

TABLES

Table 1. Baseline Data: clinical presentation and 2D echocardiographic variables

	Overall (n=59)	FMR (n=33)	DMR (n=26)	p-value
Age, year (IQR)	80 (75-85)	79 (75-83)	84 (76-86)	0.059
Male, n (%)	36 (61.0)	22 (66.7)	14 (53.8)	0.316
EuroSCORE II, % (IQR)	4 (3-7)	6 (4-8.5)	3 (2-4)	≤0.001
NYHA III/IV, n (%)	37 (62.7)	22 (66.7)	15 (57.7)	0.479
Previous Myocardial Infarction, n (%)	20 (33.9)	17 (51.5)	3 (11.5)	0.002
Prior Cardiac Surgery, n (%)	16 (27.1)	12 (36.4)	4 (15.4)	0.085
History of Atrial Fibrillation, n (%)	38 (64.4)	19 (57.6)	19 (73.1)	0.217
CRT, n (%)	11 (18.6)	11 (33.3)	0 (0.0)	≤0.001
ICD, n (%)	14 (23.7)	13 (39.4)	1 (3.8)	0.002
HF episode <1 year, n (%)	32 (54.2)	22 (66.7)	10 (38.5)	0.031
NT-proBNP, pg/mL (IQR)	3902 (1756-6305)	5471 (2964-9464)	1604 (1322-3469)	0.002
LV EDD, mm ±SD	55.7±8.5	58.8±8.7	51.8±6.6	≤0.001
LV ESD, mm ±SD	40.7±12.2	47.1±11.1	33.0±8.4	≤0.001
LV EDV, mL ±SD	133.1±55.7	151.6±62.3	109.5±34.6	0.003
LV ESV, mL ±SD	59 (41-113)	95 (55-130)	42 (29-56)	≤0.001
LV EF, % ±SD	46.5±15.4	37.9±12.6	57.4±11.4	≤0.001
LAVi, mL/m ² ±SD	62 (51-75)	59 (46-73)	68 (56-76)	0.213
MR 3+, n (%)	14 (23.7)	7 (21.2)	7 (26.9)	0.609
MR 4+, n (%)	44 (74.6)	25 (75.8)	19 (73.1)	0.814
Regurgitant Volume, mL ±SD	56.8±24.8	52.7±22.9	65.5±27.7	0.183
EROA, cm ² ±SD	0.4±0.2	0.4±0.2	0.5±0.2	0.041
Vena Contracta width, mm ±SD	6.7±1.6	6.5±1.5	7.1±1.7	0.232
Flail, n (%)	15 (25.4)	0 (0.0)	15 (57.7)	≤0.001
Isolated Prolapse, n (%)	12 (20.7)	0 (0.0)	12 (46.2)	≤0.001

Multiple Prolapse, n (%)	8 (13.6)	0 (0.0)	8 (30.8)	≤0.001
Symmetric tenting, n (%)	11 (19.0)	10 (31.2)	1 (3.8)	0.016
Asymmetric tenting, n (%)	17 (29.3)	16 (50.0)	1 (3.8)	≤0.001
Reverse Pulmonary Venous Flow, n (%)	32 (58.2)	18 (56.2)	14 (60.9)	0.732
Severe Tricuspid Regurgitation, n (%)	14 (23.7)	9 (27.3)	5 (19.2)	0.471
RV basal diameter, mm ±SD	39.7±4.9	39.8±4.4	39.7±5.7	0.102
sPAP, mmHg ±SD	41.2±11.7	40.9±12.5	41.4±10.8	0.876
TAPSE, mm ±SD	19.7±4.5	17.5±3.4	22.5±4.2	≤0.001
S wave, cm/sec ±SD	11.0±2.2	10.2±2.0	12.2±2.1	0.007

Abbreviations: NYHA, New York Heart Association; CRT, Cardiac Resynchronization Therapy; ICD, Implantable Cardiac Defibrillator; HF, Heart Failure, LV, Left Ventricle; EDD, End Diastolic Diameter; ESD, End Systolic Diameter; EDV, End Diastolic Volume; ESV, End Systolic Volume; EF, Ejection Fraction; LAVi, Left Atrial Volume indexed; MR, mitral regurgitation; EROA, Effective Regurgitant Orifice Area; RV, Right Ventricle; sPAP, systolic Pulmonary Artery Pressure; TAPSE, Tricuspid Annular Plane Excursion

Table 2. Peri-Procedural Data and Outcome with MitraClip XT_R

	Overall (n=59)	FMR (n=33)	DMR (n=26)	p-value
Concomitant MitraClip NT, n (%)	1 (1.7)	0 (0.0)	1 (3.8)	0.441
Concomitant MitraClip NT _R , n (%)	16 (27.1)	11 (33.3)	5 (19.2)	0.226
MitraClip NT or NT _R >1, n (%)	0 (0.0)	0 (0.0)	0 (0.0)	-
MitraClip XT _R >1, n (%)	18 (30.5)	8 (24.2)	10 (38.5)	0.239
Total clip(s) implanted, n (IQR)	2 (1-2)	2 (1-2)	2 (1-2)	0.679
Technical Success, n (%)	59 (100)	33 (100)	26 (100)	-
Acute Adverse Events, n (%)	1 (1.7)	0 (0.0)	1 (3.8)	0.441
MR ≤ 1+, n (%)	40 (67.8)	22 (66.7)	18 (69.2)	0.834
MR 2+, n (%)	18 (30.5)	11 (33.3)	7 (26.9)	0.595
MR 3+, n (%)	1 (1.7)	0 (0.0)	1 (3.8)	0.441
MR 4+, n (%)	0 (0.0)	0 (0.0)	0 (0.0)	-

3D Vena contracta area, cm ² ±SD	0.2±0.1	0.3±0.1	0.2±0.1	0.321
Mean Gradient, mmHg ±SD	3.4±1.2	3.3±1.2	3.6±1.2	0.319
Systolic PVF, n (%)	34 (63.0)	18 (62.1)	16 (64.0)	0.884
Variation of PVF, n (%)	52 (92.9)	27 (87.1)	25 (100)	0.062

Abbreviations: PVF, pulmonary vein flow; other abbreviations as in Table 1.

Table 3. Baseline, Post-procedural and Variation of 3D Echocardiographic Variables in FMR and DMR cohorts

FMR (n=33)	Pre-MitraClip XT_R	Post-MitraClip XT_R	Δ-mean	p-value
CC Annulus Diameter, mm±SD	39.2±6.8	39.8±6.8	+0.6	0.337
AP Annulus Diameter, mm±SD	36.2±5.7	35.1±5.6	-1.1	0.024
Annulus Height, mm±SD	6.9±1.9	7.6±2.3	+0.7	0.003
Maximum Annular Velocity, mm/s±SD	26.3±11.7	27.0±9.01	+0.7	0.782
Non-planar Angle, °±SD	145.8±23.1	136.2±24.3	-9.6	≤0.001
Sphericity Index, ±SD	1.0±0.2	0.9±0.2	-0.1	0.017
AHCWR, %±SD	18.4±6.7	19.6±6.7	+1.2	≤0.001
AML Angle, °±SD	23.2±10.8	25.1±13.2	+1.9	0.414
PML Angle, °±SD	36.3±13.7	40.8±17.5	+4.5	0.161
DMR (n=26)	Pre-MitraClip XT_R	Post-MitraClip XT_R	Δ-mean	p-value
CC Annulus Diameter, mm±SD	38.2±4.2	37.6±5.5	-0.6	0.383
AP Annulus Diameter, mm±SD	36.3±6.0	35.4±5.5	-0.9	0.303
Annulus Height, mm±SD	7.0±2.8	7.4±2.5	+0.4	0.314
Maximum Annular Velocity, mm/s±SD	35.0±14.2	27.2±10.0	-7.8	0.027
Non-planar Angle, °±SD	144.4±17.3	142.3±17.6	-2.1	0.353
Sphericity Index, ±SD	1.0±0.2	0.9±0.1	-0.1	0.004
AHCWR, %±SD	18.60±7.5	19.9±7.2	+1.3	0.100
AML Angle, °±SD	15.9±10.3	18.8±7.9	+2.9	0.256

PML Angle, °±SD	19.8±12.1	27.4±11.4	+7.6	≤0.001
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Abbreviations: CC, commissural; AP, antero-posterior; AHCWR, annulus height to commissural width ratio; AML, anterior mitral leaflet; PML, posterior mitral leaflet; other abbreviations as in Table 1.

Table 4. Univariate and Multivariate Analyses Exploring the Association of Pre-procedural Echocardiographic Variables with Optimal or Sub-Optimal results in the Overall Population

Variables	Univariate OR	95% CI	p-value	Multivariate OR	95% CI	p-value
LV EDD, mm	0.93	0.86-0.99	0.029	-	-	-
LV ESD, mm	0.95	0.91-1.00	0.062	-	-	-
LV EDV, mL	0.98	0.97-0.99	0.013	0.96	0.93-0.99	0.050
LV ESV, mL	0.99	0.97-0.99	0.030	-	-	-
TAPSE, mm	1.13	0.98-1.26	0.094	-	-	-
AML Angle, °	0.94	0.89-0.99	0.048	0.91	0.84-0.99	0.030

Abbreviations: as in Table 1 and Table 3.

Table 5. Intra and inter-observer reproducibility of 3D-Echocardiographic variables

Variables	Intra-Class Correlation Coefficient (95% CI)	
	Intra-Observer	Inter-Observer
CC Annulus Diameter, mm ± SD	0.92 (0.78-0.97)	0.63 (0.20-0.86)
AP Annulus Diameter, mm ± SD	0.73 (0.30-0.90)	0.66 (0.25-0.87)
Annulus Height, mm ± SD	0.92 (0.77-0.97)	0.93 (0.82-0.98)
Maximum Annular Velocity, mm/s ± SD	0.96 (0.89-0.98)	0.91 (0.74-0.97)
Non-planar Angle, ° ± SD	0.79 (0.46-0.93)	0.92 (0.76-0.97)
AML Angle, ° ± SD	0.84 (0.56-0.94)	0.80 (0.50-0.93)
PML Angle, ° ± SD	0.60 (0.10-0.85)	0.86 (0.63-0.95)

Abbreviations: as in Table 3.

FIGURE LEGENDS

Figure 1. Three-D *en face* view of mitral valve before and after MitraClip XT_R implantation in a patient diagnosed with FMR. Real-Time Full-Volume 3D acquisition of mitral valve (A) and the planimetry of Vena Contracta Area by 3D Color Doppler (B), at baseline and after 1 MitraClip XTR implantation. Yellow arrows indicate leaflets' coaptation deficit at baseline, and the MitraClip XTR device implanted at A2-P2 scallop level at the end of the procedure. Dashed white lines contour Vena Contracta Area before and after the device deployment.

Figure 2. Three-D reconstruction of mitral valve using the GE MVQ software in a patient diagnosed with DMR. The semi-automated software first requires the identification of six anatomical landmarks (panel A): mitral annulus commissural (MA1, MA2) and antero-posterior (P, A) hinge points, aortic annulus (Ao) and coaptation point (Coap). Therefore, the spatial alignment of the 3D data set is recreated and displayed in three orthogonal planes across mitral annulus (panel B: lateral plane A1-P1, central plane A2-P2, medial plane P3-A3). As a result, the software tracks the annular and leaflet's contour, producing a 3D rendering model (panel C) of mitral valve in an *en face* view. In this example of DMR, the prolapse of P2 scallop (yellow arrow) is then easily diagnosed.

Figure 3. Comparison of 3D MV model at baseline (A) and after MitraClip procedure (B) software in a patient diagnosed with DMR. The software also provides a colour-coded topographic map of leaflets' displacement relative to the annular plane, that facilitates the recognition and correct localization of valvular lesions. Here is reported the same DMR example of Figure 2: the leaflet prolapse at P2 scallop is identified by a red spot (panel A);

after two MitraClip XTR implantation leaflet excursion is normalized, with subsequent change in the color-coded map (panel B).