the tandem (OZ) and the quantity Symm measured the symmetry of the ovoids. Osep was defined as Osep = OL + OR, where OL and OR were the lateral distances of the left and right ovoids and the tandem. OZ was evaluated from the distance along the Z axis between the origin and the second radio-opaque marker inserted into the ovoids, while and the ovoids' symmetry was defined as Symm = abs (OL-OR)/Osep. We focused on the applicator geometry related variations to dose distribution. To evaluate the applicator geometry related variations of sagittal dose distribution, we defined two applicator points fixed to the tandem 2 cm apart towards the bladder (A1) and the rectum (A2) respectively. We compensated the ovoids' shift with deactivation of the dwell positions near the rectum in ovoids being in a low sagittal position. To obtain the best dose distribution, we considered the dose level at points A1 and A2 and the dose ratio (R). We preferred the plan variant, in which the dose level at the two applicator points did not exceed the reference dose (7 Gy) and R was close to 1.

Results: Figure 1 shows the inter-fractional variation of the ovoid separation (Osep), the ovoids' sagittal postision (OZ) and symmetry (Symm) and the optimised dose values at the applicator points A1 and A2. Our study is pertained to the Fletcher-Suit applicators with 15 degrees tandem (Nucletron). The standard deviations of inter-fractional variation of the ovoid separation and the ovoids' sagittal position were within 5.2 mm and 10.2 mm respectively, while both similar and also different values of quantity Symm occurred. The inter-fractional variations using the dose optimisation described above, resulted in variation in dose levels at the two applicator points (A1 and A2) 0.8 Gy typically, while the largest value was 1.6 Gy.