Intensity-modulated radiotherapy (IMRT) has been introduced in a number of disease in the late nineties for treating complex treatment volumes and avoiding close proximity organs at risk (OAR) that may be dose limiting. Fifteen years later, in many countries, IMRT is still not considered as a standard technique for treating gynaecological cancers. It is well accepted that delivering acute and late radiation toxicities to close to the main endpoints, IMRT may be considered as the ideal technique. By contrast, if disease-related outcomes are considered, there are still insufficient data to recommend IMRT over three-dimensional conformal radiotherapy. Moreover, with the increased accuracy of treatment delivery comes the need for greater accuracy in incorporation of organ motion to prevent geographical misses. Uterus significantly moves according to the bladder and rectal filling. The majority of motion occurs in the anterior-posterior and superior-inferior directions, with mean interfraction movements of 4.7 mm, but very large displacements up to more than 2 cm may occur with the inherent risk of poor coverage of the posterior part of the cervix or of the uterine fundus. Similarly, during post- operative irradiation, the vaginal CTV changes its position with standard deviation of 2.3 cm into the anterior or posterior direction, 1.8 cm to left or right and 1.5 cm towards the cranial. According to the majority of studies a uniform CTV planning treatment volume margin of 15 mm would fail to encompass the CTV in 5% of fractions in post-op. It rises up to 32% when the CTV includes the entire uterus. For intact cervical cancer, where gross disease is present, the significant shrinkage in tumour volume of 62% in mean, also contributes to potential unintended doses to normal tissues, but the risk is rather low.

How to deal with motion uncertainties?

It can be helpful to attempt to control rectum and bladder filling, although the compliance with instructions for bladder filling and for rectal emptying does not always result in adequate reproducibility. The construction of an ITV from CT images acquired with empty and full bladder is also another way to account for interfraction motion of the CTV. The implementation of IGRT on a daily basis is essential for judging the effectiveness of the measures previously outlined. However, one must never forget that the cervix or vaginal cuff and surrounding tissues are mobile relative to the bony pelvis, while the pelvic lymph nodes which are also part of the target are relatively fixed. Thus, the shifts to account for motion of the mobile target may move the pelvic lymph nodes out of the PTV. Consequently, care should be taken when shifting to ensure that nodal targets are still within PTV, but keeping CTV to PTV margins to 10-15 mm helps to find a good compromise without jeopardizing the OAR’s sparing. The risk of geographical misses does exist, but its level must be appreciated in the light of the dose contribution brought by the additional brachytherapy. Brachytherapy still plays a major role in the treatment of cervix carcinomas. The important dose gradient and the absence of target motion in relation to the inserted radioactive sources allow for dose escalation and 3D image guided adaptive procedure allows for accurate definition of target volumes with definition of dose volume parameters. Consequently a moderate under dosage of a part of CTV during IMRT may even compensated by the high dose delivered by brachytherapy.

The concept of adaptive IMRT seems to be applicable for the management of the complex deformable target motion that occurs during radiation of gynaecological cancers. The cervix-uterus shape and position can be predicted by bladder volume, using a patient-specific prediction model derived from pre-treatment variable bladder filling CTscans. Based on that, a strategy called “plan of the day” has been elaborated and is under investigation. In conclusion, organ motion is not an obstacle to the use of IMRT as standard technique for gynaecological cancer, especially when combined with brachytherapy, provided that PTV margins are not reduced and IGRT is adequately used. The participation to prospective studies and/or the registration of patients in database are strongly encouraged.