

Attenuation of photon beams by carbon fibre couch tops/inserts used in external beam radiotherapy

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1. Purpose

To measure the attenuation of photon beams by seven commercially available carbon fibre couch tops/inserts used in external beam radiotherapy.

2. Conclusion

It can be concluded that the attenuation in carbon fibre couch tops/inserts can be rather high. This attenuation may introduce practical implications, e.g. restrictions on beam incidence or introducing an angle-dependent correction factor dependent on couch design. Both of these approaches are cumbersome and have severe drawbacks in terms of flexibility for the user as well as the treatment planning process. The ideal solution would either be a couch top with acceptably low attenuation, where there is negligible dosimetric influence on dose distribution and monitor unit settings, or the ability to account for the presence of the couch top/insert during the treatment planning process.

It is important that the vendors supply users with well-documented and adequate information about the attenuation and the influence on buildup-dose by the couch tops/inserts for a range of commonly used energies, field sizes and angles of incidence.

3. Method

The attenuation of the carbon fibre couch tops/inserts was measured at isocentre in a 20 cm thick polystyrene phantom with the detector at 10 cm depth. The equipment for measurement consisted of ionization chambers of Baldwin-Farmer type (Nuclear Enterprise, UK) and electrometers (Sun Nuclear, USA and PTW, Germany). Measurements were made with and without the carbon fiber top/insert in the beam for 4, 6, and 10 MV photons, see Figure 1.



Figure 1. Experimental set-up with and without carbon fibre top/insert in the beam line.

Field sizes between 5x5 and 20x20 cmxcm for beams impinging normally to the top/inserts were used. These data were supplemented with 20 and 40 degrees of incidence relative to the normal using a 10x10 cmxcm field. In addition to this, measurements were done in areas recognised to have potentially high attenuation. The attenuation has been calculated as the ratio of the registered charge with and without the carbon fibre top/insert. The seven carbon fiber couch tops/inserts studied are listed in Table 1.

Table 1. Couch top materials studied. The two Aktina couches C and D are identical while D refers the solid panel insert. The measurement point for the Aktina couches C and E is located cranially of the inserts. Posisert couches G and H are two different design versions of the same couch.

Identifier	Couch type	Manufacturer
A	◆ iBEAM®	Medical Intelligence/Elekta, Sweden
B	■ iBEAM® evo	Medical Intelligence/Elekta, Sweden
C	▲ Aktina standard	Aktina Medical Corp., USA
D	● Insert to Aktina standard	Aktina Medical Corp., USA
E	◆ Aktina oblique	Aktina Medical Corp., USA
F	▲ AirPlate™	ONCOlog Medical QA AB, Sweden
G	● Posisert (1998)	Sinmed BV, The Netherlands
H	■ Posisert (2002)	Sinmed BV, The Netherlands

4. Results

The attenuation is evaluated as the ratio of registered charge with and without the carbon fibre top/insert.

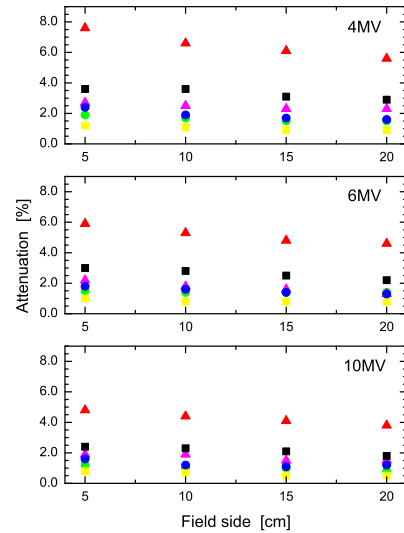


Figure 2. Data for normally impinging beams with field sizes ranging from 5x5 to 20x20 cmxcm for couch top B-D and F-H. See Table 1 for identifiers.

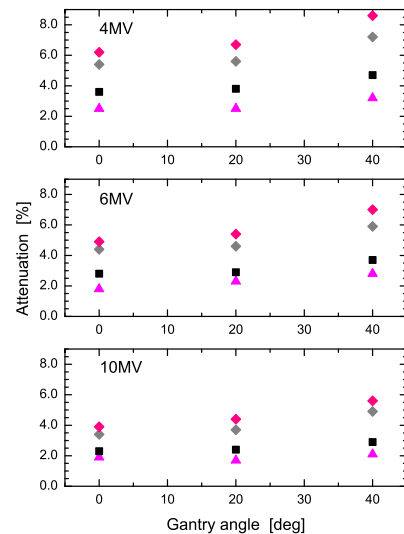


Figure 3. Data for a 10x10 cmxcm beam incident with 0, 20 and 40 degree gantry angle relative to the normal for couch tops A, B, E and F. See Table 1 for identifiers.

Table 2 show results of measurements highlighting regions with potentially high attenuation. For couch B measurements were made in the area where the extensions hook on to the main couch top, this region is denoted clamping area in the table.

Table 2. Attenuation in areas recognized to have potentially high absorption.

Couch	Area	Field [cm]	4MV	6MV	10 MV
A	H&N extension	10x10	1.8	1.6	1.2
B	Clamping area	5x5	36.1	29.4	23.0
C	Lateral strut	5x5	9.0	7.1	5.8
E	Central strut	5x5	6.8	5.6	4.6

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