defined at the TPS includes the fixation system, the program calculates the whole path as tissue; although for conformal radiotherapy heterogeneity contours can be drawn in the BEV, there is no way in doing the same in the calculation slice as it would be necessary for treatments involving large areas with low or high densities as lung treatments; large couch rotations are not addressed by the system.
Conclusions: Diamond has proven to be an efficient tool to perform independent verifications of TPS calculations. From our initial experience we have found that some minor changes in the program such as an improvement in the introduction of all the desired calculation points or the possibility of modification of the calculation slice (removing support structures, adding heterogeneities) would be very helpful to users.

EP-1169

The capability of detecting MLC leaf positioning errors in VMAT treatment plans with an upstream detector system

U. Isacsson[1], K. Nygård[1], K. Wikström[1]
[1]University Hospital, Department of Radiology Oncology and Radiation Science, Uppsala, Sweden

Purpose/Objective: The use of Volumetric Modulated Arc Therapy (VMAT) treatment plans for radiotherapy treatments of head and neck patients is increasing mainly due to shorter treatment times compared to IMRT. However, accurate multileaf collimator (MLC) leaf positioning plays an essential role in the effective implementation of VMAT. The aim for the present work is to investigate the sensitivity of a new patient specific QA-measurement system for QA during treatments with respect to MLC leaf positioning errors.
Materials and Methods: Ten head and neck patients previously planned and treated with a VMAT technique were used in the study. The original plans were exported and the leaf positions were changed to simulate five different systematic positioning errors of the MLC-banks. That is $\pm$ 0.2 mm and $\pm$ 0.5 mm of all leaf positions in each leaf bank (X1 and X2). Negative and positive errors make the leaf end-to-end distance smaller and larger, respectively. The fifth plan simulated a random error of each leaf in each control point with a standard deviation of 0.5 mm. After the MLC leaf positioning errors were introduced the plans were re-imported and re-calculated in the treatment planning system. Measurements, with a Delta^{4PT} and a Delta^{4AT} system, for the modified plans, were compared with calculated doses of the original plans and with each other. The agreement between calculation and measurement was evaluated using gamma index with 3%/3 mm and 3%/2 mm criteria.
Results: Comparing the original treatment plans with the plans representing MLC leaf positioning errors show that the target coverage decreases significantly for $\pm$ 0.5 mm leaf position errors and the dose to the organs at risk increases significantly. The sensitivity of the upstream detector system was large for all plans with clinical relevant MLC leaf positioning errors.
Conclusions: The capability of detecting clinical relevant leaf positioning errors with the upstream detector system was good.

EP-1170

Effect on dose from a titanium plate in Gamma Knife treatment

B. Reiner[1], G. Wright[1], P. Bownes[1]
[1]St James Institute of Oncology, Radiation Oncology, Leeds, United Kingdom

Purpose/Objective: After certain types of brain surgery part of the skull bone may require to be replaced by a titanium plate. If such patients have a tumour recurrence Gamma Knife treatment may be required. The effects of a 0.5mm titanium plate on dosimetry were investigated.
Materials and Methods: On a Gamma KnifePerfexion the spherical ABS phantom was used to measure dose with and without thetitanium plate (superior, one 16mm shot) and with titanium plate only within halfthe field. EBT 2 film was exposed directlyunder the plate and in a plane in 1cm wax. to 5Gy. Transmission from a single sector was measured with a 0.125cc ion chamber (PTW 31010). The central slab from the ABS phantom was placed on a Perspex block of 15x15x20cm^3 in order to position the chamber centre 5mm beneath the plate surface. Chamber,holder and phantom where fixed on the eXtend system and a CT scan performed. This arrangement was irradiated with 2 Gy to the 100% isodose from a single 16mm sector to the centre of the ion chamber as scanned(no absorber material), with the titanium plate directly in contact with the phantom surface, and with 1cm air gap Thetransmission of the titanium plate was also measured on a 6MV Linac with a10x10 and a 4x4cm field and SSD 100cm with a Farmer type chamber in 5cm water and on a orthovoltage unit with 220kV (6x6cm, FSD 53cm).
Results: On film only a dose increase of a few percent directly under the plate was measureable with the film scanner. No difference was observed on the film at 1cm depth between irradiation with or without the titanium plate and no difference observed for the half covered area. Single sector measured transmission with the ion chamber showed an absorption of 0.7% when a1cm gap of air was left between titanium plate and the surface. A dose increase of 0.4% was measured when the titanium plate was placed directly in contact to the slab of the chamber holder. On the 6MV Linac the absorption of the titanium plate was 0.6% and 0.8% for the 10x10 respectively 4x4cm field respectively. On the 220kV X-ray unit an absorption of 5.4% was measured for the 0.5mm titanium plate.
Conclusions: Absorption due to the Titanium plate used for skull bone replacement seems to be minimal for Cobalt-60 energy. The dose increase directly after the titanium plate is measureable but due to the multi circular beam arrangement of the Gamma Knife the effect is spread. Special care should be given to targets with a distance of less than 3mm to the titanium implant due to the dose increase when all beams intersect at the same place.

EP-1171

Testing the feasibility of integration of an in vivo dosimetry procedure in quality assurance of pelvic 3DCRT

M. Russo[1], A. Anitori[1], F. Greco[2], M.S. D'Ambrosio[3], M. Carcaterra[3], V. Burla[3], A. Piermattei[4]
[1]Ospedale Belcolle - AUSL VT, UU.OO. Fisica Sanitaria e Radioterapia, Viterbo, Italy
[2]Università Cattolica Sacro Cuore, U.O. Fisica Sanitaria, Roma, Italy
[3]Ospedale Belcolle - AUSL VT, U.O. Radioterapia, Viterbo, Italy
[4]Università Cattolica Sacro Cuore, Istituto di Fisica e U.O. Fisica Sanitaria, Roma, Italy

Purpose/Objective: The demand for safety and quality assurance in RT is becoming increasingly urgent. This is a need felt by professionals involved, caused by the growing complexity of RT techniques and technologies involved in treatment delivery, as well as by patients, because of the increasing attention paid by non- specialist press to RT accidents. As an associate member of a National Project financed by the National Institute of Nuclear Physics, aiming to development of in vivo dosimetry (IVD) procedures for RT, our Institution have participated in testing the IVD procedure and software, specific for 3DCRT. Here we propose the preliminary results of a trial aiming to IVD integration in quality management of pelvic RT.
Materials and Methods: 15 consecutive patients undergone to 3DCRT for pelvic cancer (prostate, rectum or gynecologic tumors) were selected. A personalized 3DCRT treatment plan was prepared for all of them, consisting of a set of 4 or 5 MLC conformed beams (open or wedged beams), with an isocentric prescription dose/fraction of 1.8 Gy, (number of fractions ranging between 25 and 43). DRRs of a couple of square orthogonal isocentric fields were also obtained for patient setup verification on linac couch. Geometric and dosimetric plan data were then transferred to the R&V Network, to make them allowable to both linac interface and IVD software. An integrated approach, based on scheduled setup verifications (SVs) and IVD checks has been tested for each selected patient during the course of RT, consisting of: i) a comparison between the EPID images of the couple of orthogonal beams and the corresponding DRRs before treatment delivery and ii) the calculation for each field of R ratio between the TPS calculated isocentric dose and the delivered dose during the treatment session.
Results: As SVs and IVD checks were scheduled on different treatment days, total amount of time required for tests during a treatment session resulted compatible with staff workload.
For all tested patients SVs showed average deviations equal to 2.9 mm, with every single value below the action level (±4 mm), confirming a day by day setup reproducibility inside quality standard. A total of 176 IVD tests were performed on 44 different sessions. In 84% of the IVD checks the results were within the accepted tolerance of 5% for R. In the 16% of cases, 1 or more R values resulted out of tolerance. The average R value on each of the 44 sessions resulted within tolerance range in 93% of cases. A more detailed analysis of unsuccessful tests revealed the following causes for dose discrepancy: presence of gas pockets, attenuating media on beam axis at beam exit, random loss of patient setup during treatment.
Conclusions: An integrated approach based on SVs and an IVD tests can be a valuable tool in quality management of pelvic 3DCRT: in case of discrepancy between delivered and planned doses, IVD gives to RT team the chance to analyze and program adequate corrections in further RT sessions.