

First Experience using the Papillon +TM Contact X-Ray brachytherapy (CXB) for breast IORT.

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Purpose

The Papillon 50TM unit was designed in 2009 to perform CXB treatment using 50 KVp X-Rays with short focus distance (FSD <4cm) and high dose rate (> 15 Gy/mn) aiming at replacing the Philips RT 50TM to treat endoscopically rectal cancer or skin cancer. In order to treat breast cancer using an intra-operative radiotherapy (IORT) approach a new Papillon+TM (P+) unit was designed (Ariane cpy. UK) and the first prototype was installed in Centre Antoine Lacassagne in Nice in March 2017 after receiving the CE Marks.



50 KVp x-ray generator. NBA applicator fixed on x-ray tube-rod (arrow)



Work station Papillon+TM

Material and method

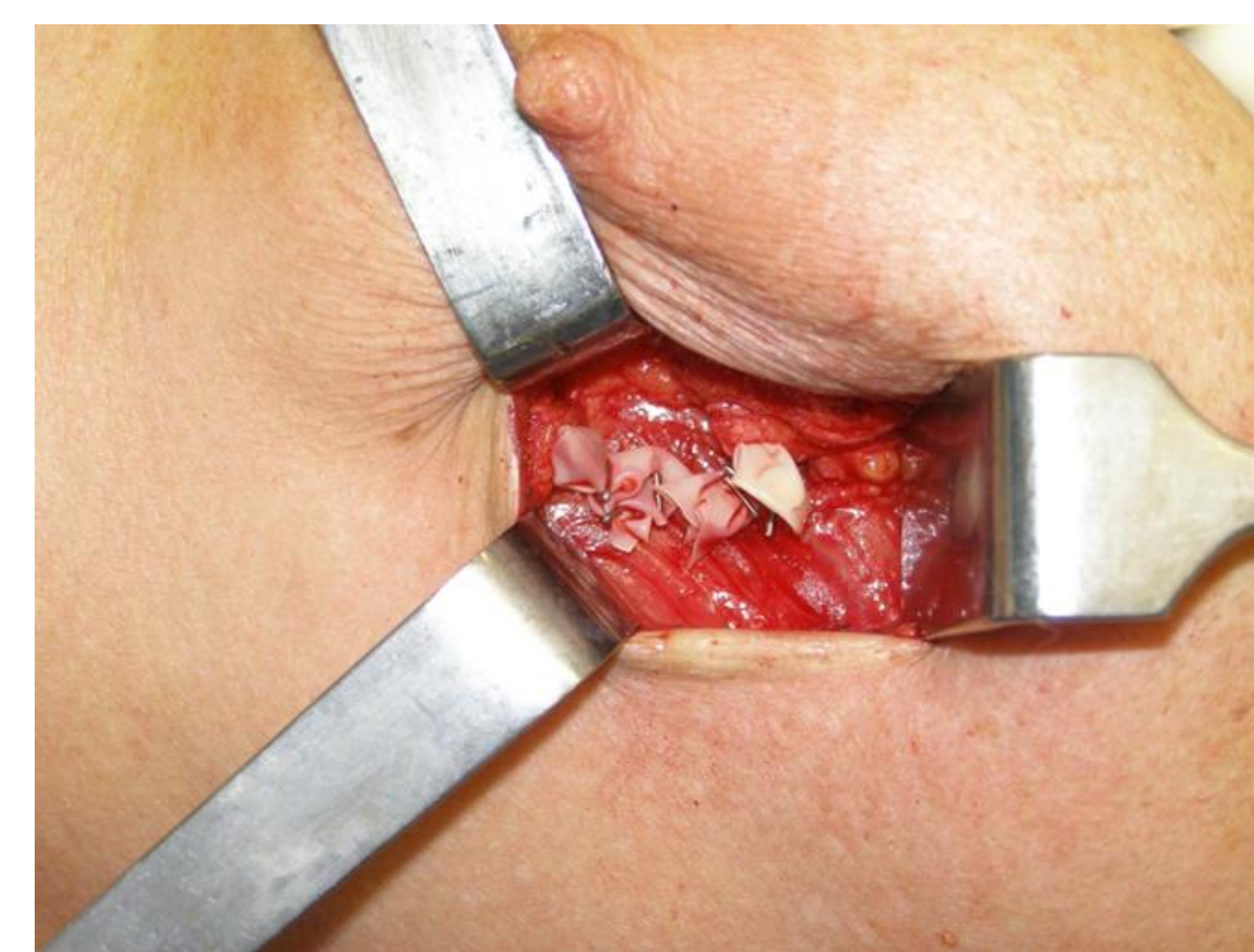
The P+ unit is a battery powered mobile X-Ray generator producing an X-Ray beam with a peak energy of 30 or 50 KVp. A tungsten transmission anode is liquid cooled to produce a dose rate of 8-18 Gy/minute depending on distance and added filtration. The useable beam angle is 310° x360° and is well adapted to breast IORT. The tube incorporates a radiation delivery rod that is 22 cm long and 1.7 cm in diameter. The X ray tube and integrated high voltage generator are mounted on an articulated arm that incorporates electromagnetic brakes on all movements. A separated work station is used to remotely control the system using a wireless connection. Various applicators can be mounted on Treatment Application Adaptors to treat breast, but also rectal and skin tumors. The physics characteristics of the machine and beam were checked during the commissioning of the P+TM by the Medical Physic team of Lacassagne.



Nice Breast Applicator (NBA) ; Diameter between 3 and 5 cm (Ultem material)

Results

The beam stability is within 3% over 1 hour and the dose homogeneity at a 40 mm diameter breast applicator surface is within $\pm 5\%$ of the central axis dose. The percentage depth dose at 5 mm is between 35% and 65% depending on the KVp, FSD and applicator diameter. Radiation protection to comply with regulation is easily achieved using a machine mounted shield and the P+ can be used in a room with only 0.3 mm lead equivalent shielding or none if room large (> 6 m X 6 m). The radiation oncologists and breast surgeons have tested the feasibility of using the P+ and NBA applicator for sham breast IORT after lumpectomy and sentinel node dissection for early breast adenocarcinoma. The whole IORT process appeared safe, simple, robust and fast. A phase I-II study (IDRCB: 2016-A01619-42) will be initiated in June 2017 to check using OSL and Gaf Chromic in vivo dosimeter that the 20 Gy dose prescribed at the surface applicator is effectively distributed in the tumor bed.



Dosimeters (OSL, Gafchromic, FLi) positioned in the tumor bed after lumpectomy for in vivo RX dose control



Positioning of the NBATM applicator after lumpectomy and fixation using a FissoTM arm mounted on the operating table



Dose quality control using a dedicated plastic insertion system and sham ultem applicators of different diameters mimicking the NBA spherical applicators.

Conclusion

The Papillon+TM is a new multipurpose CXB 50 KVp machine with the advantage of a **high dose rate** and easy radioprotection. First clinical results achieved in Nice will be presented at time of the meeting.