Purpose:Small photon beams used in radiotherapy are characterised by high dose gradients and a lack of lateral electron equilibrium. Thus, the measurement of output factors (OF) of these beams is problematic and OF measurements with different detectors for similar irradiation conditions can lead to a deviation up to 30% (Derreumaux et al., 2010). The aim of this study is to accurately determine the OF of a Cyberknife system thanks to measurements and Monte Carlo data.

Methods:OF were measured on a Cyberknife for the 5, 7.5, 10, 20 and 60 mm diameter field sizes using active detectors (high resolution diodes (IBA SFD, PTW 60016, PTW 60017, Sun Nuclear EDGE), PTW 31014 Pinpoint chamber and PTW 60003 natural diamond) and passive dosemeters (EBT2 radiochromic films and TLD micro-cubes). Correction factors for diodes (EDGE, PTW 60016, PTW 60017) and for the PTW 31014 chamber were calculated thanks to a recent methodology based on Monte Carlo data (Francescon et al., 2008 and 2009). The Cyberknife used in this study was modelled with Penelope and MCNPX Monte Carlo codes in order to determine the “true” OF.

Results:For the smallest field size, a deviation of nearly 20% was observed between the values of the OF measured with the different detectors. The agreement between the passive dosemeters was better than 2%. After correction for diodes and for the chamber, the OF obtained with these active detectors agreed within 2% with the passive OF measurements.

Conclusions:This study is encouraging concerning the determination of the output factors of the Cyberknife system. For the active detectors, the use of correction factors improves the accuracy in the OF measurements. The results obtained with the passive dosemeters in this study as well as in another study performed on a Novalis system (Bassinet et al., 2011) are promising.