ELECTRON BEAM OUTPUT OF ELEKTA SLI-PLUS LINEAR ACCELERATORS FOR IRREGULAR SHAPED FIELDS AND FOR EXTENDED SSD

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PURPOSE

- *Investigate the variation of machine output for irregular electron fields*
- *Compare measurements to calculations for irregular electron fields*
- *Establish correction methods for irregular electron fields*
- *Use the Inverse Square Law (ISL) method to determine the effective SSDs and the position of the effective point source*
- *Compare measurements to calculations for extended SSD*

Materials & Methods

A. Measurements for irregular electron fields

- *Measured the output for electron beams blocked by:*
  - standard applicators (6x6 cm^2, 10x10 cm^2, 12x12 cm^2 and 20x20 cm^2)
  - customized electron cutouts (5x4, 7x7, 8x8, 8x5, 10x5, 10x7, 8x12, 12x12, 14x7.5, 14x9, 14x12, 16x16, 18x12, 18x14 and 20x12 cm^2)
  - for all available energies (4, 6, 8, 10, 12 and 15 MeV)
- *Reference conditions, water phantom*
- *SSD=100cm, at depth of maximum dose*
- *Parallel plane ion chamber*

Materials & Methods

B. Calculations for irregular electron fields

- *Used Oncentra Masterplan to simulate measurements*
  - virtual water phantom
  - Calculation grid of 0.3mm x 0.3mm x 0.3mm
  - Electron Monte-Carlo algorithm with 150 000 histories/cm^2
- *calculations were ultimately compared to the measurements*

Materials & Methods

C. Correction methods

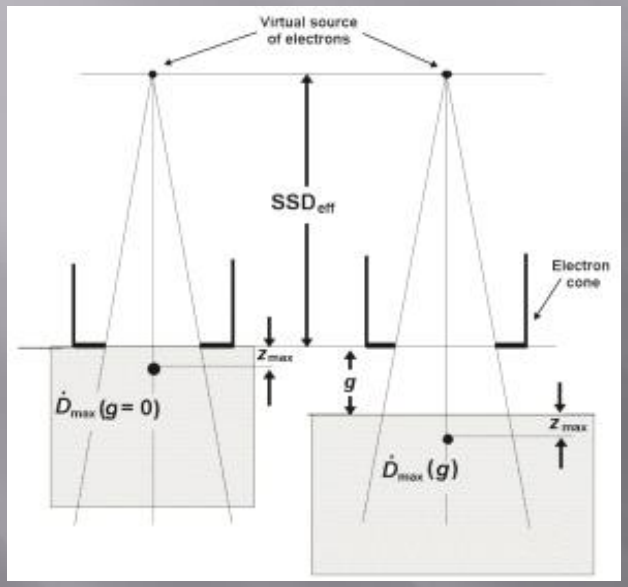
- *Evaluated the validity of the "Hogstrom method"*

$$OF^{WX,WY} = \sqrt{OF^{WX} \cdot OF^{WY}}$$

where OF^{WX} and O^{WY} are the output factors for square fields of dimensions WX^2 and WY^2

Materials & Methods

D. Measurements for Extended SSDs



- PTW MP2 water phantom 54 X 52 X 30cm^3
- Q_0 / Q_g measurement with a PTW Advanced Markus at z_{max} for g from 0 cm up to 15 cm in steps of 5 cm
- The plotting of $[Q_0 / Q_g]$ ½ as a function of g is a straight line.

$$\left(\frac{Q_0}{Q_g}\right)^{1/2} = \frac{g}{\left(SSD_{eff} + z_{max}\right)} + 1$$

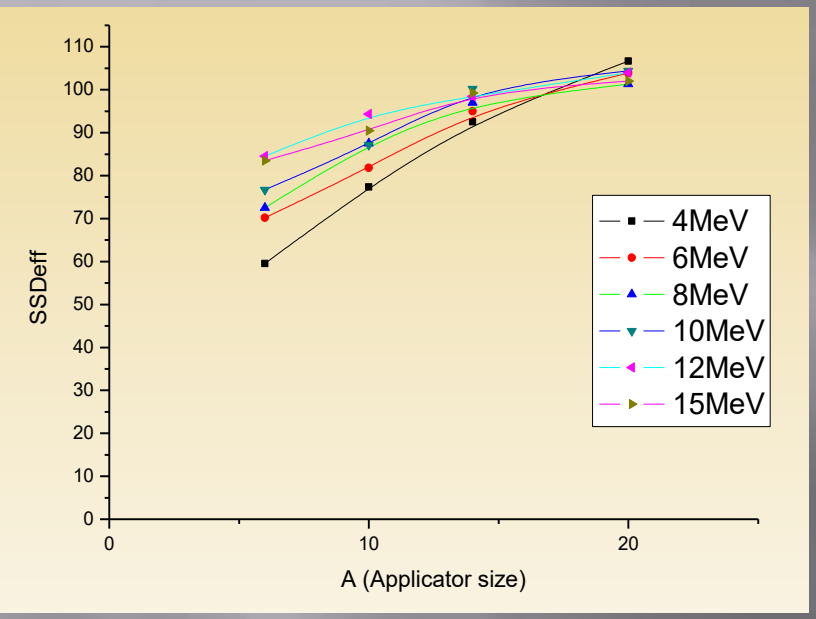
- SSD_{eff} can be obtained from the follow equation:

$$SSD_{eff} = (1/slope) - dmax$$

RESULTS

- *Measurements of relative output (cGy/100MU) for fields of various dimensions for different energies indicate that the output changes when a different applicator is used but the variation is very small for different cutouts inserted in the same applicator*
- *Since deviations between calculations and measurements where found greater than 2% in many cases, we have established a table of correction factors for MU calculations with the TPS*
- *In our case, the "Hogstrom method" predicted the output factors for non-square electron fields within 2%*

Results



Energy	Applicator			
(MeV)	6x6	10x10	14x14	20x20
4	59.86	77.31	92.71	110.6
6	70.18	81.81	95.00	104.0
8	72.55	87.49	96.82	101.29
10	76.74	87.21	100.25	104.40
12	84.51	94.36	98.46	103.93
15	83.51	90.46	99.25	102.04

Variation of SSD_{eff}

Measured effective SSDs using the ISL method.

Experimental and calculated results (Oncentra MasterPlan TPS) in good agreement within an error of less than 0.6%.

Conclusions

- Our results indicate that in the Elekta SLi Plus LINACs the insertion of cutouts for the delimitation of the field size does not influence much the machine output which is mostly depended on the use of a particular applicator and beam energy.
- Monitor Units calculated with the Oncentara Masterplan TPS need to be corrected by the use of appropriate correction factors before patient treatment
- The Hogstrom method can be used in order to predict the output factors for rectangular cutouts that will be molded in the future

Conclusions

- The results based on ISL method for the estimation of SSD_{eff} show a strong field size and energy dependency
- The comparison between the measured and calculated results shows that the ISL method can be used to determine the effective source position