

Supplemental Data S1. M-mode parameters at 3 months and 6 months after local heart irradiation (average $\pm$ SEM, n=6-9).

	BN						BNK					
	3 months			6 months			3 months			6 months		
	0 Gy	18 Gy	24 Gy	0 Gy	18 Gy	24 Gy	0 Gy	18 Gy	24 Gy	0 Gy	18 Gy	24 Gy
LVAW_d	1.6 $\pm$ 0.07	1.5 $\pm$ 0.08	1.7 $\pm$ 0.2	1.8 $\pm$ 0.1	1.7 $\pm$ 0.2	1.8 $\pm$ 0.1	1.8 $\pm$ 0.1	1.8 $\pm$ 0.08	1.7 $\pm$ 0.3	1.9 $\pm$ 0.05	1.9 $\pm$ 0.1	1.8 $\pm$ 0.2
LVAW_s	2.4 $\pm$ 0.09	2.4 $\pm$ 0.1	2.9 $\pm$ 0.2	2.8 $\pm$ 0.2	2.7 $\pm$ 0.2	2.9 $\pm$ 0.2	2.7 $\pm$ 0.2	2.7 $\pm$ 0.1	2.7 $\pm$ 0.4	3.0 $\pm$ 0.07	2.8 $\pm$ 0.06	3.0 $\pm$ 0.2
LVID_d	7.4 $\pm$ 0.2	7.1 $\pm$ 0.2	7.02 $\pm$ 0.4	7.5 $\pm$ 0.1	7.3 $\pm$ 0.1	7.4 $\pm$ 0.4	7.2 $\pm$ 0.2	7.2 $\pm$ 0.1	7.2 $\pm$ 0.3	7.6 $\pm$ 0.1	7.6 $\pm$ 0.2	7.7 $\pm$ 0.3
LVID_s	4.6 $\pm$ 0.2	4.1 $\pm$ 0.2	3.4 $\pm$ 0.4	4.2 $\pm$ 0.2	3.9 $\pm$ 0.2	3.9 $\pm$ 0.5	4.4 $\pm$ 0.3	4.2 $\pm$ 0.3	3.9 $\pm$ 0.4	4.3 $\pm$ 0.1	4.0 $\pm$ 0.1	4.5 $\pm$ 0.5
LVPW_d	1.9 $\pm$ 0.1	1.9 $\pm$ 0.1	1.8 $\pm$ 0.2	1.9 $\pm$ 0.1	1.9 $\pm$ 0.1	1.8 $\pm$ 0.2	2.5 $\pm$ 0.2	2.2 $\pm$ 0.3	2.1 $\pm$ 0.3	1.9 $\pm$ 0.04	2.1 $\pm$ 0.1	1.9 $\pm$ 0.2
LVPW_s	2.6 $\pm$ 0.1	2.6 $\pm$ 0.04	3.1 $\pm$ 0.2	2.8 $\pm$ 0.1	3.1 $\pm$ 0.05	2.9 $\pm$ 0.4	2.8 $\pm$ 0.2	3.0 $\pm$ 0.2	3.3 $\pm$ 0.4	2.8 $\pm$ 0.06	3.1 $\pm$ 0.2	2.8 $\pm$ 0.4
EF	71.2 $\pm$ 1.9	76.7 $\pm$ 2.4	85.6 $\pm$ 4.1	78.8 $\pm$ 1.3	81 $\pm$ 1	81.4 $\pm$ 5.5	74.0 $\pm$ 3.1	75.8 $\pm$ 2.9	81.3 $\pm$ 3.9	79 $\pm$ 1.5	82 $\pm$ 0.73	77.8 $\pm$ 6.2
FS	42.0 $\pm$ 1.6	46.9 $\pm$ 2.1	56.7 $\pm$ 5.1	49.1 $\pm$ 1.4	51.6 $\pm$ 1	52.3 $\pm$ 6	44.5 $\pm$ 2.9	46.2 $\pm$ 2.8	51.7 $\pm$ 4.2	49.4 $\pm$ 1.5	52.5 $\pm$ 0.8	48.5 $\pm$ 5.8
SV	212.0 $\pm$ 12.2	215.0 $\pm$ 8.5	227.0 $\pm$ 23.1	242.1 $\pm$ 8.8	237.1 $\pm$ 9.2	245.7 $\pm$ 23.9	207.6 $\pm$ 8.6	215.4 $\pm$ 8.4	233.2 $\pm$ 20.9	264.7 $\pm$ 7.9	263.5 $\pm$ 13.6	256.6 $\pm$ 23.7
V_d	298.2 $\pm$ 16.8	280.8 $\pm$ 12.9	265.7 $\pm$ 27.6	307.2 $\pm$ 10.3	294.2 $\pm$ 11.9	303.1 $\pm$ 33.7	281.2 $\pm$ 16.8	286.3 $\pm$ 11.2	287.5 $\pm$ 27.7	335.4 $\pm$ 9.7	321.0 $\pm$ 16.1	332.1 $\pm$ 36.7
V_s	86.3 $\pm$ 8	65.8 $\pm$ 9.4	38.7 $\pm$ 11.9	65.1 $\pm$ 4.7	57.1 $\pm$ 4.2	57.4 $\pm$ 21.5	73.6 $\pm$ 12.4	70.9 $\pm$ 9.6	54.2 $\pm$ 14.8	70.7 $\pm$ 5.6	57.5 $\pm$ 3.7	75.4 $\pm$ 27

LVAW: left ventricular anterior wall (in mm)
 LVID: left ventricular inner diameter (in mm)
 LVPW: left ventricular posterior wall (in mm)
 D: diameter (in mm)
 EF: ejection fraction (%)
 FS: fractional shortening (%)
 SV: stroke volume (μ l)
 V: volume (μ l)
 _d: in diastole
 _s: in systole

Shaded parameters showed a significant dose-response in linear regression analysis, as shown in Supplemental Table S2.

Supplemental Data S2. Linear regression analysis of a dose-response of M-mode parameters at 3 months after irradiation (n=6-9).

	BN			BN/Ka		
	R	SE	p-value	R	SE	p-value
LVAW in diastole	0.0036	0.0042	0.39	-0.0039	0.0052	0.46
LVAW in systole	0.018	0.0060	0.0093*	0.0020	0.0068	0.78
LVID in diastole	-0.013	0.0081	0.12	0.0044	0.0063	0.50
LVID in systole	-0.045	0.0085	<0.001*	-0.018	0.0095	0.071
LVPW in diastole	-0.0025	0.0035	0.48	-0.016	0.016	0.33
LVPW in systole	0.017	0.0066	0.018*	0.020	0.0077	0.018*
EF	0.56	0.10	<0.001*	0.26	0.11	0.036*
FS	0.56	0.11	<0.001*	0.26	0.11	0.030*
Stroke volume	0.55	0.52	0.30	0.99	0.49	0.057
Volume in diastole	-1.30	0.64	0.060	0.34	0.59	0.58
Volume in systole	-1.85	0.34	<0.001*	-0.66	0.39	0.11

R: Regression Coefficient, SE: Standard Error

*Significant dose response (p<0.05).

Supplemental Data S3. Strain analysis of systole at 3 months and 6 months after local heart irradiation (average $\pm$ SEM, n=6-9).

	BN						BNK					
	3 months			6 months			3 months			6 months		
	0 Gy	18 Gy	24 Gy	0 Gy	18 Gy	24 Gy	0 Gy	18 Gy	24 Gy	0 Gy	18 Gy	24 Gy
Radial												
V	1.6 $\pm$ 0.1	1.7 $\pm$ 0.1	2.3 $\pm$ 0.1	1.8 $\pm$ 0.2	1.7 $\pm$ 0.1	2.0 $\pm$ 0.1	1.6 $\pm$ 0.1	1.8 $\pm$ 0.07	2.1 $\pm$ 0.1	1.8 $\pm$ 0.1	1.9 $\pm$ 0.1	1.6 $\pm$ 0.1
D	0.9 $\pm$ 0.1	0.9 $\pm$ 0.1	1.3 $\pm$ 0.1	0.9 $\pm$ 0.1	0.9 $\pm$ 0.1	1.1 $\pm$ 0.1	0.8 $\pm$ 0.07	0.8 $\pm$ 0.08	1.1 $\pm$ 0.06	0.9 $\pm$ 0.07	0.9 $\pm$ 0.07	0.9 $\pm$ 0.08
S	25.6 $\pm$ 3.2	30.1 $\pm$ 3.4	41.7 $\pm$ 5.3	26.1 $\pm$ 4.1	21.9 $\pm$ 4.0	40.8 $\pm$ 4.8	24.0 $\pm$ 2.3	23.0 $\pm$ 2.0	37.2 $\pm$ 3.6	28.9 $\pm$ 4.8	22.6 $\pm$ 3.0	27.2 $\pm$ 4.2
SR	5.9 $\pm$ 0.6	5.9 $\pm$ 0.3	7.4 $\pm$ 0.6	5.7 $\pm$ 0.5	5.8 $\pm$ 0.3	7.4 $\pm$ 0.5	5.4 $\pm$ 0.4	5.5 $\pm$ 0.3	6.2 $\pm$ 0.3	5.8 $\pm$ 0.3	5.4 $\pm$ 0.7	5.3 $\pm$ 0.5
Longitudinal												
V	1.3 $\pm$ 0.1	1.0 $\pm$ 0.08	1.4 $\pm$ 0.08	1.4 $\pm$ 0.2	1.3 $\pm$ 0.2	1.4 $\pm$ 0.09	1.2 $\pm$ 0.1	1.1 $\pm$ 0.1	1.4 $\pm$ 0.1	1.4 $\pm$ 0.2	1.3 $\pm$ 0.1	1.3 $\pm$ 0.09
D	0.3 $\pm$ 0.06	0.3 $\pm$ 0.05	0.4 $\pm$ 0.07	0.4 $\pm$ 0.08	0.3 $\pm$ 0.05	0.5 $\pm$ 0.05	0.3 $\pm$ 0.02	0.3 $\pm$ 0.06	0.4 $\pm$ 0.03	0.4 $\pm$ 0.09	0.5 $\pm$ 0.1	0.5 $\pm$ 0.07
S	-16.1 $\pm$ 1.7	-15.9 $\pm$ 1.4	-20.2 $\pm$ 1.7	-19.2 $\pm$ 1.4	-17.0 $\pm$ 1.7	-20.6 $\pm$ 1.0	-17.7 $\pm$ 1.2	-16.3 $\pm$ 1.3	-20.3 $\pm$ 2.4	-20.1 $\pm$ 2.4	-17.3 $\pm$ 1.3	-19.3 $\pm$ 1.2
SR	-4.7 $\pm$ 0.2	-4.4 $\pm$ 0.3	-6.2 $\pm$ 0.7	-5.3 $\pm$ 0.4	-4.8 $\pm$ 0.4	-5.6 $\pm$ 0.3	-4.5 $\pm$ 0.4	-4.3 $\pm$ 0.2	-5.3 $\pm$ 0.7	-5.4 $\pm$ 0.7	-5.0 $\pm$ 0.4	-5.2 $\pm$ 0.4
Circumferential												
R	129.6 $\pm$ 6.2	149.8 $\pm$ 13.9	241.5 $\pm$ 32.0	143.4 $\pm$ 10.3	139.7 $\pm$ 11.9	166.9 $\pm$ 19.8	127.7 $\pm$ 11.7	174.2 $\pm$ 19.9	161.8 $\pm$ 6.2	151.4 $\pm$ 8.9	158.8 $\pm$ 6.9	141.8 $\pm$ 20.0
D	4.0 $\pm$ 0.6	6.2 $\pm$ 0.9	6.1 $\pm$ 1.1	3.4 $\pm$ 0.7	4.1 $\pm$ 0.7	5.9 $\pm$ 0.9	3.7 $\pm$ 0.8	3.2 $\pm$ 0.7	5.3 $\pm$ 0.7	5.4 $\pm$ 0.3	4.2 $\pm$ 0.5	3.7 $\pm$ 0.4
S	-23.8 $\pm$ 1.9	-24.4 $\pm$ 1.9	-36.6 $\pm$ 2.1	-23.7 $\pm$ 1.5	-21.1 $\pm$ 1.4	-28.1 $\pm$ 1.7	-21.0 $\pm$ 1.9	-22.6 $\pm$ 1.8	-28.8 $\pm$ 1.7	-21.4 $\pm$ 1.9	-24.2 $\pm$ 1.5	-21.1 $\pm$ 1.8
SR	-5.4 $\pm$ 0.4	-5.7 $\pm$ 0.5	-9.0 $\pm$ 0.6	-5.9 $\pm$ 0.5	-5.5 $\pm$ 0.6	-6.5 $\pm$ 0.3	-5.4 $\pm$ 0.4	-6.0 $\pm$ 0.3	-6.8 $\pm$ 0.4	-5.5 $\pm$ 0.5	-6.6 $\pm$ 0.5	-4.9 $\pm$ 0.5

V: Velocity (cm/s)

D: Displacement (mm)

S: Strain (%)

SR: Strain Rate (1/s)

R: Rate (degrees/s)

Shaded parameters showed a significant dose-response in linear regression analysis, as shown in Supplemental Table S3.

Supplemental Data S4. Linear regression analysis of a dose-response of strain analysis parameters in systole at 3 months after irradiation (n=6-9).

	BN			BN/Ka		
	R	SE	p-value	R	SE	p-value
Radial						
Velocity	0.024	0.0086	0.013*	0.018	0.0064	0.012*
Displacement	0.014	0.0057	0.020*	0.012	0.0043	0.011*
Strain	0.61	0.27	0.035*	0.47	0.20	0.034*
Strain Rate	0.056	0.033	0.11	0.029	0.019	0.14
Longitudinal						
Velocity	0.0003	0.0061	0.96	0.0080	0.0069	0.26
Displacement	0.0001	0.0036	0.97	0.0050	0.0024	0.053
Strain	-0.15	0.10	0.16	-0.085	0.12	0.48
Strain Rate	-0.051	0.034	0.15	-0.027	0.032	0.42
Circumferential						
Rate	4.20	1.56	0.014*	1.57	0.71	0.04*
Displacement	0.089	0.056	0.13	0.053	0.046	0.26
Strain	-0.47	0.15	0.0062*	-0.29	0.11	0.015*
Strain Rate	-0.13	0.040	0.0033*	-0.057	0.022	0.017*

R: Regression Coefficient, SE: Standard Error

*Significant dose response (p<0.05).

Supplemental Data S5. Strain analysis of diastole at 3 months and 6 months after local heart irradiation (average $\pm$ SEM, n=6-9).

	BN						BNK					
	3 months			6 months			3 months			6 months		
	0 Gy	18 Gy	24 Gy	0 Gy	18 Gy	24 Gy	0 Gy	18 Gy	24 Gy	0 Gy	18 Gy	24 Gy
Radial												
V	-2.1 $\pm$ 0.2	-2.2 $\pm$ 0.2	-3.5 $\pm$ 0.3	-2.3 $\pm$ 0.2	-1.9 $\pm$ 0.2	-2.6 $\pm$ 0.2	-1.9 $\pm$ 0.2	-1.9 $\pm$ 0.3	-2.8 $\pm$ 0.2	-1.9 $\pm$ 0.1	-2.1 $\pm$ 0.2	-2.1 $\pm$ 0.2
D	-0.03 $\pm$ 0.005	-0.007 $\pm$ 0.002	-0.02 $\pm$ 0.008	-0.02 $\pm$ 0.006	-0.009 $\pm$ 0.002	-0.02 $\pm$ 0.003	-0.02 $\pm$ 0.004	-0.03 $\pm$ 0.009	-0.01 $\pm$ 0.003	-0.01 $\pm$ 0.003	-0.03 $\pm$ 0.003	-0.02 $\pm$ 0.007
S	-2.8 $\pm$ 0.4	-3.7 $\pm$ 0.7	-3.5 $\pm$ 0.7	-4.3 $\pm$ 0.7	-5.0 $\pm$ 1.2	-3.1 $\pm$ 0.7	-2.8 $\pm$ 0.5	-3.1 $\pm$ 0.5	-2.2 $\pm$ 0.6	-4.2 $\pm$ 1.0	-3.9 $\pm$ 1.1	-4.3 $\pm$ 0.9
SR	-7.3 $\pm$ 1.1	-7.8 $\pm$ 0.7	-10.3 $\pm$ 1.0	-7.4 $\pm$ 0.7	-6.1 $\pm$ 0.5	-8.9 $\pm$ 1.1	-5.7 $\pm$ 0.5	-6.5 $\pm$ 0.9	-8.9 $\pm$ 0.8	-5.9 $\pm$ 0.5	-5.9 $\pm$ 0.6	-7.1 $\pm$ 0.7
Longitudinal												
V	-1.5 $\pm$ 0.08	-1.3 $\pm$ 0.08	-1.6 $\pm$ 0.2	-1.5 $\pm$ 0.2	-1.0 $\pm$ 0.1	-1.7 $\pm$ 0.2	-1.5 $\pm$ 0.3	-1.3 $\pm$ 0.3	-1.4 $\pm$ 0.1	-1.7 $\pm$ 0.3	-1.2 $\pm$ 0.2	-1.7 $\pm$ 0.3
D	-0.1 $\pm$ 0.03	-0.1 $\pm$ 0.02	-0.2 $\pm$ 0.03	-0.1 $\pm$ 0.05	-0.1 $\pm$ 0.01	-0.1 $\pm$ 0.02	-0.2 $\pm$ 0.2	-0.2 $\pm$ 0.1	-0.1 $\pm$ 0.03	-0.2 $\pm$ 0.1	-0.1 $\pm$ 0.04	-0.1 $\pm$ 0.01
S	2.4 $\pm$ 0.5	2.1 $\pm$ 0.6	2.3 $\pm$ 0.6	1.4 $\pm$ 0.4	1.6 $\pm$ 0.4	2.3 $\pm$ 0.4	3.5 $\pm$ 2.3	2.7 $\pm$ 0.7	2.3 $\pm$ 0.6	2.0 $\pm$ 0.8	2.0 $\pm$ 0.6	2.3 $\pm$ 0.5
SR	6.0 $\pm$ 0.2	5.7 $\pm$ 0.5	7.6 $\pm$ 0.5	5.8 $\pm$ 0.6	5.0 $\pm$ 0.5	7.2 $\pm$ 0.5	8.9 $\pm$ 3.9	5.4 $\pm$ 0.7	7.4 $\pm$ 0.8	6.5 $\pm$ 0.5	5.8 $\pm$ 0.8	6.9 $\pm$ 0.7
Circumferential												
R	-144.3 $\pm$ 13.0	-194.0 $\pm$ 18.8	-258.1 $\pm$ 23.4	-179.4 $\pm$ 10.8	-168.7 $\pm$ 16.5	-180.0 $\pm$ 17.6	-141.1 $\pm$ 11.1	-135.0 $\pm$ 9.3	-198.6 $\pm$ 15.3	-168.9 $\pm$ 18.0	-164.8 $\pm$ 23.6	-142.8 $\pm$ 12.4
D	-1.6 $\pm$ 0.4	-0.8 $\pm$ 0.1	-1.9 $\pm$ 0.6	-2.9 $\pm$ 1.2	-1.5 $\pm$ 0.2	-1.0 $\pm$ 0.3	-1.4 $\pm$ 0.3	-1.5 $\pm$ 0.4	-0.9 $\pm$ 0.3	-1.0 $\pm$ 0.2	-1.3 $\pm$ 0.3	-1.7 $\pm$ 0.2
S	1.3 $\pm$ 0.2	0.7 $\pm$ 0.1	1.7 $\pm$ 0.4	1.4 $\pm$ 0.2	1.4 $\pm$ 0.2	1.0 $\pm$ 0.1	1.9 $\pm$ 0.4	1.6 $\pm$ 0.3	1.1 $\pm$ 0.1	0.9 $\pm$ 0.1	1.5 $\pm$ 0.2	1.3 $\pm$ 0.3
SR	6.9 $\pm$ 0.7	7.7 $\pm$ 0.6	14.0 $\pm$ 1.2	7.4 $\pm$ 0.5	6.3 $\pm$ 0.6	8.8 $\pm$ 0.8	6.2 $\pm$ 0.6	7.0 $\pm$ 0.7	9.2 $\pm$ 0.7	5.8 $\pm$ 0.5	7.3 $\pm$ 0.8	6.6 $\pm$ 0.7

V: Velocity (cm/s)

D: Displacement (mm)

S: Strain (%)

SR: Strain Rate (1/s)

R: Rate (degrees/s)

Shaded parameters showed a significant dose-response in linear regression analysis, as shown in Supplemental Table S6.

Supplemental Data S6. Linear regression analysis of a dose-response of strain analysis parameters in diastole at 3 months after irradiation (n=6-9).

	BN			BN/Ka		
	R	SE	p-value	R	SE	p-value
Radial						
Velocity	-0.049	0.018	0.012*	-0.033	0.014	0.030*
Displacement	0.00040	0.00040	0.37	0.00030	0.00030	0.33
Strain	-0.035	0.038	0.36	0.020	0.034	0.57
Strain Rate	-0.11	0.057	0.058	-0.12	0.045	0.015*
Longitudinal						
Velocity	0.0012	0.0090	0.90	-0.0050	0.011	0.64
Displacement	-0.0022	0.0016	0.18	-0.0016	0.0023	0.49
Strain	-0.0060	0.034	0.86	0.052	0.037	0.18
Strain Rate	0.057	0.030	0.069	0.088	0.046	0.070
Circumferential						
Rate	-4.49	1.30	0.0026*	-2.039	0.92	0.040*
Displacement	-0.0059	0.029	0.84	0.017	0.020	0.40
Strain	0.012	0.02	0.56	-0.030	0.016	0.079
Strain Rate	0.26	0.075	0.0024*	0.11	0.045	0.020*

R: Regression Coefficient, SE: Standard Error

*Significant dose response (p<0.05).