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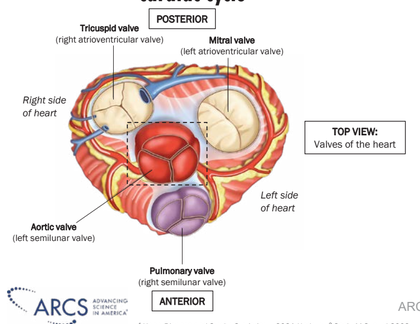
3D Bioprinting a Tissue Engineered Aortic Valve for a Biomimetic and Integrated Leaflet Scaffold

Aortic valve disease in children

~14 in every 1,000 live births [1]

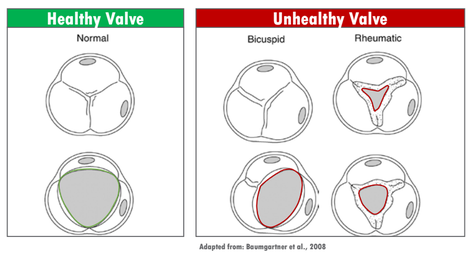
Valve Function:

Maintain unidirectional blood flow throughout the cardiac cycle [2]



When is aortic valve replacement necessary?

- **Aortic valve disease (stenosis and regurgitation)**
- **Congenital valve defects – two leaflets fuse together, as bicuspid aortic valves**
- **Rheumatic fever – leaflets become damaged due to untreated infection**



Adopted from: Baumgartner et al., 2008

[1] Heart Disease and Stroke Statistics – 2021 Update. [2] Sack, M.S. et al 2009

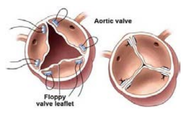
Current treatment options

1 Ross Procedure

Henaine et al. 2012

- Pulmonary valve autograft
- Transforms single-valve disease to 2 valve disease

2 Repair



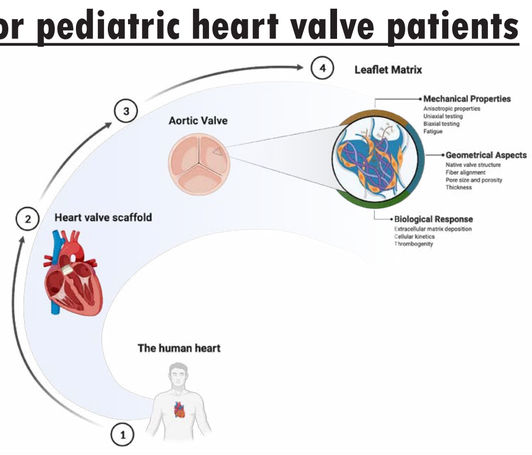
- Repair of aortic regurgitation
- Associated with low risk of infection, and preserves valve strength

3 Replacement

- Replacement of valve with either a mechanical or biological valve
- Performed through open-heart surgery or transcatheter

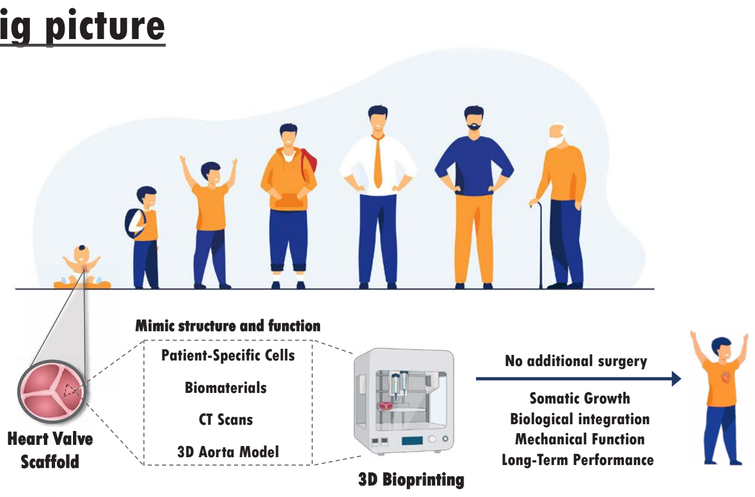
Limitations			
	• Aortic dilatation	• Size: 15 mm – 29 mm	• Degradation and calcification
	• Regurgitation	• Lifelong anticoagulation	• Valve refitting surgery

Clinical need for pediatric heart valve patients



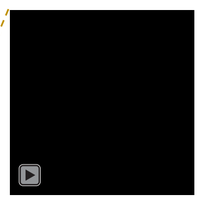
A need for a functional valve capable of somatic growth and remodeling

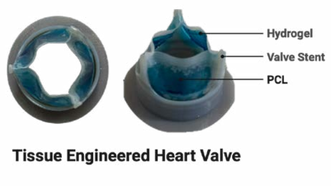
The big picture



Valve design and assembly

Aptus Bioreactor, 2021





Tissue Engineered Heart Valve

Assembly

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Scholar Awards Celebration
November 17, 2022