Correlation between the Fletcher-Suit applicator geometry and sagittal dose distribution

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Purpose: Depending on the patient anatomy and pathology and on the construction of the FS applicator different geometrical arrangements in ovoid separation, in ovoids' sagittal level with respect to the tandem were experienced. The aim of the study is to evaluate the influence of main geometrical parameters, such as: the ovoid separation, symmetry and the ovoids' sagittal shift on dose distribution in different FS applicator arrangements. We investigated the FS applicator geometry related influence to sagittal dose distribution, therefore, we excluded the patient anatomy related effects.

Material and methods: We considered 73 treatment fractions of 22 patients. All insertions were performed by the same gynecologist with the same type of FS applicator with 15 degrees tandem (Nucletron), while the treatment plans were generated by the same physicist using the same treatment planning method with the Plato Brachytherapy Planing System v13.7. We compared the sagittal dose distribution of different FS applicator geometries with dose levels at two applicator points, defined 2 cm with respect

of the tandem towards the bladder (A1) and rectum (A2). We considered the dose level at points A1 and A2 and the ratio of doses (R). We preferred the plan variant, in which the dose to points A1 and A2 did not exceed the reference dose (7 Gy) and R was close to 1. We computed the Pearson correlation coefficients (P) between the dose levels at the applicator points and the ovoid separation, symmetry and the ovoids' sagittal shift. We also obtained the P values of filtered dataset for insertions with the ovoids being in correct sagittal positions, for insertions with narrow ovoid separation and for asymmetric arrangements.

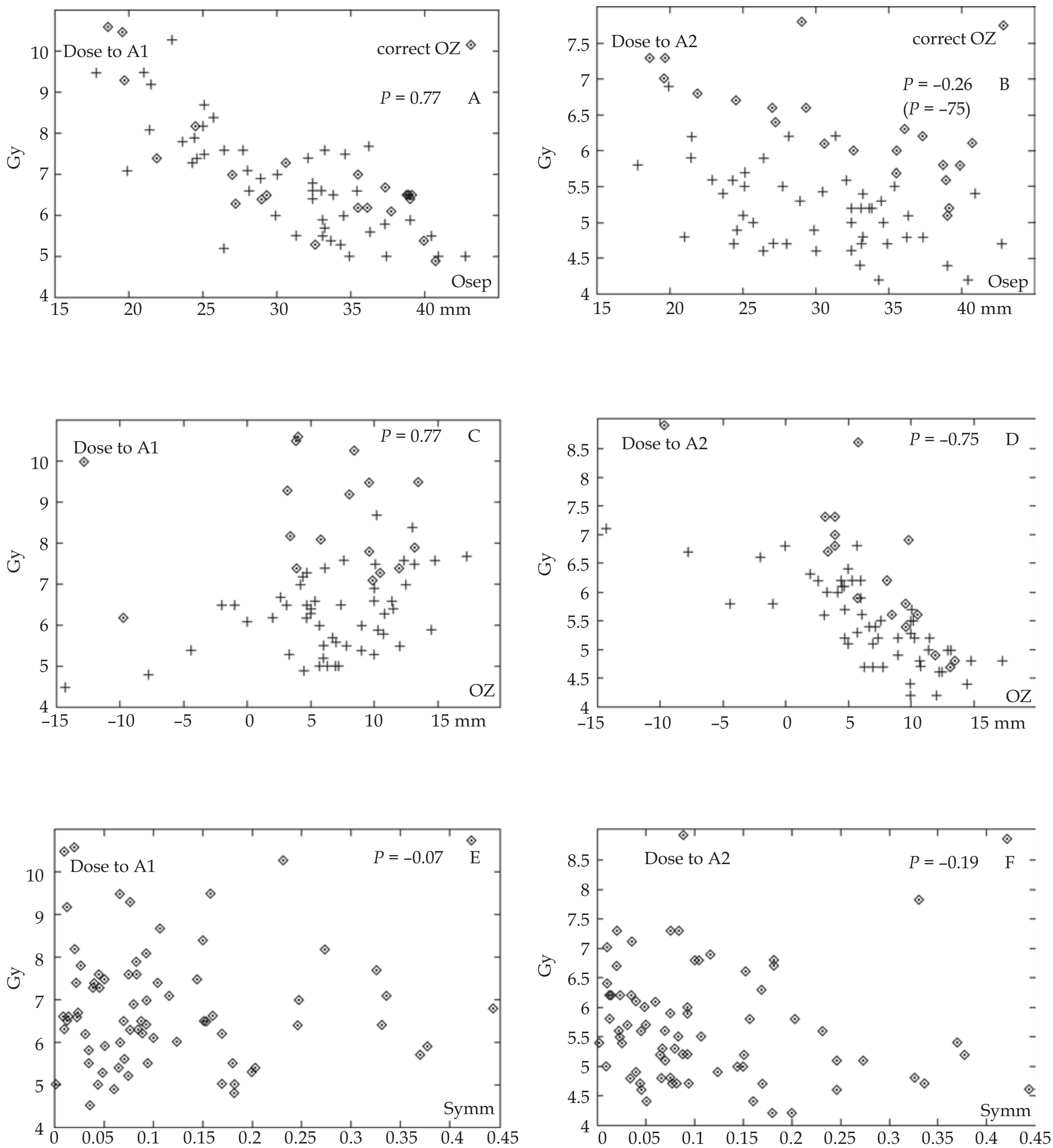

Fig. 1. Distribution of dose values to applicator points

Results: Figure 1 shows the optimised dose values at the two applicator points as function of the ovoid separation (Osep), the ovoids sagittal level (OZ) and of the ovoids' symmetry (Symm). Strong correlation ($P = -0.77$) was found between the ovoid separation and dose values to applicator points A1 and A2 for FS applicators with the ovoids being in correct sagittal position. Also strong correlation was found ($P = 0.75$) between the dose values to points A2 and OZ, while medium correlation ($P = 0.3$) was given between OZ and A1. No correlation was between dose values to A1 and A2 and the symmetry (Symm). We obtained similar *P* values for filtered datasets, such as: for FS insertions with correct ovoid position, for narrow ovoid separation and for asymmetric ovoid arrangements. The only difference was: strong correlation ($P = 0.75$) was given between the ovoid separation and dose values to both A1 and A2 for FS applicators with ovoids being in correct sagittal position.

Conclusions: The most important factors determining the sagittal dose distribution of a given FS insertion are: the ovoid separation and the ovoids' sagittal position with respect to the tandem, while the ovoid symmetry had no influence. FS applicator geometries with correct ovoid position and large ovoid separation provide acceptable sparing of organs at risk. In addition of dose optimisation described above, FS insertions with small ovoid separation or insertions with ovoids being shifted towards the bladder or rectum need further measures to decrease the dose to organs at risk.