In the course of our work four (4) patent applications were filed. 1) Electromedical device for intra operative radiation therapy by the means of ionizing radiation with energy higher than 9 MeV. 2) Electron irradiation head position regulation system of electromedical device for intra operative radiation therapy. 3) Electron beam forming system in treatment head of the mobile intra operative accelerator. 4) Electromedical device for intra operative radiation therapy with electronic control of ionization irradiation beam placement. Applications 1-3 have been granted a patent, application 4 is still pending.

Conclusions: The IntraLine accelerator meets all of the objectives set for the demonstrator. However, future clinical application of this device may possibly require new mechanical and electrical schemes aiming at minimizing the device's size and weight. Current work also focuses on the device's motion support control system, as well as its treatment planning system.

EP-1575

First experience with the ArcCHECK QA system

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Purpose/Objective: A 4D detector array (ArcCHECK, Sun Nuclear) has been developed specifically for rotational delivery QA and dosimetry. The purpose of this study was to evaluate the feasibility of the ArcCHECK as a patient specific QA device for different rotational treatment techniques. We report the preliminary results of the evaluation and discuss the determination of clinically relevant acceptance criteria.

Materials and Methods: The ArcCHECK device is a cylindrical water-equivalent phantom (PMMA) with a three-dimensional array (21 cm diameter and length) of 1386 diode detectors arranged in a spiral pattern at depth 2.9 cm with 10 mm sensor spacing.. The proprietary SNC Patient software is used to compare the device measured planar dose distribution to that calculated by the TPS.

We analyzed 40 treatment plans: 19 Dynamic Conformal Arc Therapy (DCAT) treatment plans for stereotactic radiotherapy of brain tumors, 11 Static Conformal Arc Therapy (SCAT) treatment plans for stereotactic radiotherapy of lung tumors and 10 Volumetric Modulated Arc Therapy (VMAT) treatment plans for different treatment sites (5 lung, 3 head & neck, 1 liver and 1 head). The DCAT plans were constructed and calculated using the iPlan 3.0 TPS while the Oncentra Masterplan 4.3 TPS was used for the other plans. All the patient plans were recalculated for the ArcCHECK phantom geometry. For the DCAT plans a Monte Carlo algorithm was used, while a Collapsed Cone algorithm was used for the SCAT and VMAT plans.

All measurements were carried out with 6 MV photon beams on a Varian TrueBeam STx linear accelerator using the ArcCHECK phantom with a solid homogenous PMMA insert. The pass rate of the g index was used to compare the measured and the calculated dose distribution. We used absolute dose mode and local dose difference normalization for the comparison as well as the minimum dose threshold equal to 10%. Two levels of acceptance criteria were tested for the comparison: 3%/3mm and 2%/2mm.

Results: The measurements performed in the course of approximately 7 weeks showed a stable performance of the ArcCHECK device. Average g-passing rates for all treatment plans, including the passing rate intervals, are shown in Table 1. Differences in passing rates between the DCAT, SCAT and VMAT plans are all statistically significant ($p < 0.05$) except between DCAT and SCAT plans using the 3%/3mm criteria.

Table 1: The average γ-passing rates for all treatment plans used to compare measured and calculated dose distributions. The passing rate intervals are shown in brackets.

	DCAT (n = 19)	SCAT (n = 11)	VMAT (n = 10)
γ(3%/3mm)	99.7 % [96.4–100 %]	99.5 % [98.1–100 %]	94.8 % [91.9–98.2 %]
γ(2%/2mm)	96.4 % [83.6–100 %]	92.0 % [87.0–96.7 %]	83.5 % [76.8–90.5 %]

Conclusions: In general the ArcCHECK device showed to be a convenient and robust tool for pre-treatment QA which is easy to use and handle. However we found that in order to sharpen the QA acceptance criteria and become more sensitive to the clinically relevant dose differences, it requires tailoring which takes into account beam delivery technique as well as 3D dose distribution.

Further work is ongoing to include in the QA routines 3DVH comparison and the possibility to estimate the dose distribution in the patient.

EP-1576

Comparison of three 2D-array detectors to verify SBRT treatments with the Octavius 4D

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Purpose/Objective: To compare three 2D-arrays of detectors, which have different distances between detectors and chamber sizes, used to verify SBRT treatments with Octavius 4D.

Materials and Methods: Ten SBRT treatments of different locations were selected (including lung, liver, vertebra and nose) for the study. In one of them, four additional plans were made, in three of which the same leaf was shifted a distance of 2, 3 and 4 mm (one distance for each plan) in all beams; in the fourth plan, the leaves positions were randomly changed for overdosing the spinal cord. The intention of the four modified plans was to study the 2D-array sensitivity to detect errors or changes. All treatments were computed by the treatment planning system (TPS) RayStation 4.0.3.4 (RaySearch Laboratories, Stockholm, Sweden) that uses the collapsed cone convolution algorithm. A linear accelerator (Elekta Synergy) was used to verify the SBRT treatments with 6 MV photons.

The three 2D-arrays (PTW-Freiburg, Germany) that were used are: Octavius 729 with 729 ionization chambers with dimensions of 5x5x5 mm^3 and a distance of 10 mm between chamber centers, Octavius 1000 SRS with smaller 977 liquid ionization chambers (2.3x2.3x0.5 mm^3) and higher resolution (distance of 2.5mm between chamber centers in the central area and 5 mm in the outer area) and Octavius 1500 with 1405 chambers with a size of 4.4x4.4x3 mm^3 and a chamber

spacing of 7.1 mm center to center. During measurements, the 2D-arrays are embedded in the Octavius 4D phantom.
The software used with Octavius 4D to compare the TPS calculated treatments and the measured treatments in the accelerator, was the Verisoft 6.0. Octavius 4D measures planar dose distributions depending on the gantry angle and after that, the software reconstructs a 3D dose distribution.
To obtain the differences between dose distributions, calculated with the TPS vs measured on the accelerator, the local 3D gamma-index (3%, 3 mm criterion) with a threshold of 10% for the maximum absorbed dose was used.
Results: The global results were: 99.97±0.10% of evaluated voxels passed the gamma-index criterion for Octavius 1000 SRS; 99.44 ±0.39 % for Octavius 1500; and 95.37±1.33 % for Octavius 729. There is a clear relationship between the resolution of the 2D-array and the number of points passing the 3D gamma-index criterion.
Table I shows the results obtained by comparing the measured modified plans and the original plan given by the TPS. Here we could see that as the chamber sizes is less, the detector is more sensitive to detect the forced variation in the leaves position due to the signal averaging is lower.

	Detectors		
Compared Plans	**1000 SRS**	**1500**	**729**
10-10	99,9%	99,6%	92,5%
10-2mm	98,7%	98,7%	92,6%
10-3mm	96,4%	98,6%	91,0%
10-4mm	93,9%	97,7%	90,4%
10-Spinal Cord	94,1%	96,7%	90,8%

Table I. Comparison results between the planned original plan (10) and the measured modified plans for the three detectors using the gamma-index 3% 3mm criterion.

Conclusions: Octavius 1000 SRS is the most suitable to verify SBRT. It gives the best results for the 3D gamma-index criterion due to it has the smallest distance between chambers and it's the most sensitive detecting the errors or position variations in the leaves due to the smallest size of its chambers. Octavius 1500 is also useful to verify SBRT and allows to measure IMRT treatments due to its size.

EP-1577

Abstract withdrawn

EP-1578

Current practice of cranial stereotactic radiosurgery (CSRS) in the UK

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Purpose/Objective: To examine the UK's current practices in CSRS.
Materials and Methods: A questionnaire, designed to include Gamma Knife (GK), Cyberknife (CK), Linac-Based (LB) and TomoTherapy (TT), was sent to 70 radiotherapy and radiosurgery centres in the UK between June and November 2014.
Results: 85.7% (60/70) of centres responded. Of these, 33.3% (20/60) were performing CSRS, 8.3% (5/60) are in the process of implementing CSRS and are planning to be clinical by August 2015 and 8.3% (5/60) are planning to implement CSRS by October 2016. The remaining 50% (30/60) are not performing CSRS and do not plan to implement it before October 2016.
25% (5/20) treat up to 4 patients per month, 45% (9/20) treat 5-15 patients per month and 30% (6/20) treat more than 16 patients per month. There are 29 machines used for CSRS in the country (14 LB, 6 CK, 7 GK and 1 TT) but they are not all dedicated to CSRS. The most commonly used techniques are non-coplanar static fields (used by 85% of centres), non-coplanar dynamic conformal arcs (20%) and circular collimator arcs (20%). 70% are using 6MV photons and 30% using Cobalt-60 (~1.25MV). A range of imaging modalities is used for outlining: Fused CT&MR (70%), MR (60%), CT (50%), Angiogram (45%), PET (20%) and Fused CT&PET (10%).
A large range of answers were given for the most common prescription isodose. Two peaks were seen: 20% (4/20) usually prescribe to the 45-50% isodose, 20% (4/20) to the 80-85% isodose, with the remaining centres prescribing between these 2 groups and up to the 95-100% isodose.
Patient specific QA measurements are performed on every plan by 35% (7/20) and 65% (13/20) decreased the measurements taken after 10-25 plans. The results show a wide range of detectors and phantoms being used for QA measurements.
The most common treatment sites are solitary and multiple brain metastases, followed by acoustic neuromas, meningiomas and AVMs. The majority of centres (70%) stated that treatment delivery usually takes less than 1 hour.
The results show that pre-treatment and during-treatment imaging is used in the majority of CK and LB treatments but not used at all in GK. When asked for a figure of acceptable setup accuracy, 50% stated sub-millimetre accuracies with the remaining ranging from 1-2mm.
Conclusions: The number of centres delivering CSRS is increasing and will continue to increase in the next 2-3 years. This is particularly the case with LB radiosurgery. Most centres are aiming to expand their service to treat more indications and more patients. There is a wide variety of planning procedures, QA methods, prescription protocols and delivery practices despite the fact that the indications treated by all centres are comparable.

EP-1579

Comparing the daily Quality Assurance measurement of Flattened beams (FF) with unflattened (FFF) beams

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Purpose/Objective: To compare the daily dose measurement of Flattening Filter (FF) beams with Flattening Filter Free (FFF) beams of 6MV and 10MV in Elekta Versa HD, and to evaluate the performance of using daily constancy check device with lowered dose rate in FFF beams.
Materials and Methods: The daily assurance measurement, including Central Axis Dose (CAX), beam flatness, beam symmetry (GT and LR direction), and beam quality factor