

# Artificial heart valves

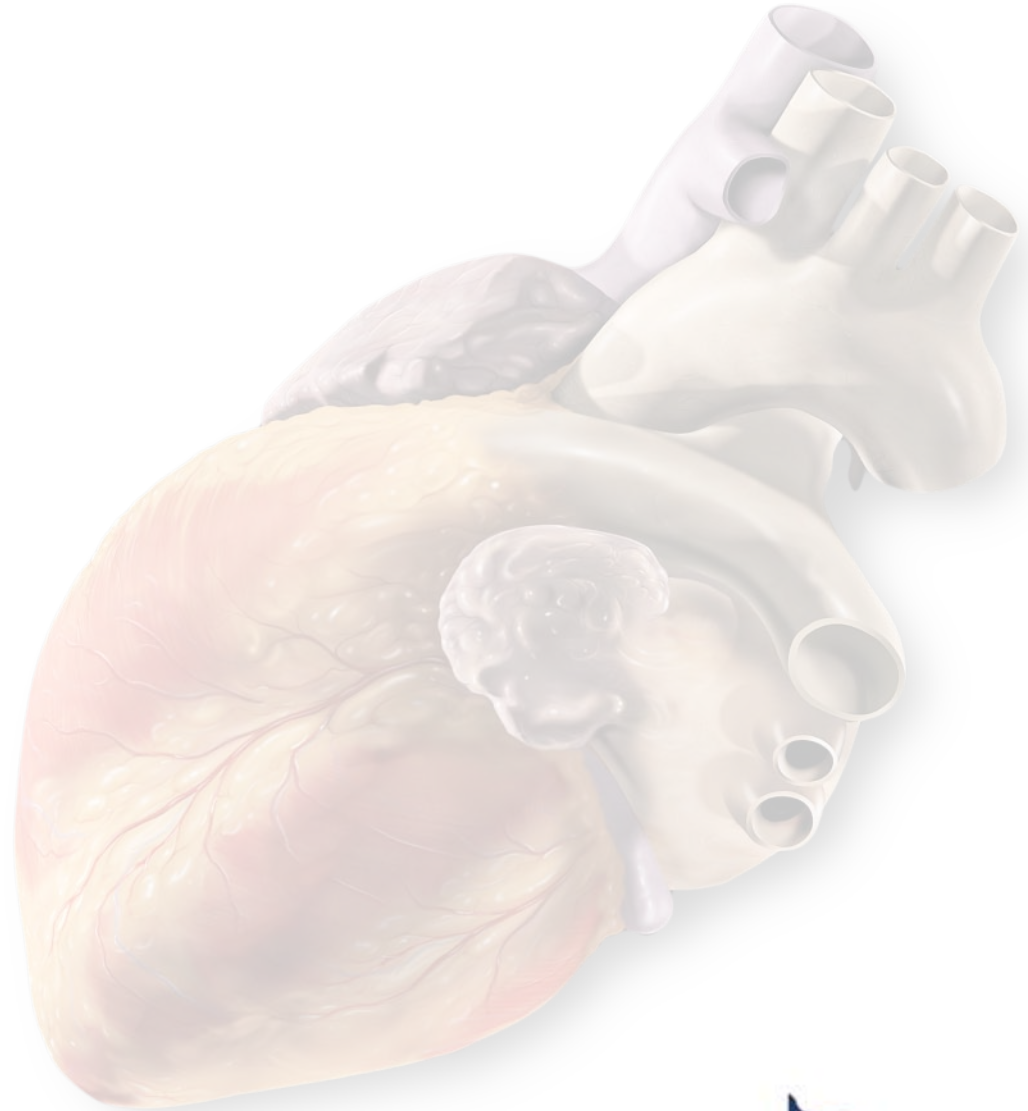
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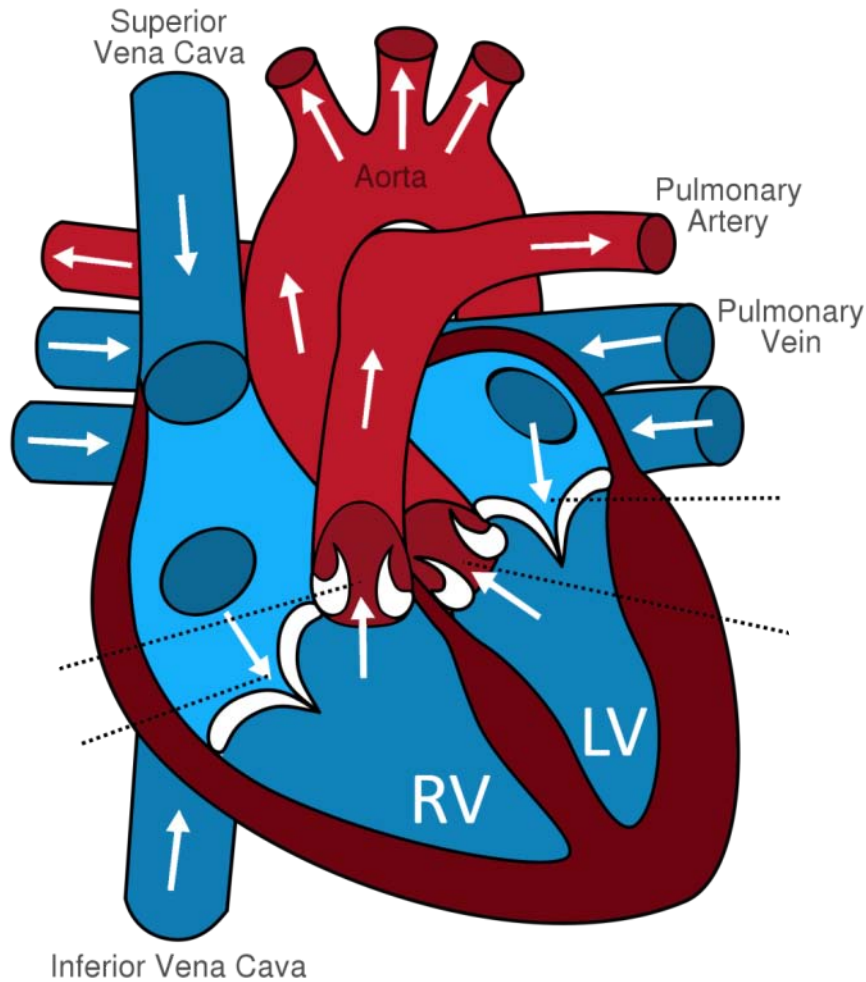
March 29, 2011

# Overview

- Introduction
- Classification
- History
- Fabrication
- Problems
- Comparison
- Conclusion



# Introduction



There are four valves in the human heart for guiding the blood flow.

- 2 atrioventricular valves
- 2 semilunar valves

# Introduction

Indications for heart valve repair/replacement:

- Congenital deformation
- Valve stenosis
- Valve insufficiency/regurgitation

~ 95,000 heart valve surgeries/year worldwide

# Classification

Mechanical Heart Valves (MHV)	Biological Heart Valves (BHV)		

# History

First successful operation of a mitral valve stenosis

1923

# History

First successful implant of an artificial heart-valve (MHV)

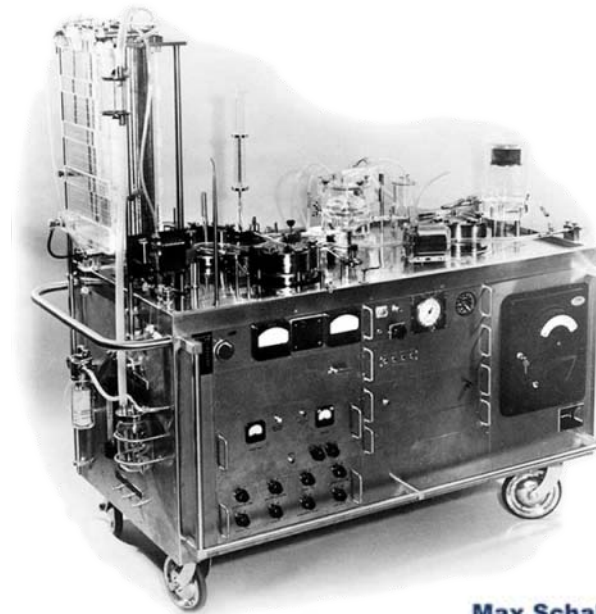
1952



# History

First successful open heart operation using a heart-lung-machine

1953

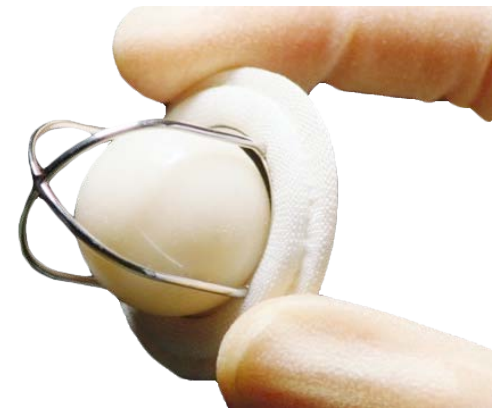




# History

Starr-Edwards caged-ball valve (MHV)

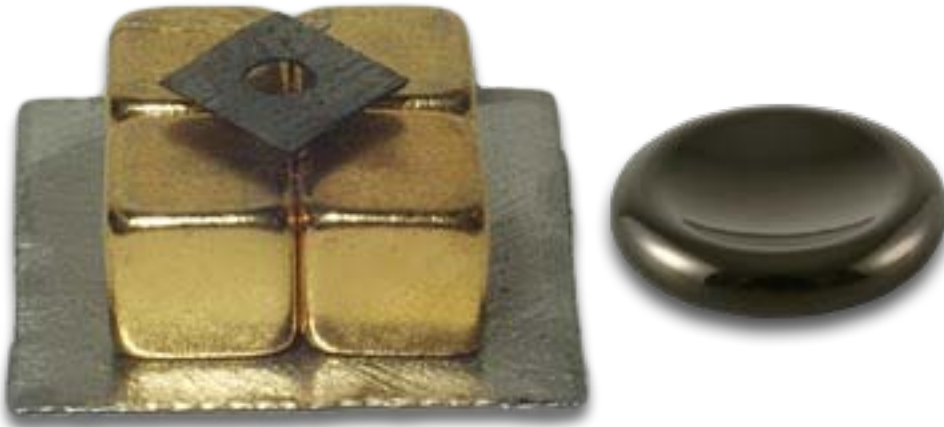
1960



# History

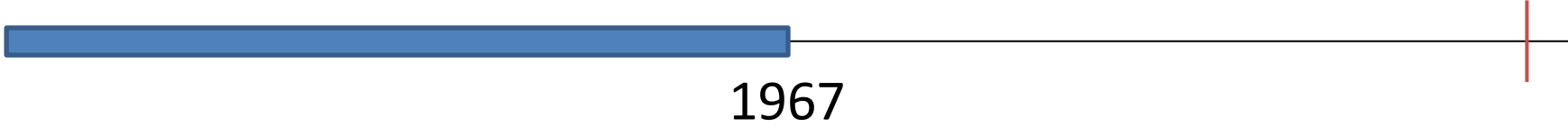
Discovery of pyrolytic carbon

1963



# History

First pulmonary allograft transplant (BHV)



A horizontal timeline is shown. A blue bar starts from the left and ends at a vertical tick mark labeled '1967'. A thin black line extends from this tick mark to the right, ending at a red vertical tick mark.

1967

# History

First pyrolytic carbon valve (MHV)

1968



# History

Bjork-Shiley tilting-disk valve (MHV)

1969



# History

St. Jude Medical bileaflet valve (MHV)

1979

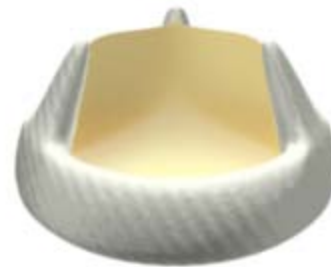


# History

First pericardial valve (BHV)



1981



# History

First stentless pericardial valve (BHV)



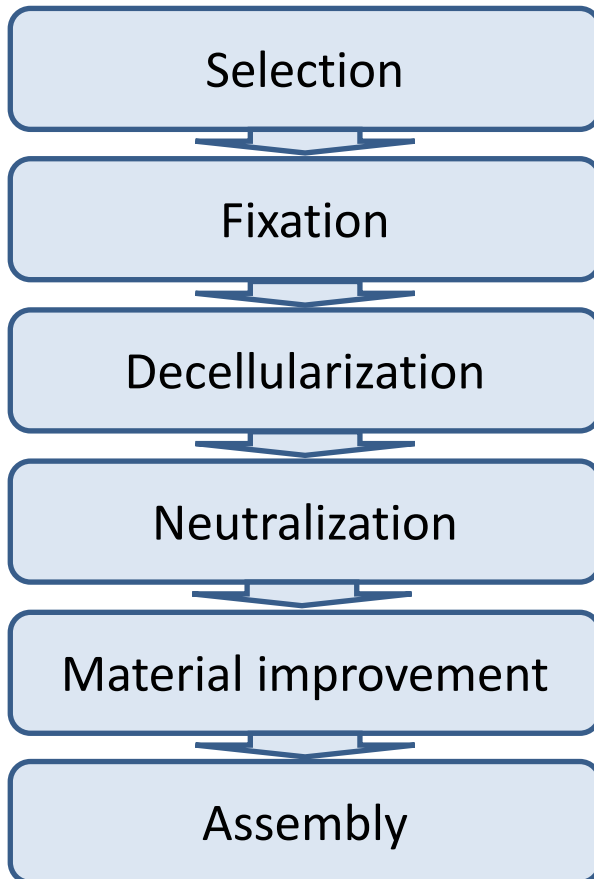


# History

First percutaneous valve replacement (BHV)

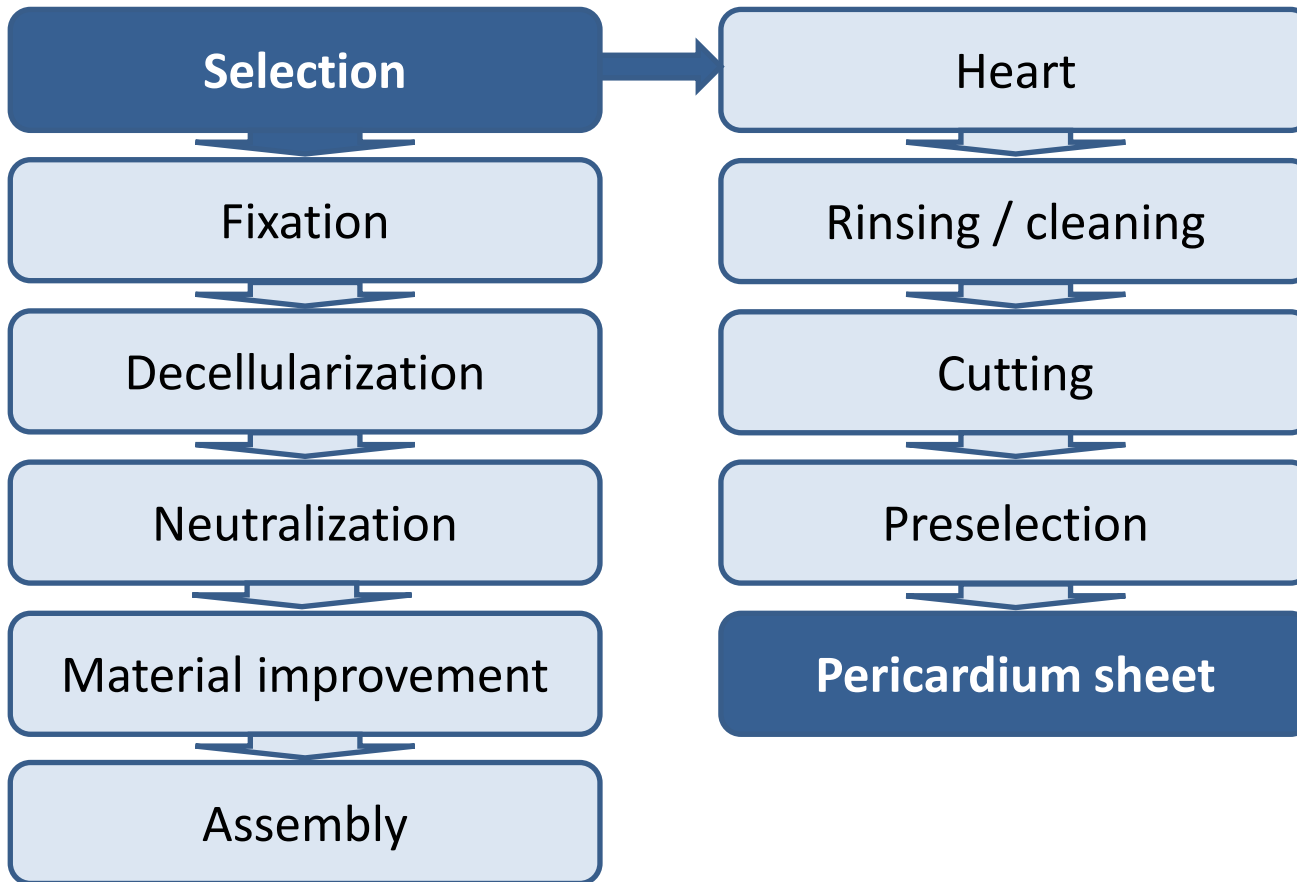


# Fabrication

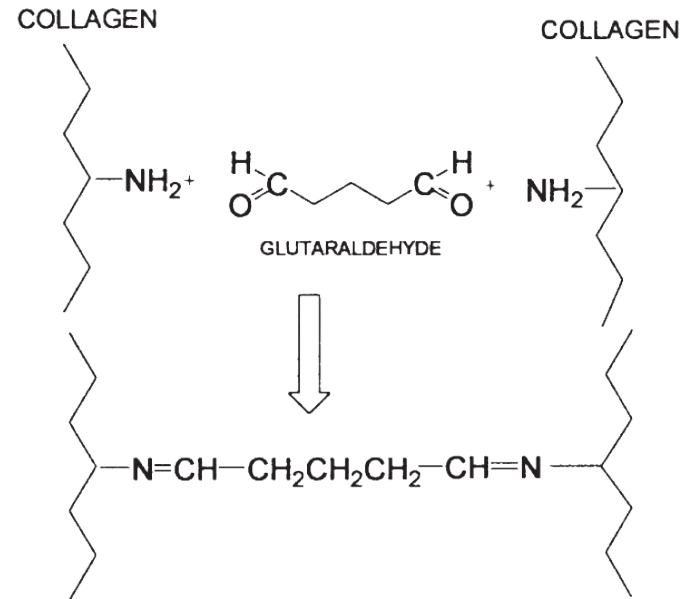
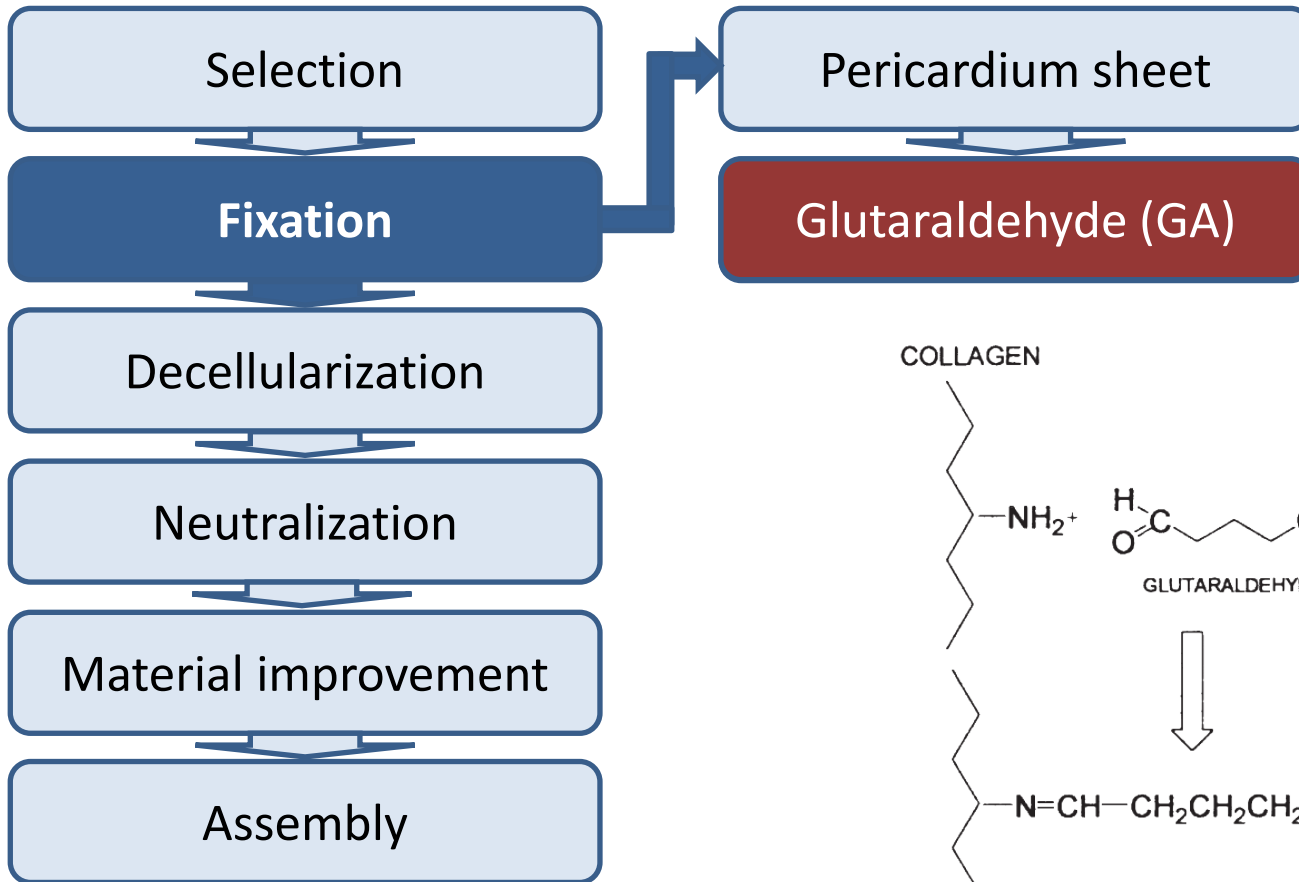


- No standard procedure
- Difficult biological processes
- No in-vitro testing

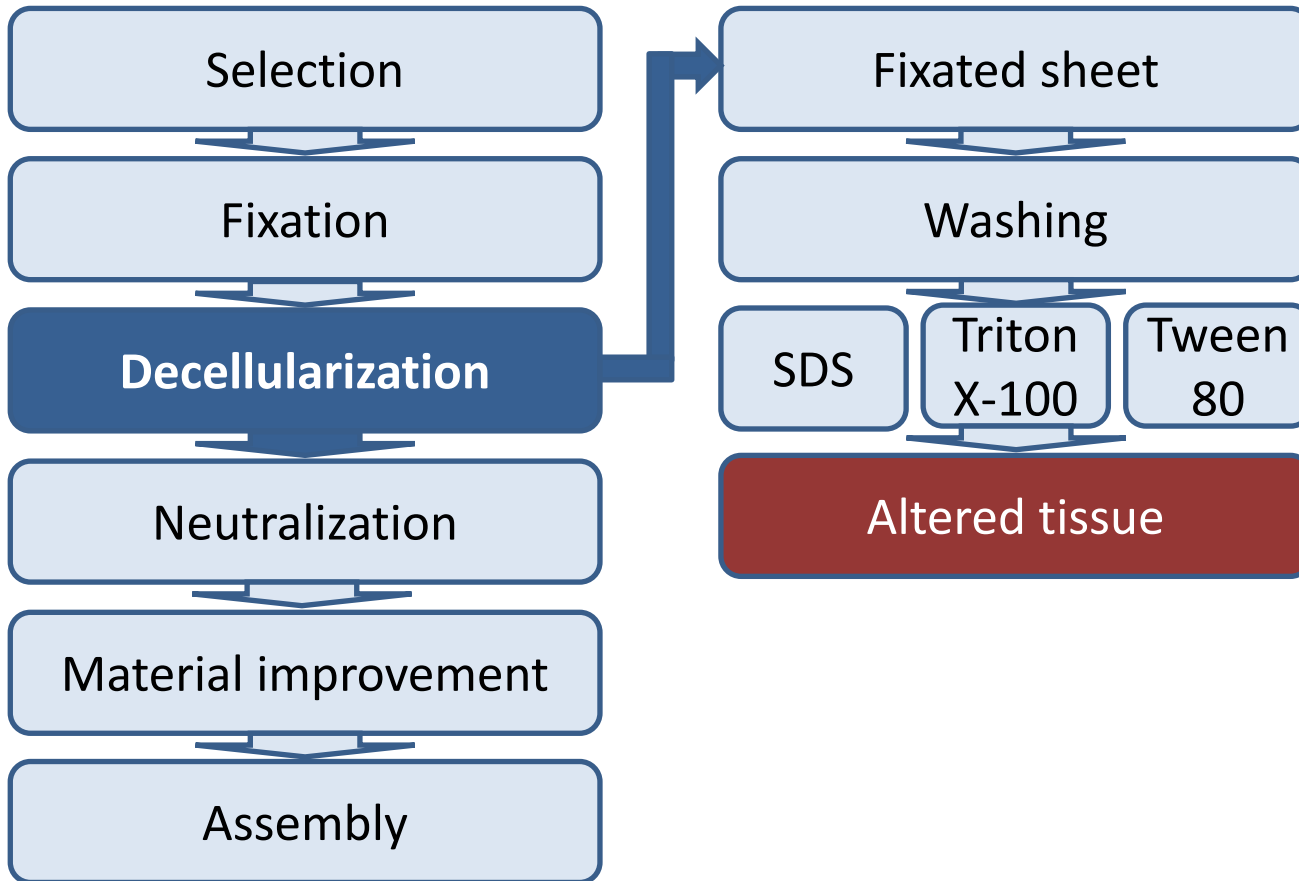
# Fabrication



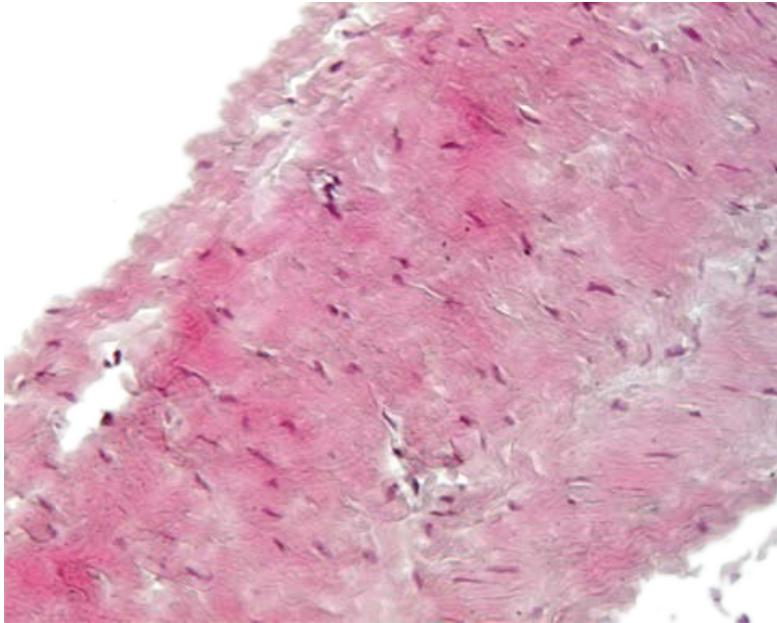
# Fabrication



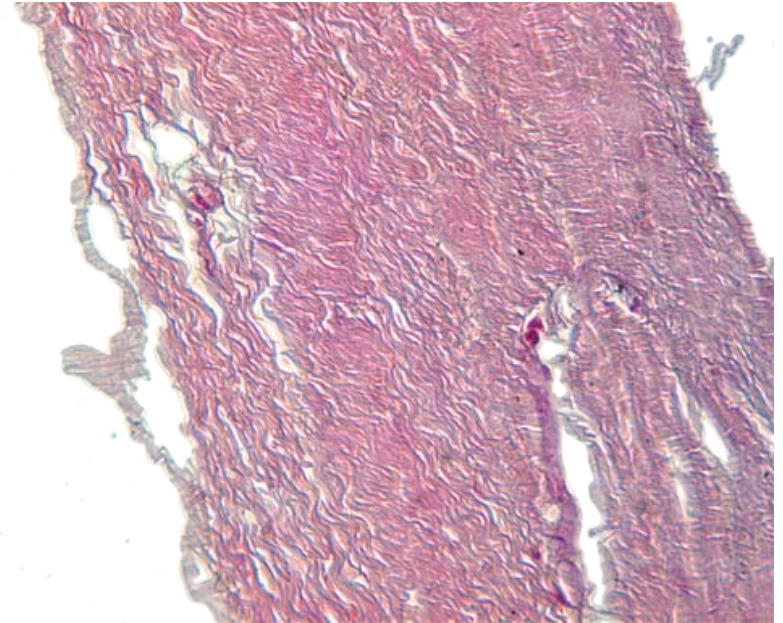
# Fabrication



# Fabrication: decellularization

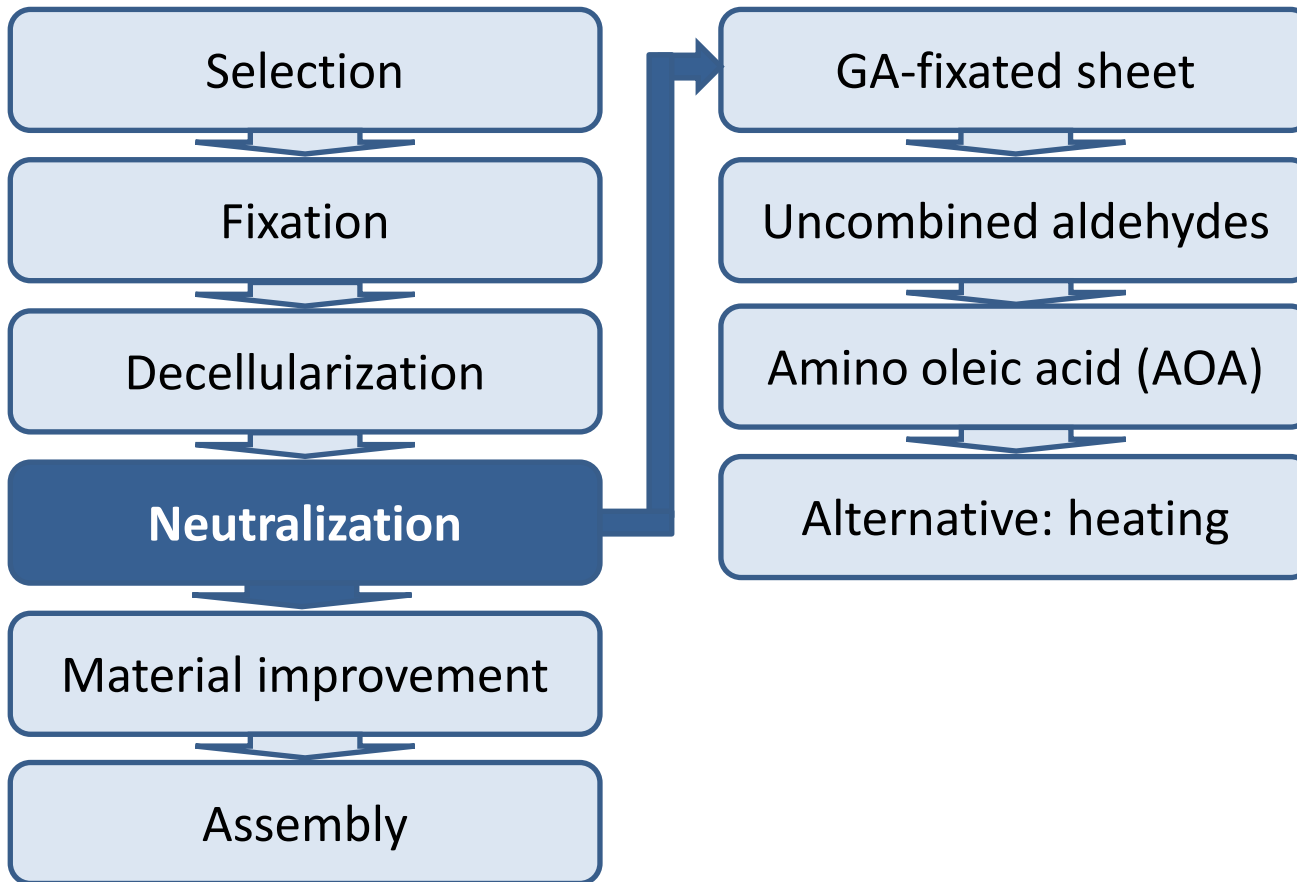


Native porcine pericardium with hematoxylin and eosin stain (mag. 300x)

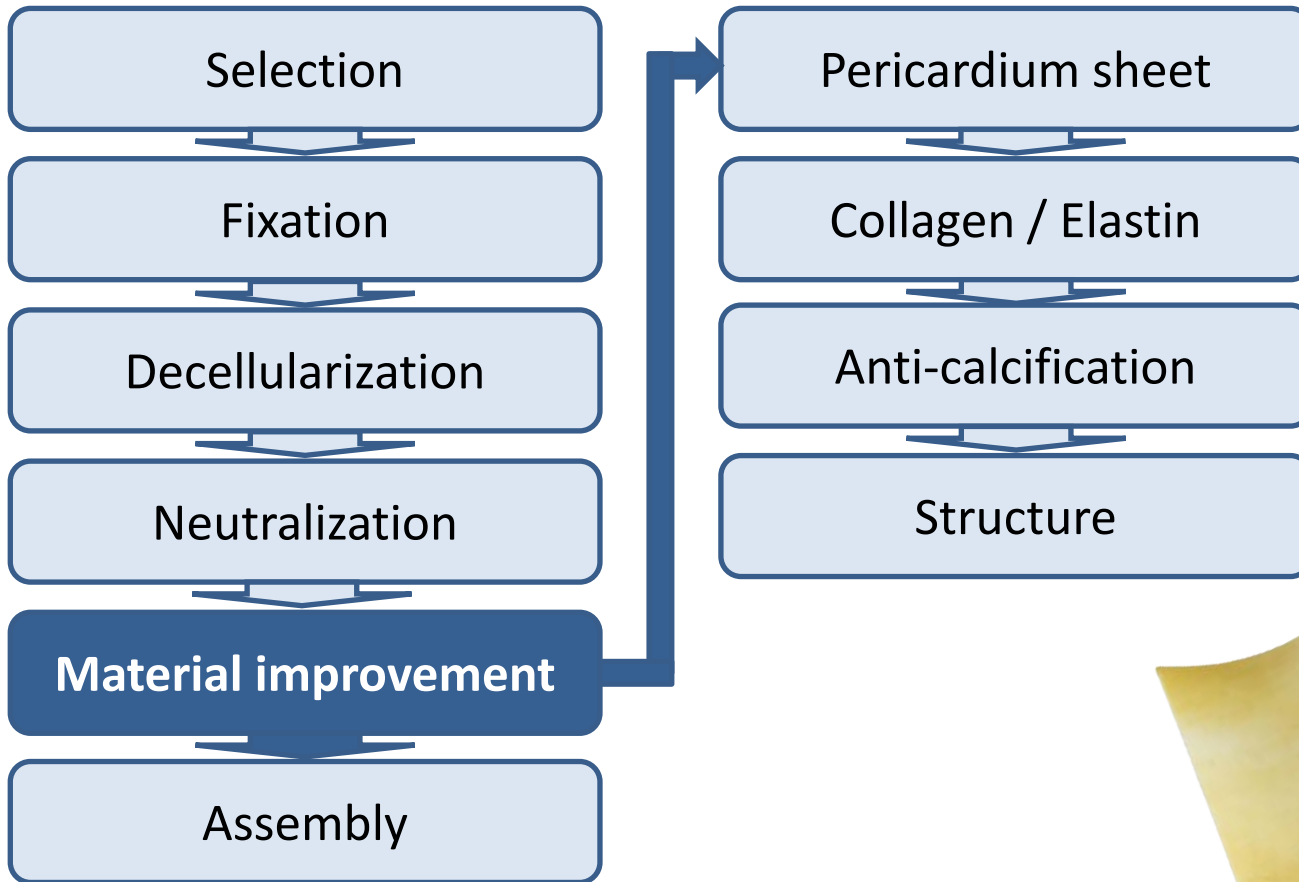


Bovine pericardium with hematoxylin and eosin stain (mag. 300x)

# Fabrication

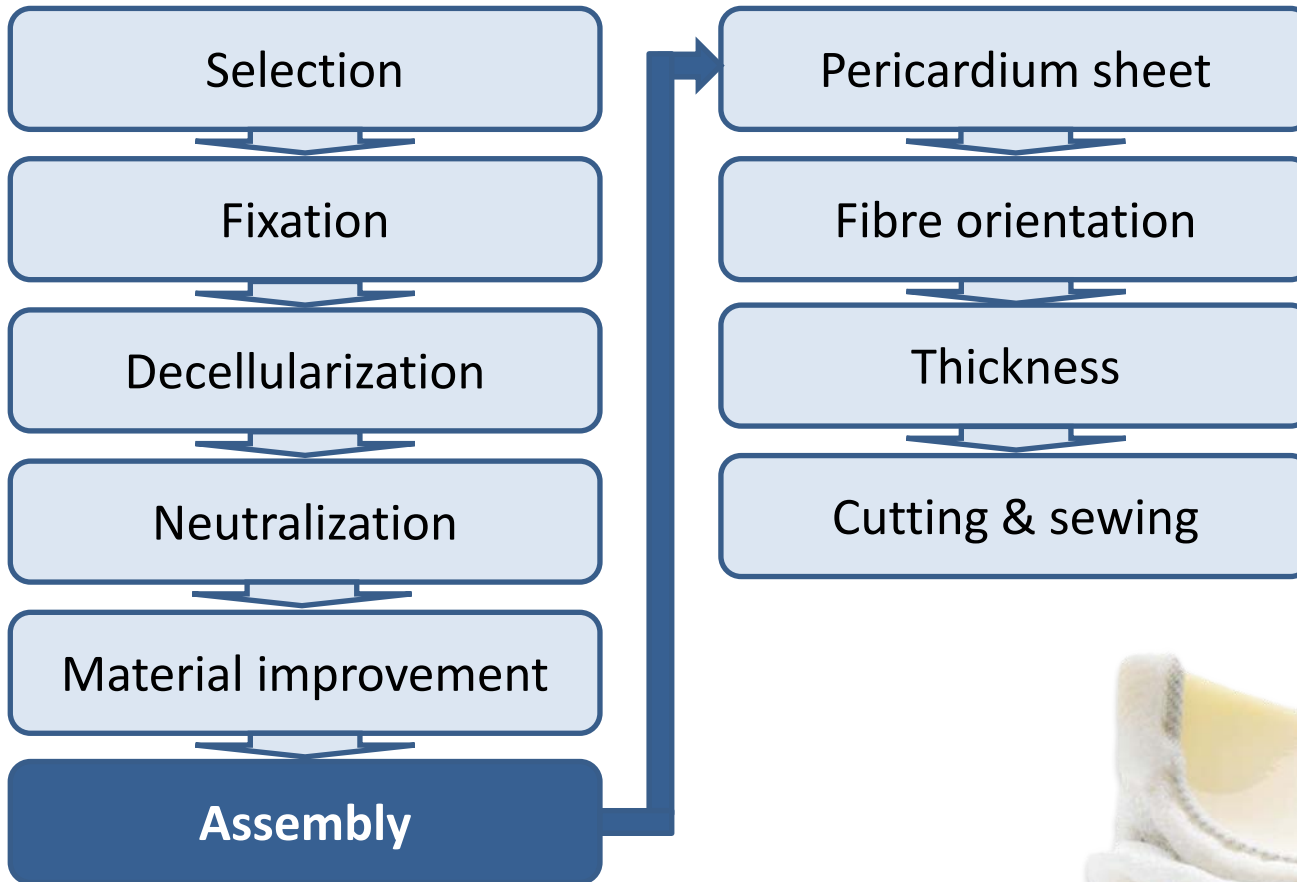


# Fabrication





# Fabrication



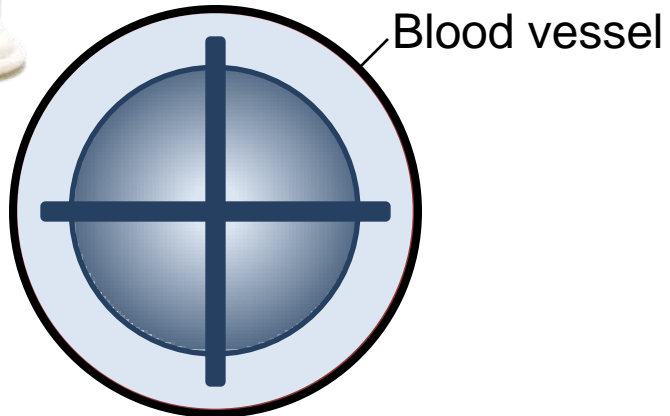
# Problems

Mechanical heart valves	Biological heart valves

# Problems

## Mechanical heart valves

- Coagulation
- Cell damage
- Tissue irritation



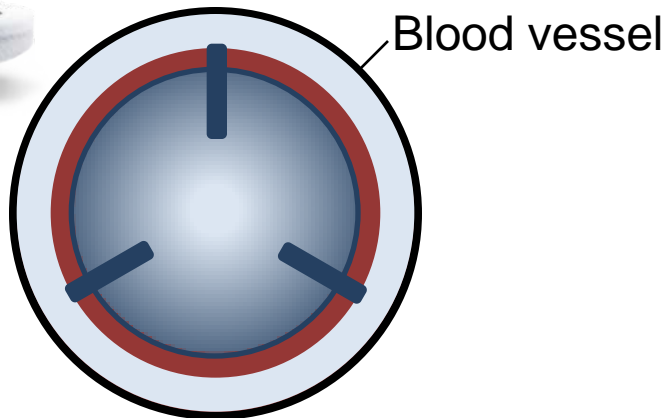
Caged-ball valve

## Biological heart valves

# Problems

## Mechanical heart valves

- Coagulation
- Cell damage
- Tissue irritation



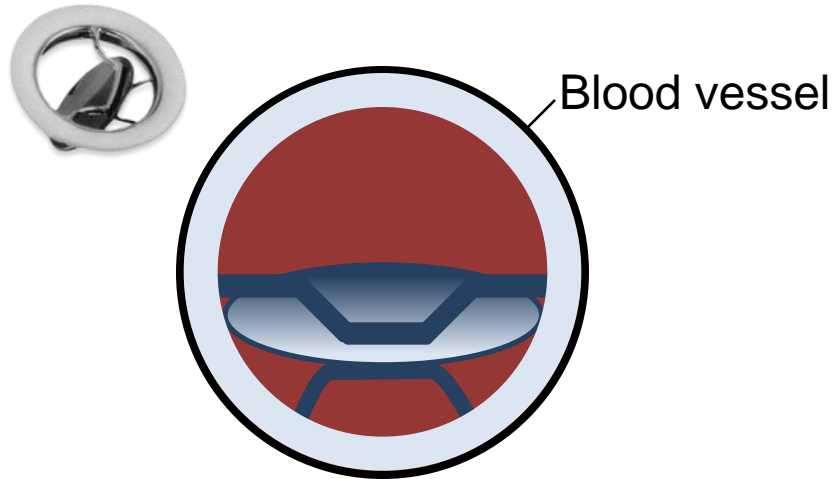
Caged-ball valve

## Biological heart valves

# Problems

## Mechanical heart valves

- Coagulation
- Cell damage
- Tissue irritation



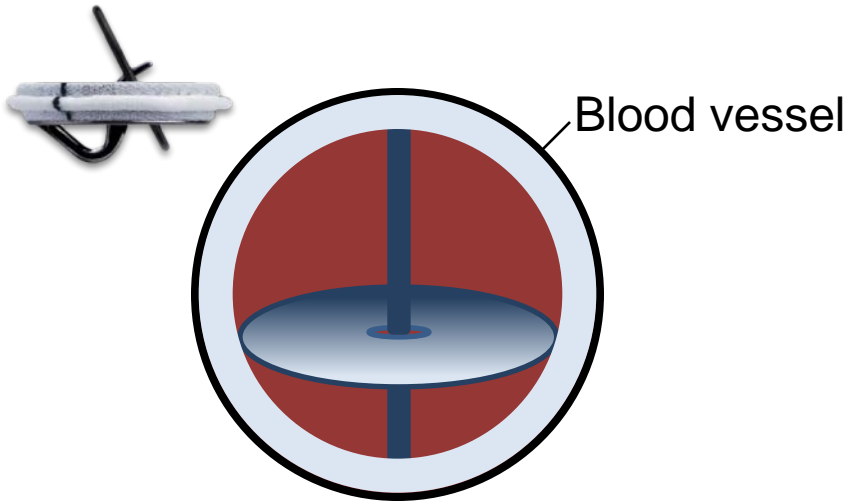
Tilting-disk valve

## Biological heart valves

# Problems

## Mechanical heart valves

- Coagulation
- Cell damage
- Tissue irritation



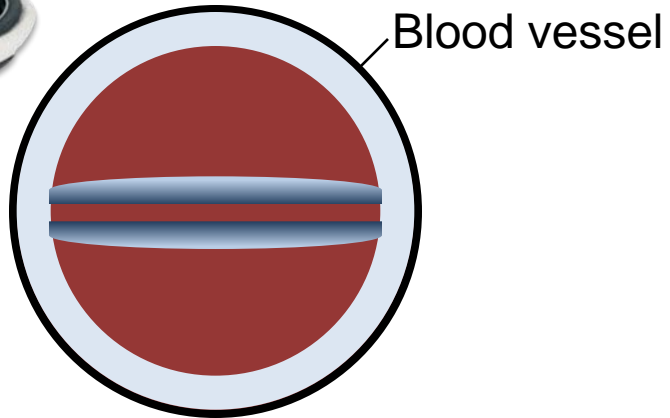
Tilting-disk valve

## Biological heart valves

# Problems

## Mechanical heart valves

- Coagulation
- Cell damage
- Tissue irritation



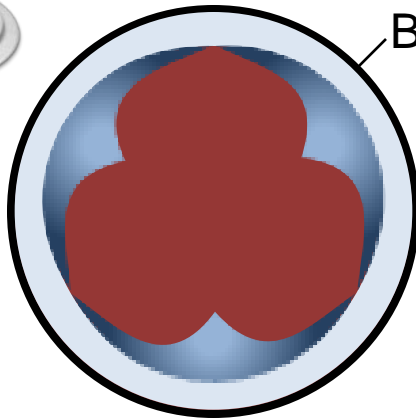
Bileaflet valve

## Biological heart valves

# Problems

## Mechanical heart valves

- Coagulation
- Cell damage
- Tissue irritation



Blood vessel

Trileaflet valve

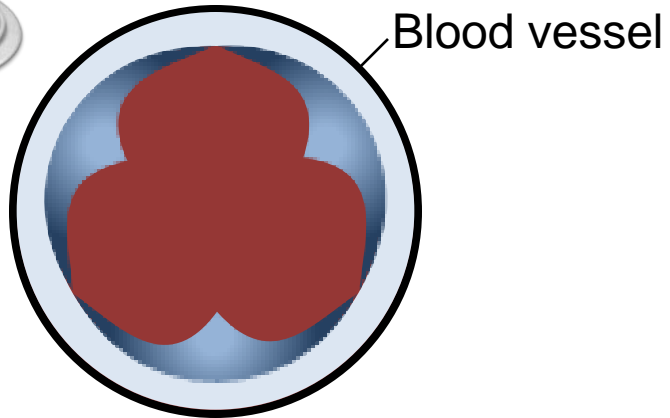
## Biological heart valves



# Problems

## Mechanical heart valves

- Coagulation
- Cell damage
- Tissue irritation



Trileaflet valve

## Biological heart valves

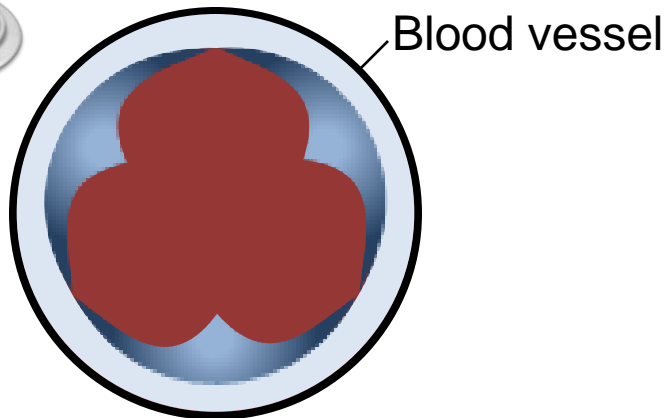
- Calcification



# Problems

## Mechanical heart valves

- Coagulation
- Cell damage
- Tissue irritation



Trileaflet valve

## Biological heart valves

- Calcification

Anti-calcification treatment

Calcified leaflets removal



Percutaneous implantation

# Comparison

	Mechanical heart valves	Biological heart valves
Advantages		
Disadvantages		

# Conclusion

Future topics:

- Increasing long-term stability of biological valves
- Understanding calcification processes
- Focus on percutaneous implantation

Biological heart valves will replace mechanical valves eventually.

Thank you for your attention!