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#### DEFINING PATENT FORAMEN OVALE MORPHOLOGY USING THREE-DIMENSIONAL TRANSOESOPHAGEAL ECHOCARDIOGRAPHY AND RELATIONSHIP TO SHUNT SIZE

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**Background** Three dimensional transoesophageal echocardiography (3D TOE) has allowed better understanding of atrial septal anatomy and patent foramen ovale (PFO) morphology. Anatomical variations seen in patients undergoing transcatheter device closure may influence device choice and procedural success. Currently there is no standardised approach to 3D TOE imaging of a PFO. The aim of this study was to utilise a 3D imaging protocol to describe/quantify PFO morphological features of clinically important PFO's and relate our findings to shunt size.

**Methods** We examined 3D TOE images of the atrial septum in consecutive patients with otherwise structurally normal hearts undergoing TOE assessment prior to PFO closure. Datasets were obtained using Philips iE33 and then analysed offline (QLab 3DQ, Philips Healthcare). Linear measurements recorded included: tunnel dimensions, fossa ovalis dimensions, and septal sway. Other characteristics assessed included left atrial opening morphology, right atrial anatomy and presence of an atrial septal aneurysm (>10 mm septal

excursion from the midline). Morphological features were categorised as either simple or complex. Complex defects were those with one or more of the following: long tunnel length (>8 mm), multiple openings into the left atrium, atrial septal aneurysm, hybrid defect (additional small defect(s) in fossa ovalis), thick secundum septum (>8 mm), Eustachian ridge (ER), Eustachian valve or Chiari network. The size of right-to-left shunt either at rest or with Valsalva manoeuvre was assessed by transthoracic contrast echocardiography and graded according to the number of bubbles seen in a single still frame in the left atrium as: small-to-moderate (<25 bubbles), large (25–50 bubbles) and very large (>50 bubbles).

**Results** 3D datasets were available for analysis in 73 patients. Mean age of the population was 47±12.7 years. and 62% were male. The most frequent indication for PFO closure was stroke (48%). Linear dimensions recorded from 3D datasets are presented (table). Left atrial opening was categorised as high, opening onto the left atrial roof, in 18% of patients and presence of multiple left atrial openings was observed in 8%. Atrial septal aneurysm was present in 12%. A prominent Eustachean ridge was seen in 78% patients and was positioned high on fossa ovalis in 32% cases. The majority of patients (88%) had one or more complex morphological features. There was no clear association observed between shunt size and size of PFO.

**Conclusions** 3D transoesophageal echocardiography allows a practical, qualitative, and quantitative assessment of PFO morphology. In our cohort of patients a variety of complex anatomical features are demonstrated. Shunt size did not correlate with PFO dimensions.

	All Subjects (n=73)
Tunnel length (mm)	6.4±3.4
RA tunnel opening (mm)	8.5±3.8
LA tunnel opening (mm)	8.7±4.7
Septal Sway (mm)	5±3
Fossa Ovalis dimension (mm) <i>Anterior-posterior</i>	17±4.9
<i>Superior-inferior</i>	19.4±6.8
Secundum septum thickness (mm)	5.4±1.6

Figure 1