

A semi-automated method to obtain metrics of interest to evaluate an Ascending Aortic Aneurysm evolution

Jacques Tomasi^{1, 2}, Pierre Flores¹, Leonardo Geronzi³, Waleed Al Badi¹, Pascal Haigron², Jean-Philippe Verhoye^{1, 2}

University hospital of Rennes, Rennes, France

University of Rennes

University of Roma, Roma, Italy

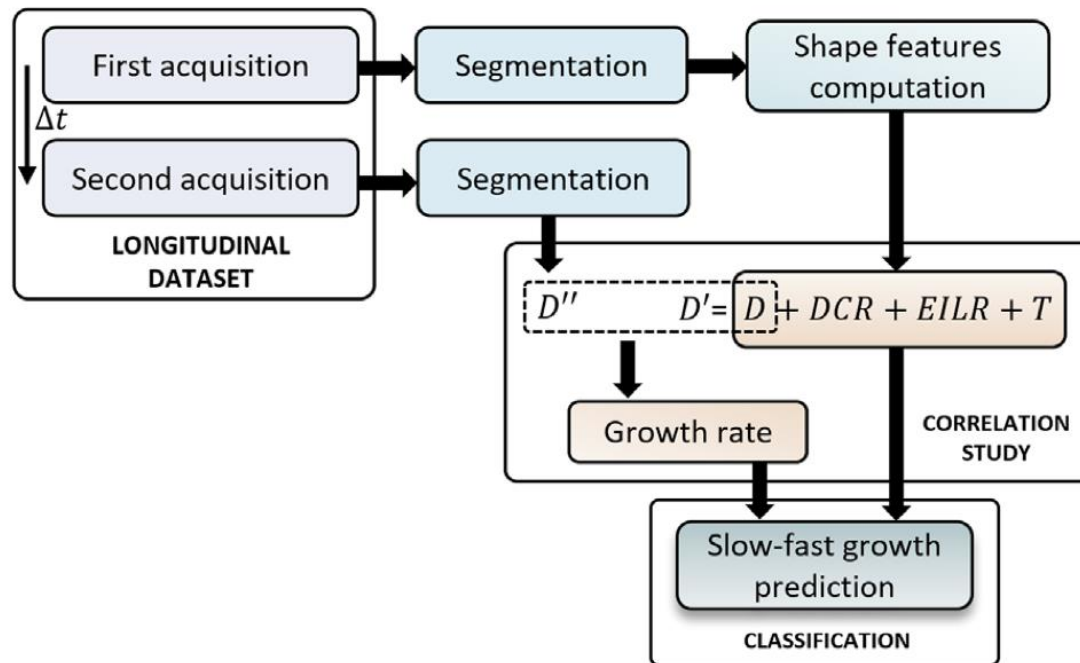
Introduction

- **Ascending aortic aneurysm**
 - 3-4 % of people aged from 65 years old
- **Many dissections appear below admitted 50mm diameter max**
- **Diameter max measurement is insufficient**
 - How to identify patients at high risk of rupture or dissection ?
- **We present a workflow to obtain new metrics**



Methods

- 91 patients follow up with serial CT-scans

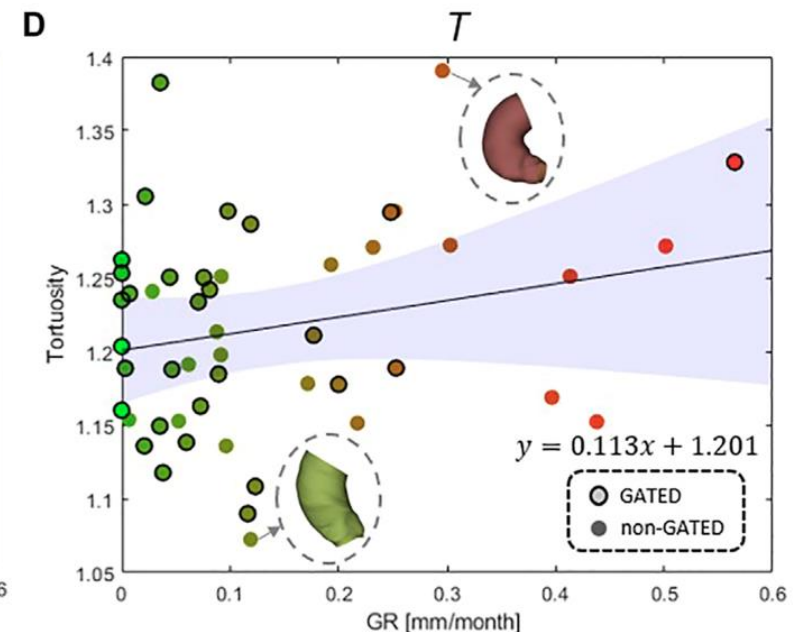
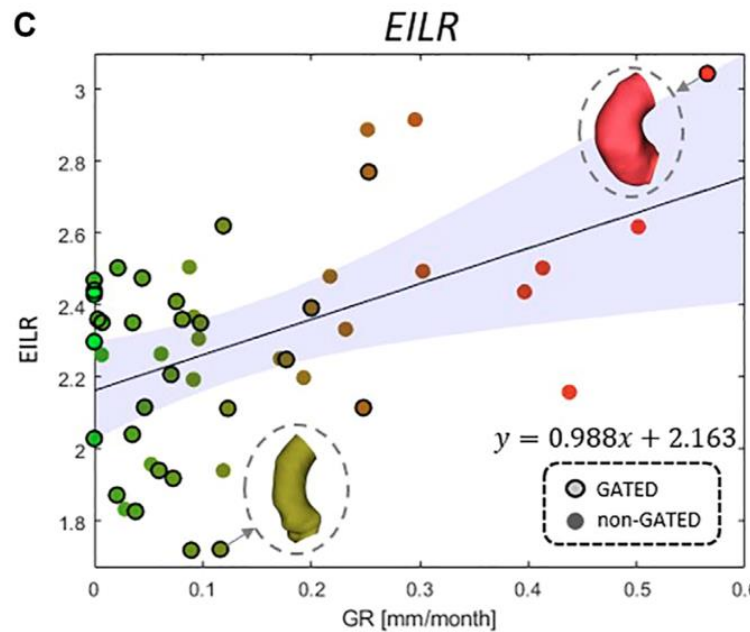
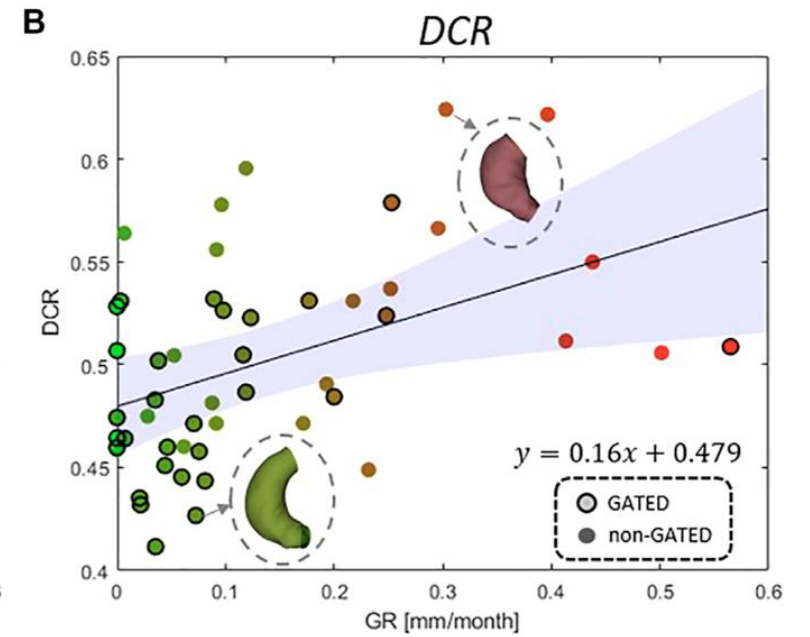
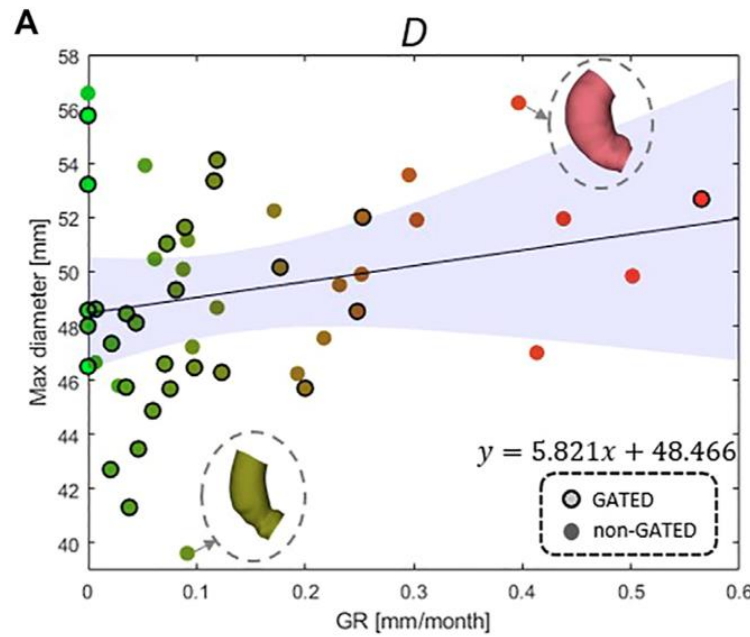


Maximum diameter D
Ratio DCR between D and
length of centerline
Ratio $EILR$ between length
of external and internal
lines
Tortuosity T

Results

- Positive relationship between growth rate and

- Diameter D
- Ratio DCR
- Ratio EILR
- Tortuosity T



ANEURYSM GROWTH RATE OVER THE MONTHS



Results

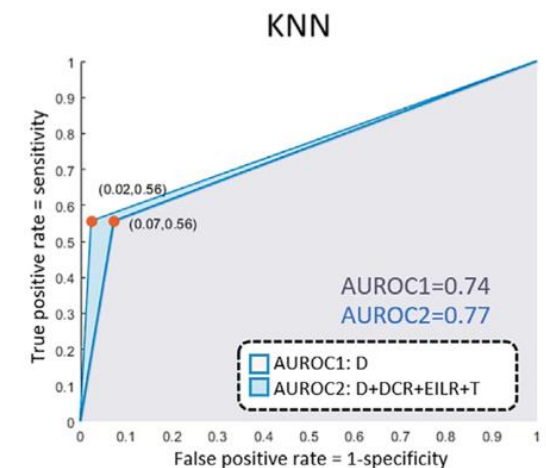
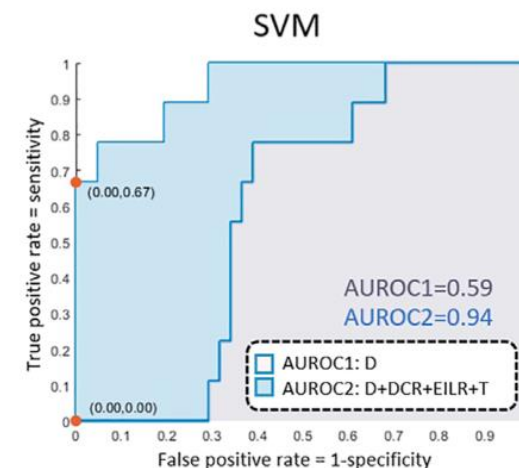
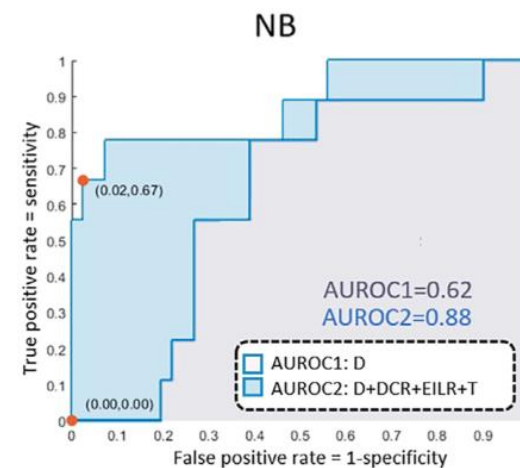
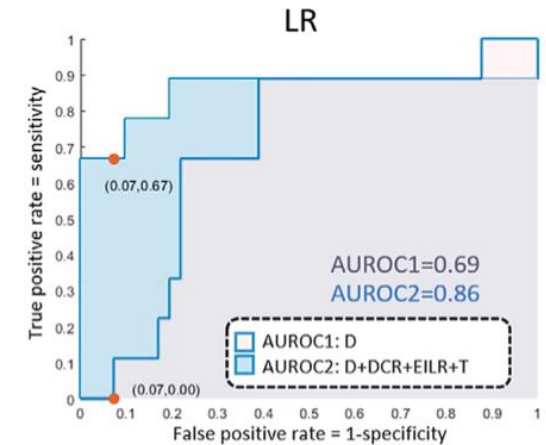
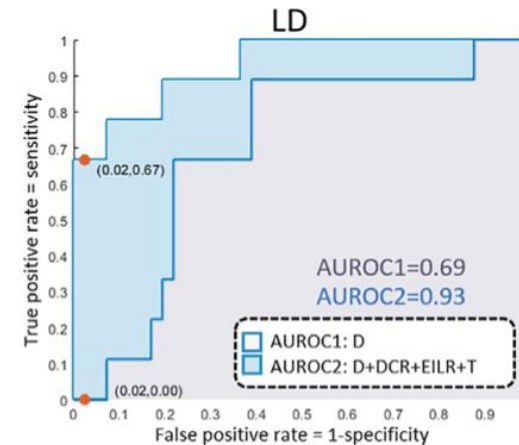
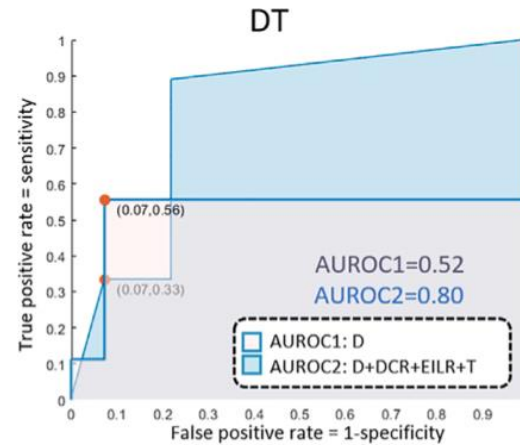
	DT	LD	LR	NB	SVM	KNN
Accuracy (<i>D</i>)	82%	80%	76%	82%	82%	86%
Accuracy (<i>D</i> + <i>DCR</i> + <i>EILR</i> + <i>T</i>)	86%	92%	88%	92%	94%	90%
Sensitivity (<i>D</i>)	33.3%	0%	0%	0%	0%	55.6%
Sensitivity (<i>D</i> + <i>DCR</i> + <i>EILR</i> + <i>T</i>)	55.6%	66.7%	66.7%	66.7%	66.7%	55.6%
Specificity (<i>D</i>)	92.7%	97.6%	92.7%	100%	100%	92.7%
Specificity (<i>D</i> + <i>DCR</i> + <i>EILR</i> + <i>T</i>)	92.7%	97.6%	92.7%	97.6%	100%	97.6%
LHR+ (<i>D</i>)	4.56	0	0	//	//	7.62
LHR+ (<i>D</i> + <i>DCR</i> + <i>EILR</i> + <i>T</i>)	7.62	27.79	9.13	27.79	+∞	23.17
LHR- (<i>D</i>)	0.72	1.02	1.08	1	1	0.48
LHR- (<i>D</i> + <i>DCR</i> + <i>EILR</i> + <i>T</i>)	0.48	0.34	0.36	0.34	0.33	0.45

- **DT decision Tree, LD linear discriminant, LR Logistic regression, NB naive bayes, SVM support vector machine, KNN k-nearest neighbours**
- **Diameter alone has a poor accuracy**
- **Using the 4 measurements SVM has the best accuracy**

AUROC between different methods

D alone

All measurements



Conclusion

- **This method provides new metrics of interest**
 - Diameter along centerline
 - Lengths of external and internal curvature
 - Surface
 - Volume
 - Strain and local growth
- **Correlation between those metrics and aneurysmal growth can be shown**
- **Diameter alone is not sufficient to predict aneurysmal growth**

