

Radiation Exposure of Large versus Mini C-arm in Hand/Wrist Fractures: Cadaveric Study and a Review of the Current Literature

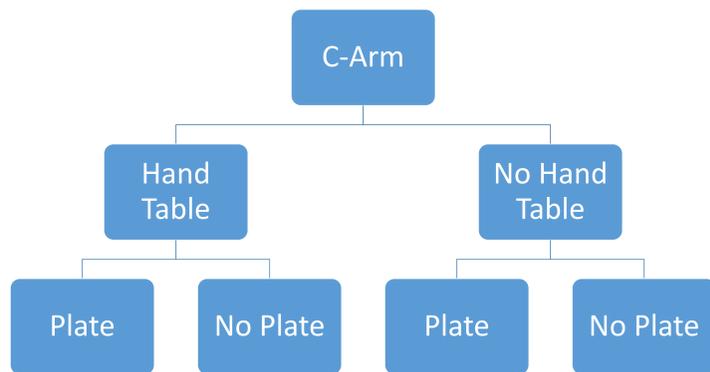
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OBJECTIVE

- To clarify the differences in direct and scatter radiation exposure between the large C-arm and mini C-arm in hand/wrist procedures and perform a review of the current literature.

METHODS

- One large and one mini C-arm in the vertical position with the image intensifier below the cadaver arm.
- Two configurations: on the image intensifier and on a hand table. Both configurations used a stainless steel distal radius volar locking plate.



- A Radcal 2025 micrometer placed directly on the cadaver skin at the center of the beam was a marker for patient exposure.
- A Victoreen 450P ion chamber at the surgeon's waist height measured radiation scatter to the surgeon.



Table 1. Radiation and Scatter Exposure and Output With Use of Mini and Large C-Arms

C-Arm	Configuration	Cadaver Exposure (mR/s)	Surgeon Scatter (µR/s)	kVp	milliampere (mA)
Mini C-arm	No Table	1.57	1.3	59	72
	No Table w/ plate	1.67	1.25	59	72
	Hand Table	3.5	2.0	66	84
	Hand Table w/ plate	4	1.72	66	84
Large C-arm	No Table	0.6	0.75	51	54
	No Table w/ plate	0.62	0.75	51	54
	Hand Table	0.83	1.0	52	58
	Hand Table w/ plate	0.82	1.33	52	58

Table 2. Proportional Radiation Exposure and Surgeon Scatter Comparing Mini vs. Large C-Arms

Exposure and Condition	Mini C-arm (a)	Large C-arm (b)	Proportional Exposure	Difference in Exposure
Direct Radiation (mR/s)				
No Hand Table	1.57	0.6	2.62	161%
No Hand Table with Plate	1.67	0.62	2.69	169%
Hand Table	3.5	0.83	4.22	322%
Hand Table with Plate	4	0.82	4.88	388%
Surgeon Scatter (µR/s)				
No Hand Table	1.3	0.75	1.73	73%
No Hand Table with Plate	1.25	0.75	1.67	67%
Hand Table	2	1	2.00	100%
Hand Table with Plate	1.37	1.33	1.03	3%

Note. Proportional Exposure was calculated by dividing a/b. Difference in exposure was calculated by subtracting 1 (or 100%) from the Proportional Exposure and multiplying by 100 to achieve a percentile.

RESULTS

- In both configurations, the mini C-arm transmitted increased levels of radiation to the cadaver and scatter to the surgeon.
- Exposure directly on the arm with no hand table resulted in 161% more direct exposure to the cadaver and 73% more scatter exposure to the surgeon's waist.
- With the addition of the hand table, the mini C-arm resulted in a 322% increase in exposure to the specimen and 100% more radiation scatter to the surgeon.
- With installation of a surgical repair plate in both configurations, the mini C-arm resulted in 169% more cadaver exposure and 67% more surgeon scatter exposure without the arm table, and 388% more to the cadaver and 3% more to the surgeon with arm table.

CONCLUSIONS

- Large C-arm produces less initial radiation and less scatter exposure compared to mini c-arm using cadaveric specimens, with and without both the hand table and surgical plate especially where direct exposure is concerned