

## Supplementary data

Table 4. Effective radiation dose (ED) in mSv, calibration information and image quality score of various roentgen settings without and with external tube filtration

kV ml + lm	mAs ml + lm	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
No filtration																		
73 + 90	25 + 12.5	0.094	14	0.036	8	0.514	14	0.026	8	0.188	11	10	9	0.010	1,410	1,747	0.21	1
125	5 + 6	0.074	11	0.034	9	0.344	23	0.039	12	0.207	11	9	7	0.052	792	1,517	0.24	1
125	6 + 5	0.089	0	N/A	0	N/A	23	0.039	12	0.190	10	10	N/A	N/A	659	1,791	N/A	2
2 mm Al																		
73 + 90	25 + 12.5	0.072	0	N/A	0	N/A	18	0.028	11	0.239	12	8	N/A	N/A	1,117	1,699	N/A	2
125	5 + 6	0.062	12	0.030	10	0.256	16	0.048	12	0.195	11	10	7	0.019	861	1,459	0.25	1
125	6 + 5	0.072	0	N/A	0	N/A	23	0.030	12	0.138	9	9	N/A	N/A	513	1,589	N/A	2
0.1 mm Cu + 1 mm Al																		
73 + 90	25 + 12.5	0.061	18	0.030	9	0.293	18	0.044	9	0.246	15	8	9	0.013	1,270	1,788	0.21	1
125	5 + 6	0.055	10	0.018	6	0.372	21	0.067	10	0.226	11	10	8	0.034	633	1,521	0.21	1
125	6 + 5	0.064	0	N/A	0	N/A	22	0.032	12	0.208	4	10	N/A	N/A	647	1,550	N/A	2
0.2 mm Cu + 1 mm Al																		
73 + 90	25 + 12.5	0.044	8	0.031	15	0.577	11	0.028	9	0.424	9	7	7	0.085	787	1,446	0.15	1
125	5 + 6	0.044	10	0.054	4	58.697	20	0.038	11	0.258	9	9	N/A	N/A	670	1,200	N/A	2
125	6 + 5	0.052	13	0.033	0	N/A	20	0.025	11	0.105	6	10	N/A	N/A	465	1,502	N/A	2

kV = kilovoltage, ml = medio-lateral, lm = latero-medial, mAs = milliampere-seconds, Cu = copper, Al = aluminum

A. Effective radiation dose (ED) in millisievert (mSv)

B. Number of fiducial markers left image

C. Error of fiducial markers left image

D. Number of control markers left image

E. Error of control markers left image

F. Number of fiducial markers right image

G. Error of fiducial markers right image

H. Number of control markers right image

I. Error of control markers right image,

J. Number of acetabulum bone markers left image

K. Number of acetabulum bone markers right image

L. Number of 3D markers

M. Crossing line distance

N. Contour detection left image

O. Contour detection right image

P. Difference value

Q. Image quality is defined as good image quality with analyzable image (1) or poor image quality with not analyzable image (2).

Table 5. Effective radiation dose (ED) in mSv, calibration information and image quality score of various roentgen settings without and with external tube filtration

kV	mAs	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
No filtration																		
77	8	0.033	0	N/A	0	N/A	0	N/A	0	N/A	5	5	N/A	N/A	825	1,368	N/A	2
77	12.5	0.052	0	N/A	0	N/A	18	0.026	11	0.286	10	8	N/A	N/A	1,194	1,382	N/A	2
77	16	0.066	9	0.020	8	0.341	23	0.035	11	0.291	12	11	13	0.063	1,276	1,786	0.16	1
77	25	0.104	10	0.018	4	52.16	24	0.027	12	0.195	10	10	N/A	N/A	1358	1,758	N/A	2
85	8	0.044	0	N/A	0	N/A	15	0.039	10	0.348	8	9	N/A	N/A	864	1,540	N/A	2
85	12.5	0.069	20	0.034	9	0.284	21	0.032	11	0.257	12	10	10	0.031	1,238	1,696	0.19	1
85	16	0.088	14	0.024	11	0.236	23	0.021	11	0.145	13	10	12	0.023	1,491	1,728	0.21	1
85	25	0.138	11	0.042	11	0.395	23	0.021	11	0.135	14	10	11	0.031	1,136	1,789	0.18	1
90	8	0.051	0	N/A	0	N/A	22	0.028	12	0.380	9	10	N/A	N/A	945	1,407	N/A	2
90	12.5	0.080	0	N/A	0	N/A	22	0.025	11	0.175	12	10	N/A	N/A	921	1,537	N/A	2
90	16	0.103	13	0.036	0	N/A	23	0.027	11	0.239	11	10	N/A	N/A	1,078	1,785	N/A	2
90	25	0.159	17	0.027	8	0.195	24	0.032	12	0.181	12	11	9	0.043	1,028	1,815	0.16	1
102	8	0.071	0	N/A	0	N/A	21	0.026	12	0.187	10	10	N/A	N/A	926	1,705	N/A	2
102	12.5	0.111	16	0.034	10	0.483	23	0.024	11	0.258	11	10	9	0.048	819	1,792	0.18	1
102	16	0.143	16	0.054	11	0.462	23	0.041	12	0.154	10	12	11	0.042	1,067	1,732	0.2	1
102	25	0.223	17	0.032	12	0.358	24	0.037	12	0.176	13	11	13	0.042	996	1,860	0.19	1
2 mm Al																		
77	8	0.026	0	N/A	0	N/A	0	N/A	0	N/A	0	4	N/A	N/A	641	1,445	N/A	2
77	12.5	0.04	0	N/A	0	N/A	14	0.024	7	14.229	6	7	N/A	N/A	746	1,473	N/A	2
77	16	0.051	0	N/A	0	N/A	20	0.087	11	0.215	13	8	N/A	N/A	1,225	1,568	N/A	2
77	25	0.081	8	0.009	6	0.359	22	0.028	12	0.224	11	10	8	0.054	1,034	1,832	0.17	1
85	8	0.035	0	N/A	0	N/A	16	0.029	11	0.583	11	9	N/A	N/A	912	1,310	N/A	2
85	12.5	0.054	0	N/A	0	N/A	21	0.030	12	0.187	8	10	N/A	N/A	772	1,725	N/A	2
85	16	0.069	10	0.021	7	0.379	19	0.026	12	0.216	13	10	11	0.029	1,112	1,796	0.18	1
85	25	0.108	18	0.029	0	N/A	22	0.026	11	0.187	12	10	N/A	N/A	932	1,749	N/A	2
90	8	0.041	0	N/A	0	N/A	23	0.050	12	0.230	9	9	N/A	N/A	853	1,560	N/A	2
90	12.5	0.064	0	N/A	0	N/A	22	0.031	12	0.192	7	10	N/A	N/A	1,010	1,603	N/A	2
90	16	0.081	13	0.035	7	0.285	23	0.021	12	0.179	12	9	9	0.043	1,137	1,831	0.18	1
90	25	0.127	16	0.036	11	0.481	22	0.028	12	0.181	12	12	12	0.031	1,020	1,751	0.19	1
102	8	0.057	0	N/A	0	N/A	22	0.028	12	0.282	8	10	N/A	N/A	845	1,576	N/A	2
102	12.5	0.089	13	0.043	7	0.296	24	0.028	12	0.157	11	11	10	0.035	973	1,723	0.18	1
102	16	0.114	18	0.032	8	0.337	24	0.032	11	0.182	12	10	10	0.036	819	1,740	0.17	1
102	25	0.179	19	0.037	12	0.280	24	0.025	12	0.238	13	9	10	0.017	854	1,802	0.17	1
0.1 mm Cu + 1 mm Al																		
77	8	0.022	0	N/A	0	N/A	0	N/A	0	N/A	3	4	N/A	N/A	602	1,324	N/A	2
77	12.5	0.034	0	N/A	0	N/A	10	0.025	9	0.250	8	8	N/A	N/A	873	1,536	N/A	2
77	16	0.044	0	N/A	0	N/A	14	0.028	9	0.266	10	7	N/A	N/A	1,147	1,832	N/A	2
77	25	0.069	11	0.032	5	0.464	23	0.027	12	0.204	10	10	10	0.04	1,280	1,777	0.17	1
85	8	0.030	0	N/A	0	N/A	12	0.032	11	0.244	6	10	0	N/A	842	1,681	N/A	2
85	12.5	0.014	0	N/A	0	N/A	20	0.024	11	0.192	8	8	N/A	N/A	905	1,723	N/A	2
85	16	0.060	16	0.033	11	0.329	22	0.033	12	0.149	13	9	11	0.026	1,530	1,753	0.20	1
85	25	0.094	12	0.026	9	0.286	23	0.030	12	0.146	11	10	9	0.02	931	1,662	0.18	1
90	8	0.036	0	N/A	0	N/A	18	0.035	10	0.218	6	7	N/A	N/A	767	1,393	N/A	2
90	12.5	0.056	0	N/A	0	N/A	23	0.024	12	0.209	11	10	N/A	N/A	1,366	1,358	N/A	2
90	16	0.071	16	0.026	11	0.65	22	0.028	12	0.298	13	10	10	0.017	1,337	1,747	0.20	1
90	25	0.112	11	0.039	8	0.351	23	0.055	12	0.172	8	10	7	0.024	1,006	1,819	0.21	1
102	8	0.051	0	N/A	0	N/A	23	0.038	12	0.257	7	11	N/A	N/A	753	1,335	N/A	2
102	12.5	0.079	9	0.025	11	0.407	23	0.024	12	0.222	8	8	5	0.039	870	1,687	0.19	1
102	16	0.102	16	0.044	5	14.459	24	0.023	12	0.171	12	10	N/A	N/A	824	1,590	N/A	2
102	25	0.159	22	0.036	12	0.288	24	0.031	12	0.210	14	10	12	0.037	1,238	1,672	0.20	1
0.2 mm Cu + 1 mm Al																		
77	8	0.016	0	N/A	0	N/A	0	N/A	0	N/A	0	2	N/A	N/A	508	1,229	N/A	2
77	12.5	0.025	0	N/A	0	N/A	0	N/A	0	N/A	6	8	N/A	N/A	919	1,367	N/A	2
77	16	0.032	0	N/A	0	N/A	17	0.040	9	0.392	5	8	N/A	N/A	917	1,341	N/A	2
77	25	0.051	0	N/A	0	N/A	20	0.069	11	0.222	9	10	N/A	N/A	1,338	1,573	N/A	2
85	8	0.023	0	N/A	0	N/A	10	0.024	7	14.522	8	8	N/A	N/A	746	1,134	N/A	2
85	12.5	0.036	0	N/A	0	N/A	20	0.041	8	0.166	10	10	N/A	N/A	980	1,534	N/A	2
85	16	0.046	0	N/A	0	N/A	22	0.030	12	0.310	9	10	N/A	N/A	704	1,596	N/A	2
85	25	0.072	16	0.049	8	0.443	23	0.022	12	0.224	11	11	10	0.06	1,145	1,808	0.21	1
90	8	0.027	0	N/A	0	N/A	19	0.033	11	0.209	7	9	N/A	N/A	823	1,388	N/A	2
90	12.5	0.043	8	0.023	5	0.640	22	0.025	12	0.254	8	10	6	0.026	850	1,583	0.17	1
90	16	0.055	10	0.031	7	0.385	22	0.034	12	0.220	10	10	7	0.059	946	1,692	0.20	1
90	25	0.087	15	0.033	10	0.38	22	0.029	12	0.147	14	11	12	0.057	795	1,732	0.16	1
102	8	0.040	0	N/A	0	N/A	21	0.037	12	0.233	11	9	N/A	N/A	693	1,389	N/A	2
102	12.5	0.063	12	0.033	6	0.532	24	0.024	12	0.198	9	9	6	0.042	630	1,596	0.18	1
102	16	0.080	0	N/A	0	N/A	24	0.041	12	0.226	10	10	N/A	N/A	623	1,601	N/A	2
102	25	0.125	18	0.017	11	0.292	24	0.038	12	0.160	12	9	9	0.043	836	1,661	0.16	1

For footnotes, see Table 4.