

Photon-counting CT versus energy-integrating detector and flat-panel CT for cadaveric wrist arthrography with additional tin filter dose reduction

ELECTRONIC SUPPLEMENTARY MATERIAL

Table S1. SNR and CNR calculations

Kernel	Filter	Dose protocol	Scanner			Combined	<i>p</i> -values		
			PCD- CT	EID- CT	FPD- CT ¹		PCD vs. EID	PCD vs. FPD	EID vs. FPD
			(mean ± SEM)						
SNR	Br76/Ur77/normal	1.5 mGy	0.68	0.56	1.08	0.001	0.672	0.014	0.001
			±	±	±				
			0.04	0.04	0.15				
		3 mGy	0.68	0.6 ±	1.08	0.001	0.825	0.015	0.002
			±	0.04	±				
			0.05		0.15				
		6 mGy	0.7 ±	0.66	1.08	0.006	0.95	0.026	0.009
			±	±	±				
			0.05	0.06	0.15				
		1.5 mGy	0.62	0.4 ±	1.08	<0.001	0.261	0.004	<0.001
			±	0.04	±				
			0.05		0.15				
		0.8/1 mGy	0.59	0.36	1.08	<0.001	0.233	0.002	<0.001
			±	±	±				
			0.05	0.03	0.15				
	0.1/0.5 mGy	0.45	0.27	1.08	<0.001	0.366	<0.001	<0.001	
		±	±	±					
		0.04	0.02	0.15					
	Br89/Ur89/sharp	1.5 mGy	0.44	0.23	0.61	<0.001	0.032	0.111	<0.001
			±	±	±				
			0.03	0.01	0.09				
		3 mGy	0.54	0.23	0.61	<0.001	0.02	0.658	<0.001
			±	±	±				
			0.04	0.02	0.09				
		6 mGy	0.57	0.26	0.61	<0.001	0.001	0.907	<0.001
			±	±	±				
			0.04	0.02	0.09				
		1.5 mGy	0.38	0.2 ±	0.61	<0.001	0.064	0.021	<0.001
			±	0.01	±				
			0.03		0.09				
		0.8/1 mGy	0.33	0.24	0.61	<0.001	0.493	<0.001	<0.001
			±	±	±				
			0.03	0.01	0.09				
	0.1/0.5 mGy	0.18	0.28	0.61	<0.001	0.462	<0.001	<0.001	
		±	±	±					
		0.02	0.01	0.09					

CNR	Br76/Ur77/normal	/	1.5	0.38	0.27	0.85	<0.001	0.679	0.003	<0.001
			mGy	± 0.06	± 0.1	± 0.12				
		/	3 mGy	0.39 ± 0.07	0.35 ± 0.09	0.85 ± 0.12	<0.001	0.949	0.003	0.001
			6 mGy	0.42 ± 0.07	0.43 ± 0.09	0.85 ± 0.12				
		Sn	1.5	0.4 ± 0.07	0.2 ± 0.06	0.85 ± 0.12	<0.001	0.261	0.001	<0.001
			mGy							
	Br89/Ur89/sharp	/	0.8/1	0.43 ± 0.07	0.21 ± 0.07	0.85 ± 0.12	<0.001	0.211	0.004	<0.001
			mGy							
		/	0.1/0.5	0.31 ± 0.06	0.12 ± 0.06	0.85 ± 0.12	<0.001	0.241	<0.001	<0.001
			mGy							
		/	1.5	0.25 ± 0.05	0.06 ± 0.04	0.53 ± 0.07	<0.001	0.03	0.001	<0.001
			mGy							
		/	3 mGy	0.32 ± 0.06	0.1 ± 0.03	0.53 ± 0.07	<0.001	0.014	0.017	<0.001
			6 mGy	0.35 ± 0.05	0.15 ± 0.04	0.53 ± 0.07				
		Sn	1.5	0.28 ± 0.04	0.04 ± 0.03	0.53 ± 0.07	<0.001	0.03	0.001	<0.001
			mGy							
		Sn	0.8/1	0.24 ± 0.04	0.04 ± 0.02	0.53 ± 0.07	<0.001	0.006	<0.001	<0.001
			mGy							
		/	0.1/0.5	0.12 ± 0.02	0.01 ± 0.02	0.53 ± 0.07	<0.001	0.149	<0.001	<0.001
			mGy							

SNR and CNR Calculations for all dose protocols, filter used and reconstruction kernels using the ROI-based measurement of signal attenuation. Mean values and the standard error of mean ($\pm$ SEM) are given. The p -values of the Tukey post hoc analysis as well as the combined p -value of the ANOVA is reported. p -values for significant differences between PCD-CT and EID-CT as well as non-significant differences between PCD-CT and FPD-CT are highlighted in bold. ANOVA Analysis of variance, CNR Contrast-to-noise ratio, CT Computed tomography, EID-CT Energy-integrating detector CT, FPD-CT Flat-panel detector CT, PCD-CT Photon-counting detector CT, ROI Region-of-interest, SNR Signal-to-noise ratio, SEM Standard error of mean.

¹ Added data for a better overview. The FPD-CT did not provide different dose protocols or a tin filter

Table S2 Detailed grading features

Rating	Intrinsic structures*	Trabecular structures	Cartilage structures
Nondiagnostic	Very high noise, no visible distinction between anatomical structures	Very high noise, no visible distinction between anatomical structures	Very high noise, no visible distinction between anatomical structures
Very poor	Blurred structures	Trabeculae not clearly discernible	Blurred surfaces, cartilage not identifiable
Poor	Structures barely visible	Trabeculae barely identifiable	Cartilage surface barely discernible
Satisfactory	Clear anatomical structures, low contrast	Trabecular structures visible, low contrast	Adequate delineation of cartilage surface
Good	Well defined structures, some noise	Good visualization of trabecular structures, good contrast	Smooth cartilage surfaces, good contrast
Very good	Sharp delineation, minimal noise	Fine trabecular structures visible	Sharply defined cartilage, smaller irregularities identifiable
Excellent	Excellent delineation, almost no noise	Very fine trabecular details, excellent contrast	Excellent delineation of the cartilage

Detailed grading features for the three independent readers to assess image quality

*Such as scapholunate ligament, triangular fibrocartilage complex, lunotriquetral ligament.

Table S3 Detailed quality assessment and analysis of intrinsic structures

		Intrinsic structures					<i>p</i> -values		
Kernel	Filter	Dose protocol	PCD-CT	EID-CT	FPD-CT ¹	Combined	PCD vs. EID	PCD vs. FPD	EID vs. FPD
Br76/Ur77/normal	/	1.5 mGy	3.67 (3-4)	2.33 (1-4)	5 (4-7)	<0.001	0.001	0.003	<0.001
		3 mGy	4.59 (3-6)	2.9 (2-4)	5 (4-7)	<0.001	<0.001	0.922	<0.001
		6 mGy	5.81 (4-7)	3.47 (2-5)	5 (4-7)	<0.001	<0.001	0.035	<0.001
	Sn	1.5 mGy	4.3 (3-6)	2.03 (1-3)	5 (4-7)	<0.001	<0.001	0.231	<0.001
		0.8/1 mGy	3.33 (2-5)	1.77 (1-3)	5 (4-7)	<0.001	0.001	0.002	<0.001
		0.1/0.5 mGy	1.44 (1-2)	1.23 (1-2)	5 (4-7)	<0.001	1	<0.001	<0.001
		1.5 mGy	3.48 (2-5)	1 (1-1)	4.57 (3-7)	<0.001	<0.001	0.088	<0.001
		3 mGy	4.41 (3-7)	1.27 (1-2)	4.57 (3-7)	<0.001	<0.001	1	<0.001
Br89/Ur89/sharp	/	6 mGy	5.37 (3-7)	1.37 (1-3)	4.57 (3-7)	<0.001	<0.001	0.231	<0.001
		1.5 mGy	3.26 (2-5)	1 (1-1)	4.57 (3-7)	<0.001	<0.001	0.019	<0.001
		0.8/1 mGy	2.3 (1-4)	1 (1-1)	4.57 (3-7)	<0.001	0.003	0.001	<0.001
	Sn	0.1/0.5 mGy	1.04 (1-2)	1 (1-1)	4.57 (3-7)	<0.001	1	<0.001	<0.001

Quality assessment of three readers for intrinsic structures on a 7-point rating scale. Mean ratings and their range are reported as well as the combined *p*-values of the Friedman-test and the *p*-values of the post hoc analysis. *p*-values for significant superiority of the PCD-CT as well as non-significant differences compared to the FPD-CT are highlighted in bold. *CT* Computed tomography, *EID-CT* Energy-integrating detector CT, *FPD-CT* Flat-panel detector CT, *PCD-CT* Photon-counting detector CT.

¹ Added data for a better overview. The FPD-CT did not provide different dose protocols or a tin filter.

Table S4 Detailed quality assessment and analysis of trabecular structures

			Trabecular structures rating value (mean [min–max])			<i>p</i> -values			
Kernel	Filter	Dose protocol	PCD-CT	EID-CT	FPD-CT ¹	Combined	PCD vs. EID	PCD vs. FPD	EID vs. FPD
Br76/Ur77/normal	/	1.5 mGy	4.33 (3-6)	2.53 (1-4)	4.5 (3-5)	<0.001	<0.001	1	<0.001
		3 mGy	4.93 (4-6)	3.33 (2-5)	4.5 (3-5)	<0.001	<0.001	0.403	0.001
		6 mGy	5.93 (4-7)	3.97 (3-5)	4.5 (3-5)	<0.001	<0.001	<0.001	0.199
	Sn	1.5 mGy	4.33 (3-6)	2.3 (2-3)	4.5 (3-5)	<0.001	<0.001	1	<0.001
		0.8/1 mGy	3.19 (2-4)	1.9 (1-3)	4.5 (3-5)	<0.001	0.001	0.003	<0.001
		0.1/0.5 mGy	1.3 (1-2)	1.3 (1-2)	4.5 (3-5)	<0.001	1	<0.001	<0.001
	/	1.5 mGy	3.44 (2-5)	1 (1-1)	4.23 (3-6)	<0.001	<0.001	0.029	<0.001
		3 mGy	4.93 (2-7)	1.33 (1-3)	4.23 (3-6)	<0.001	<0.001	0.307	<0.001
		6 mGy	5.59 (3-7)	1.4 (1-3)	4.23 (3-6)	<0.001	<0.001	0.013	<0.001
	Sn	1.5 mGy	3.19 (1-4)	1 (1-1)	4.23 (3-6)	<0.001	<0.001	0.024	<0.001
0.8/1 mGy		2.15 (1-3)	1 (1-1)	4.23 (3-6)	<0.001	0.002	<0.001	<0.001	
0.1/0.5 mGy		1 (1-1)	1 (1-1)	4.23 (3-6)	<0.001	1	<0.001	<0.001	
Br89/Ur89/sharp									

Quality assessment of three readers for trabecular structures on a 7-point rating scale. Mean ratings and their range are reported as well as the combined *p*-values of the Friedman-test and the *p*-values of the post hoc analysis. *p*-values for significant superiority of the PCD-CT as well as non-significant differences compared to the FPD-CT are highlighted in bold. *CT* Computed tomography, *EID-CT* Energy-integrating detector CT, *FPD-CT* Flat-panel detector CT, *PCD-CT* Photon-counting detector CT.

¹ Added data for a better overview. The FPD-CT did not provide different dose protocols or a tin filter.

Table S5 Detailed quality assessment and analysis of cartilage structures

Kernel	Filter	Dose protocol	Cartilage structures rating value (mean [min-max])			Combined	<i>p</i> -values		
			PCD-CT	EID-CT	FPD-CT ¹		PCD vs. EID	PCD vs. FPD	EID vs. FPD
Br76/Ur77/normal	/	1.5 mGy	4.37 (3-5)	2.2 (1-4)	5.3 (4-6)	<0.001	<0.001	0.043	<0.001
		3 mGy	5.07 (3-6)	2.9 (1-4)	5.3 (4-6)	<0.001	<0.001	1	<0.001
		6 mGy	5.81 (4-7)	3.6 (2-5)	5.3 (4-6)	<0.001	<0.001	0.231	<0.001
	Sn	1.5 mGy	4.26 (3-5)	2 (1-3)	5.3 (4-6)	<0.001	<0.001	0.013	<0.001
		0.8/1 mGy	3.37 (2-5)	1.7 (1-3)	5.3 (4-6)	<0.001	0.001	0.001	<0.001
		0.1/0.5 mGy	1.52 (1-2)	1.27 (1-2)	5.3 (4-6)	<0.001	1	<0.001	<0.001
		1.5 mGy	3.59 (2-5)	1 (1-1)	4.8 (4-6)	<0.001	<0.001	0.013	<0.001
	/	3 mGy	4.7 (3-6)	1.27 (1-2)	4.8 (4-6)	<0.001	<0.001	1	<0.001
		6 mGy	5.56 (3-7)	1.4 (1-3)	4.8 (4-6)	<0.001	<0.001	0.17	<0.001
		1.5 mGy	3.37 (2-5)	1 (1-1)	4.8 (4-6)	<0.001	<0.001	0.003	<0.001
Br89/Ur89/sharp	Sn	0.8/1 mGy	2.37 (1-3)	1 (1-1)	4.8 (4-6)	<0.001	0.003	<0.001	<0.001
		0.1/0.5 mGy	1 (1-1)	1 (1-1)	4.8 (4-6)	<0.001	1	<0.001	<0.001

Quality assessment of three readers for cartilage structures on a 7-point rating scale. Mean ratings and their range are reported as well as the combined *p*-values of the Friedman-test and the *p*-values of the post hoc analysis. *p*-values for significant superiority of the PCD-CT as well as non-significant differences compared to the FPD-CT are highlighted in bold. *CT* Computed tomography, *EID-CT* Energy-integrating detector CT, *FPD-CT* Flat-panel detector CT, *PCD-CT* Photon-counting detector CT.

¹ Added data for a better overview. The FPD-CT did not provide different dose protocols or a tin filter.