Heritability of coronary geometry

initial experiences

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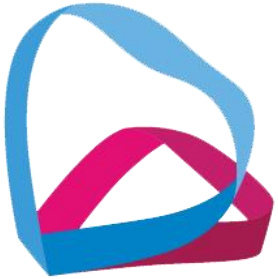

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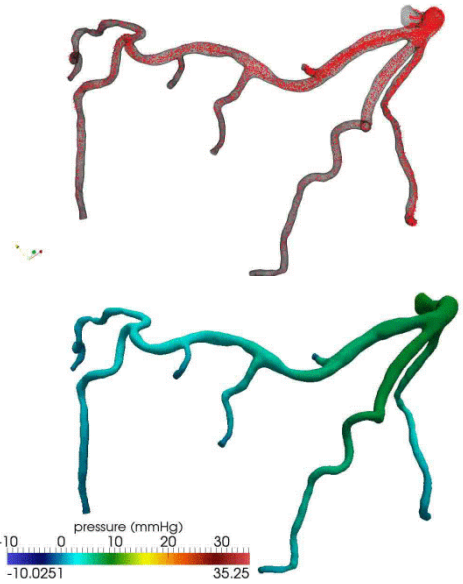
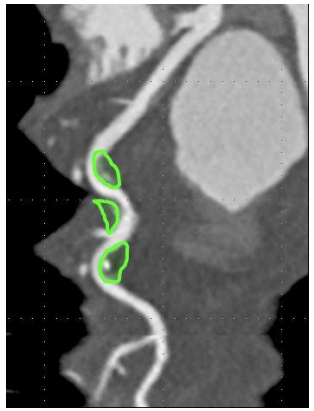
Coronary Geometry Affects

- Coronary blood flow[1]
- Coronary shear stress[2]
- Plaque formation[3]
- Plaque structure[4]





Objective:

Determine to what extent environmental and genetic factors contribute to the geometry of the coronaries

[1]: Govindaraju K et al., Phys Med. 2013 May;29(3):225-32.
[2]: Zhang JM et al., Int J Numer Method Biomed Eng. 2015 Jan 28.
[3]: Assemat P et al., Comput Struct Biotechnol J. 2014 Aug 2;10(17):98-106.
[4]: Eshtehardi P et al., J Am Heart Assoc. 2012 Aug;1(4):e002543

Quantification of geometrical similarity

Root Mean Square Error:RMSE

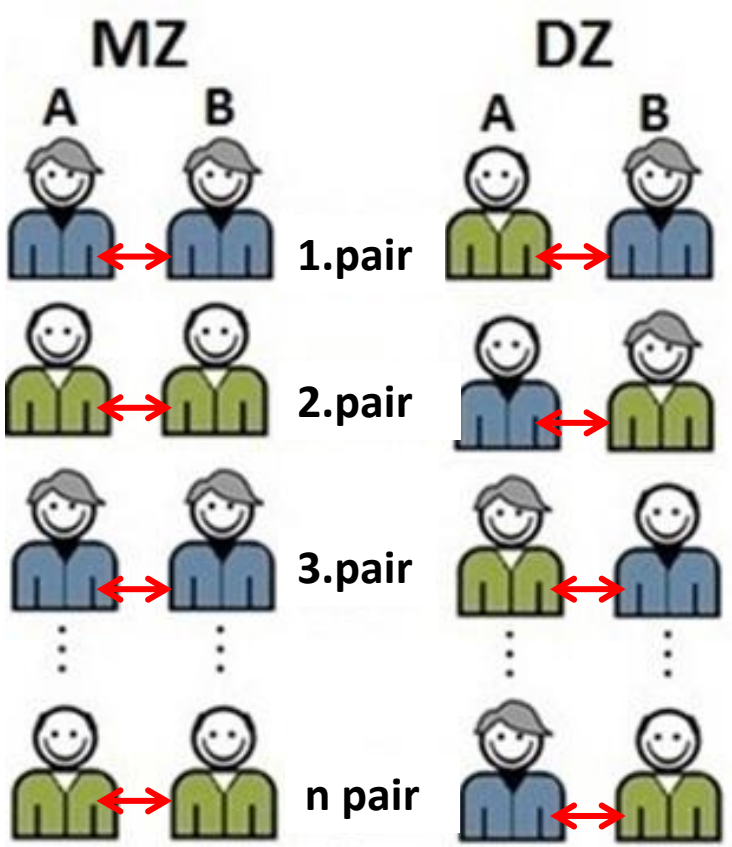
$$RMSE = \sqrt{\frac{\sum {d_i}^2}{n}}$$

d_i: distance between corresponding points

n: number of compared points

Smaller the RMSE value, similar the coronary geometry of the twins

Classical Twin Studies



$Average_{MZ}$ $Average_{DZ}$

$Average_{MZ} < Average_{DZ}$

Environment < Genetics

$Average_{MZ} \geq Average_{DZ}$

Environment > Genetics

MZ: Monozygotic DZ:Dizygotic

Average: Average of RMSE values in MZ and DZ group

RMSE Values of MZ and DZ Twins Segment-based Analysis

Segment	MZ Median (mm)	MZ IQR	DZ Median (mm)	DZ IQR	p*
proxRCA	2.7	1.5 – 3.2	2.7	1.8 – 3.3	> 0.05
midRCA	2.3	2.1 – 2.5	2.5	2.0 – 2.8	
distRCA	2.6	1.4 – 3.8	2.8	2.5 – 3.5	
rPDA	2.3	1.4 – 4.3	2.8	1.0 – 4.2	
LM	0.6	0.1 – 1.2	0.9	0.6 – 1.1	
pLAD	1.2	0.6 – 2.1	1.0	0.8 – 1.3	
mLAD	2.3	2.0 – 2.8	2.6	1.5 – 3.3	
dLAD	3.0	2.8 – 4.3	3.9	2.6 – 5.7	
Diag	2.4	1.6 – 3.0	1.5	0.9 – 2.3	
pLCX	1.9	0.8 – 3.0	1.4	0.3 – 1.7	
mdLCX	0.8	0 .0 – 1.7	2.6	2.6 – 4.7	
OM	1.3	1.5 – 2.1	2.1	0.5 – 3.1	

*: Mann-Whitney U test

RMSE Values of MZ and DZ Twins Patient-based Analysis

Segments	MZ Median (mm)	MZ IQR	DZ Median (mm)	DZ IQR	p*
RCA – LAD – LCX	14.6	11.7 – 21.8	20.0	12.2 – 20.6	0.57
RCA – LAD – LCX – PDA – PLB	20.8	14.8 – 29.2	22.7	18.0 – 33.0	0.41

Conclusions

- To our knowledge we were the first to compare coronary geometry between twins using the Kabsch algorithm
- We did not find significant difference of RMSE values between monozygotic and dizygotic twin neither on a patient nor on a segmental basis

*: Mann-Whitney U test