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Dual Lumen Interventions to promote False Lumen Thrombosis in Chronic Aortic Dissections:

The FLIRT Procedure: What is it; When is it useful; How to do it?

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Inching towards the ascending Aorta: *Endovascular targets may change…*

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Article

Nonsurgical Repair of the Ascending Aorta: Why Less Is More

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What is it?

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ORIGINAL STUDIES WILEY

False lumen intervention to promote remodelling and thrombosis—The FLIRT concept in aortic dissection

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Abstract

Objective: Thoracic endovascular aortic repair (TEVAR) has changed the management of aortic dissection by induced remodelling. Beyond reconstructing the true lumen, we describe the concept of False Lumen Intervention to promote Remodelling and Thrombosis (FLIRT) in both type A and B aortic dissection.

Methods: Between 2011 and 2017, 10 patients with aortic dissection (5 type A; 5 type B) underwent FLIRT using a combination of patent foramen ovale (PFO) or atrial septal defect (ASD) occluders, coils and glue. Patients were followed by computed tomography (CT) angiogram prior to, and 6 months following, discharge to evaluate false lumen (FL) thrombosis and aortic remodelling. Outcomes analyzed comprised successful device delivery, completeness of FL thrombosis and aortic remodelling, procedure related complications and mortality.

Results: FLIRT induced aortic remodelling in all cases of proximal dissection, with aortic shrinkage from 63.8 ± 7.5 pre-FLIRT, to 50.2 ± 6.6 mm ($P = 0.057$) and an increase in true lumen area from 5.8 ± 3.6 to 11.4 ± 2.5 cm^2 ($P = 0.006$). In distal dissection (after previous TEVAR with residual FL flow), FLIRT successfully induced FL thrombosis in 4 of 5 cases at first attempt (1 case required additional coiling of the gutter between left subclavian artery and stent-graft for complete thrombosis). While maximal aortic diameter remained unchanged (55.6 ± 9.1 pre-FLIRT and 54.4 ± 13.7 mm at follow-up), true lumen area increased from 7.8 ± 2.3 pre-procedure, to 10.6 ± 1.5 cm^2 at follow-up ($P = 0.016$), consistent with remodelling.

Initial **FLIRT series** (10) and summary of the concept in 2018

Extending series of 31 and counting…

Average Euroscore II 20% (5-51)

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When is it useful ?

FLIRT with the impossible…FL management in this type A dissection?

75 y/o female

- Admitted from a routine surveillance CT of thoracic aortic aneurysm showed a new dissection in aortic root

- Hypertension
- Apronectomy in Feb 1999
- Coronary angiogram : LAD 70% stenosis in 2001
- Infra-renal AAA repair in 2006
- Permanent pacemaker implantation in Mar 2007
- Osteoarthritis with total knee replacements
- Lower gastrointestinal haemorrhage with bowel resection in 2015, end-to-end anastomosis
- Aorto-femoral bypass

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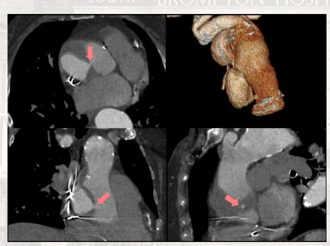
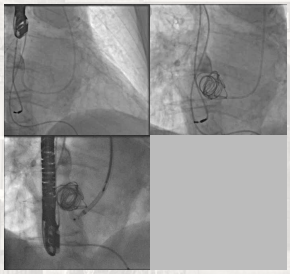
When is it useful?

Individualised approach – false lumen management in type A dissection



Type A dissection confined to just above the aortic root to mid ascending aorta.
Measured 26 x 42 mm
Entry tear diameter 5mm

Individualised approach – false lumen management in type A dissection



Angiogram confirms the false lumen and entry tear.

- 15 x 5 mm coils deployed via MP followed by a 10mm Amplatzer PFO closure device placed across the entry tear.
- Final angiogram shows tear sealed and coronary ostium unblocked.

Individualised approach – false lumen management in type A dissection

CT scan 3 days after procedure

No contrast communication to the false lumen

CT scan 6 months after procedure

Device sealing in site precisely with excellent remodelling

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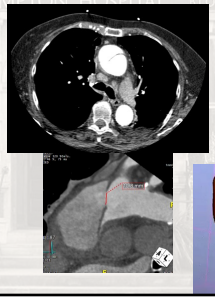
When is it useful?
Hybrid workplace for endovascular procedures

How to do it ?

No surgery, no stent graft ...FLIRT as alternative strategy!

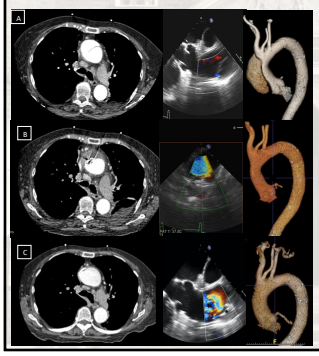


CASE M.P

Inoperable
Euroscore II 21%

CASE M.P

Interventional Repair of type A aortic dissection by use of FLIRT



pre procedure
(FLIRT)

CT and echo images pre-procedure (A), at discharge (B) and 6-month follow-up (C) showing entry closure false lumen thrombus and shrinkage with true lumen expansion (remodelling) (patient no.2). Star shows the ASD occluder.

At discharge

6 months F/U

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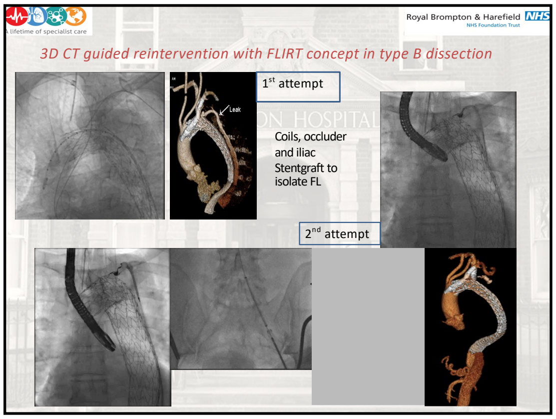
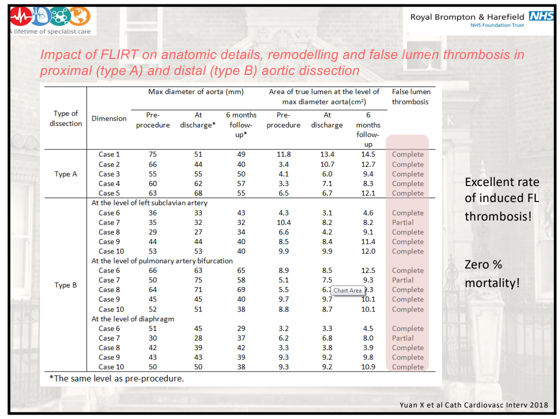
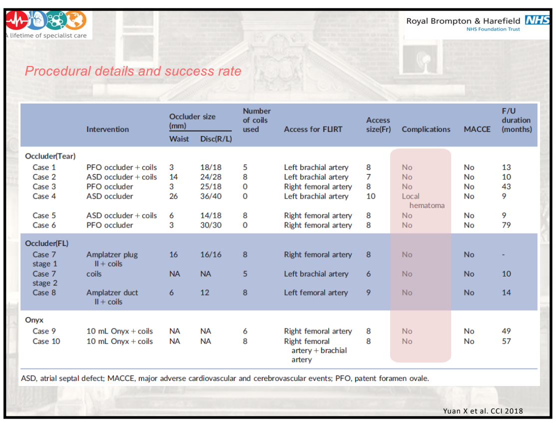




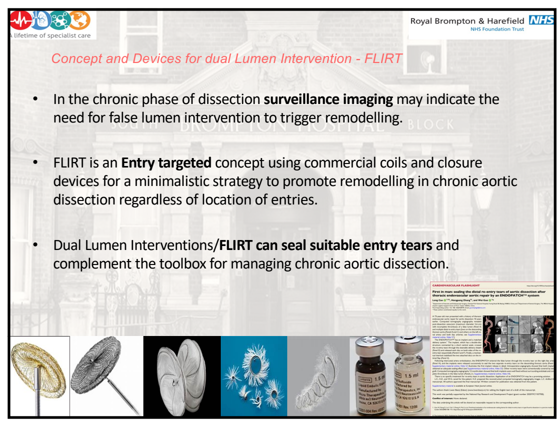
Type of dissection	Dimension	Max diameter of aorta (mm)			Area of true lumen at the level of max diameter aorta(cm²)			False lumen thrombosis
		Pre-procedure	At discharge*	6 months follow-up*	Pre-procedure	At discharge	6 months follow-up	
Type A	Case 1	75	51	49	11.8	13.4	14.5	Complete
	Case 2	66	44	40	3.4	10.7	12.7	Complete
	Case 3	55	55	50	4.1	6.0	9.4	Complete
	Case 4	60	62	57	3.3	7.1	8.3	Complete
	Case 5	63	68	55	6.5	6.7	12.1	Complete
Type B	At the level of left subclavian artery							
	Case 6	36	33	43	4.3	3.1	4.6	Complete
	Case 7	35	32	32	10.4	8.2	8.2	Partial
	Case 8	29	27	34	6.6	4.2	9.1	Complete
	Case 9	44	44	40	8.5	8.4	11.4	Complete
	Case 10	53	53	40	9.9	9.9	12.0	Complete
	At the level of pulmonary artery bifurcation							
	Case 6	66	63	65	8.9	8.5	12.5	Complete
	Case 7	50	75	58	5.1	7.5	9.3	Partial
	Case 8	64	71	69	5.5	6.[illegible]	[illegible].3	Complete
	Case 9	45	45	40	9.7	9.7	10.1	Complete
	Case 10	52	51	38	8.8	8.7	10.1	Complete
	At the level of diaphragm							
	Case 6	51	45	29	3.2	3.3	4.5	Complete
	Case 7	30	28	37	6.2	6.8	8.0	Partial
	Case 8	42	39	42	3.3	3.8	3.9	Complete
	Case 9	43	43	39	9.3	9.2	9.8	Complete
	Case 10	50	50	38	9.3	9.2	10.9	Complete

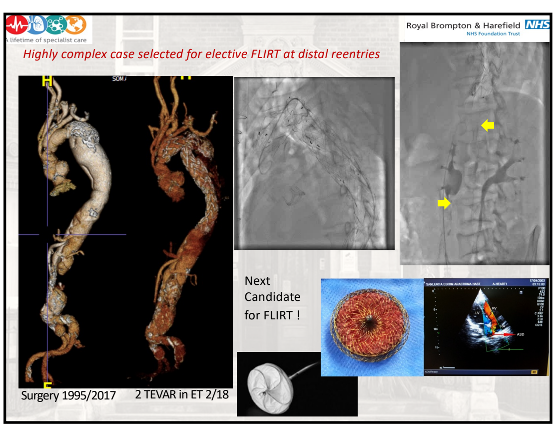
*The same level as pre-procedure.

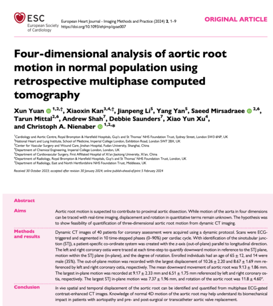


	Intervention	Occluder size (mm) Waist	Occluder size (mm) Disc(R/L)	Number of coils used	Access for FLIRT	Access size(Fr)	Complications	MACCE	F/U duration (months)
Occluder(Tear)									
Case 1	PFO occluder + coils	3	18/18	5	Left brachial artery	8	No	No	13
Case 2	ASD occluder + coils	14	24/28	8	Left brachial artery	7	No	No	10
Case 3	PFO occluder	3	25/18	0	Right femoral artery	8	No	No	43
Case 4	ASD occluder	26	36/40	0	Left brachial artery	10	Local hematoma	No	9
Case 5	ASD occluder + coils	6	14/18	8	Right femoral artery	8	No	No	9
Case 6	PFO occluder	3	30/30	0	Right femoral artery	8	No	No	79
Occluder(FL)									
Case 7 stage 1	Amplatzer plug II + coils	16	16/16	8	Right femoral artery	8	No	No	-
Case 7 stage 2	coils	NA	NA	5	Left brachial artery	6	No	No	10
Case 8	Amplatzer duct II + coils	6	12	8	Left femoral artery	9	No	No	14
Onyx									
Case 9	10 mL Onyx + coils	NA	NA	6	Right femoral artery	8	No	No	49
Case 10	10 mL Onyx + coils	NA	NA	8	Right femoral artery + brachial artery	8	No	No	57

ASD, atrial septal defect; MACCE, major adverse cardiovascular and cerebrovascular events; PFO, patent foramen ovale.







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ORIGINAL ARTICLE

Four-dimensional analysis of aortic root motion in normal population using retrospective multiphase computed tomography

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Abstract

Aims Aortic root motion is suspected to contribute to proximal aortic dissection. While motion of the aorta in four dimensions can be traced with real-time imaging, displacement and rotation in quantitative terms remain unknown. The hypothesis was to show feasibility of quantification of three-dimensional aortic root motion from dynamic CT imaging.

Methods and results Dynamic CT images of 40 patients for coronary assessment were acquired using a dynamic protocol. Scans were ECG-triggered and segmented in 10 time-stepped phases (0–90%) per cardiac cycle. With identification of the sinotubular junction (STJ), a patient-specific co-ordinate system was created with the *z*-axis (out-of-plane) parallel to longitudinal direction. The left and right coronary ostia were traced at each time-step to quantify downward motion in reference to the STJ plane, motion within the STJ plane (in-plane), and the degree of rotation. Enrolled individuals had an age of 65 ± 12, and 14 were male (35%). The out-of-plane motion was recorded with the largest displacement of 10.26 ± 2.20 and 8.67 ± 1.69 mm referenced by left and right coronary ostia, respectively. The mean downward movement of aortic root was 9.13 ± 1.86 mm. The largest in-plane motion was recorded at 9.17 ± 2.33 mm and 6.51 ± 1.75 mm referenced by left and right coronary ostia, respectively. The largest STJ in-plane motion was 7.37 ± 1.96 mm, and rotation of the aortic root was 11.8 ± 4.60°.

Conclusion *In vivo* spatial and temporal displacement of the aortic root can be identified and quantified from multiphase ECG-gated contrast-enhanced CT images. Knowledge of normal 4D motion of the aortic root may help understand its biomechanical impact in patients with aortopathy and pre- and post-surgical or transcatheter aortic valve replacement.