Durability of Mitral Valve Surgery: Repair, Replacement or simply a clip?
La chirurgie cardiaque innovatrice et durable
Mitral valve disease

• Mitral regurgitation in 1.7% of the population,
• 56% of individuals with congestive heart failure.
• MR is a major cause of heart failure and disability.¹
• Severe MR compromises left ventricular function, induces pulmonary hypertension, alters heart architecture and predisposes to atrial fibrillation.²


Prevalence of mitral valve disease

- > 70 years increased prevalence of 5.5% \(^1\)
- MR second most frequently operated valve disease\(^2\)
- Can remain asymptomatic
- Severe MR most likely becomes symptomatic after 6 years


Prevalence of mitral valve disease

Paradigm shift in mitral surgery?

Paradigm shift in mitral surgery?

2014

- No significant outcome difference between repair and replacement in regards of remodelling and survival

Replacement is more durable

Paradigm shift in mitral surgery? Is it new?

**Repair = replacement**

**Repair better than replacement**

**Replacement better than repair**
Mitral valve

Drawing from Walt Disney for Ch. Bailey 1946
Structural vs functional  = Primary vs secondary

*In primary MR*, the valvular incompetence is caused by compromised or structurally disrupted components of the valve apparatus

*In functional (secondary) MR* the valve is structurally normal, with the regurgitation resulting from failure of coaptation of the mitral valve leaflets without coexisting structural changes of the valve itself.
Structural vs functional = Primary vs secondary

- normal
- Primary structural
- Primary structural
- Secondary functional
Structural vs functional = Primary vs secondary

Structural/primary

Functional / secondary
Geometric MR in Dilated Cardiomyopathy
“loss of closure cylinder”

Badhwar, Bolling, chapter in: Advances in Heart Failure, 2004
Geometric MR in Ischemia

Badhwar, Bolling, chapter in: Advances in Heart Failure, 2004
"Functional mitral regurgitation is a common clinical entity which will likely increase in the future due to predicted demographic changes. It is also associated with poor long-term survival."
One fits all vs. tailored treatments options
One fits all vs. tailored treatments options
One fits all vs. tailored treatments options
38 mm ring size
Durability of surgical mitral valve
Freedom from SVD > 60y

CONCLUSIONS: In patients aged 50–65 years undergoing AVR with the Carpentier-Edwards Perimount bioprosthesis, the expected valve durability was 19 years. Age was not a significant risk factor for SVD within this age group. Patient selection and attention to timing of re-intervention may be determinants of long-term outcomes.

Mitral valve durability

Very late outcomes for mitral valve replacement with the Carpentier-Edwards pericardial bioprosthesis: 25-year follow-up of 450 implantations.

The expected valve durability was 16.6 years for the entire cohort (11.4, 16.6, and 19.4 years for patients aged <60, 60 to 70, and >70 years, respectively)

Durability of surgical mitral valves

From 2008 through 2011 (our 4-year study period), 70 Magna valves were implanted in the mitral position at a single institution (the Cleveland Clinic) - Thermofix

90% of patients were free from significant structural valve degeneration at 5 years

1. Intrinsic cuspal calcification can be prevented or delayed by calcium mitigant treatment

2. Structural degeneration due to stress can be prevented or delayed by tissue selection, leaflet design and valve circularity

*No clinical data are available which evaluate the long-term impact of the Edwards Lifesciences tissue treatment in patients.*
Comparison of anti-calcification treatments

Degree of Anti-Calcification

None (Glutaraldehyde Fixation)

Only one binding site addressed

Both binding sites addressed (Residual glut. & Phospholipids)

Medtronic CoreValve
Medtronic Acurate TA
Medtronic Engager
JenaValve TA
Medtronic Engager
DirectFlow TF

Symetis
St Jude Portico
Medtronic CoreValve Evolut

Edwards SAPIEN XT THV

Christoph Huber, CCV HUG 2016
CIRCULAR GEOMETRY FOR LOW LEAFLET STRESS
Areas of high stress can induce collagen degeneration that over time could lead to tearing and valve failure\(^1\)

Valve designs that reduce leaflet stresses “are likely to have improved performance in long-term applications”\(^2\)
Circularity at the annulus maximizes area and flow to minimize load on the left ventricle.
The principles of aortic valve replacement have not changed since 1962\(^{(1)}\)

**Principles**
- Predictable procedure
- Optimal hemodynamics
- Low rate of complications
- Durability

**Surgical and transcatheter aortic valve**

- **CIRCULAR GEOMETRY FOR LOW LEAFLET STRESS**
- **TISSUE CHOICE AND LEAFLET MATCHING**
- **ANTI-CALCIFICATION TISSUE TREATMENT**

The Alfieri stitch – the double orifice valve

Mitraclip
Accelerated Development of TAVI devices

- CoreValve ReValving System (May 2007)
  - Edwards SAPIEN (September 2008)
  - Edwards SAPIEN XT (March 2009)
- JenaValve (September 2010)
- CoreValve Evolut (September 2011)
- Direct Flow Medical (January 2012)
- St. Jude Portico (November 2012)
- Boston Scientific Lotus™ Valve System (October 2013)
Current CE Mark Approved Devices*

Medtronic CoreValve
Sadra Medical Lotus
St. Jude Portico
Direct Flow Medical
Edwards SAPIEN XT
Symetis ACCURATE TA
Edwards SAPIEN 3
JenaValve

*As of 2014
DEVICES PENDING CE MARK APPROVAL

- Edwards CENTERA
- Medtronic Evolut R
- Symetis ACCURATE TF
- JenaValve Plus

- Colibri Heart Valve
- Heart Leaflet Technology
- NVT Allegra
- Trinity Valve
EuroPCR 2016: Half of transcatheter heart valves show degeneration within 10 years of TAVI

First study of long-term durability shows high rates of valve degeneration

Study Design and major findings:

- 704 patients received a TAVR from 2002-2011
  - Edwards SAPIEN XT (36%)
  - Edwards SAPIEN (50%)
  - Cribier-EdwardsTM valves (14%)
- 2 pioneering centers: St. Paul's Vancouver and University Hospital of Rouen, France
- Final study cohort was 378 patients due to death, insufficient follow-up data points a
- Kaplan-Meier Freedom from Valve Degeneration
  - 94% at 4 years
  - 82% at 6 years
  - 50% at 8 years
Transcatheter mitral valve replacement

- Tendyn
- Edwards FORTIS
- Twelve
- Tiara
- Edwards CardiAQ
Transcatheter mitral valve replacement 2014
Transcatheter mitral valve replacement

Five transcatheter mitral valve systems implanted in humans: CardiAQ valve system (CardiAQ Valve Technologies, Inc.) Tiara™ valve (Neovasc Inc., Richmond, Canada); FORTIS valve (Edwards Lifesciences, Irvine, CA, USA); Tendyne valve (Tendyne Inc., Roseville, MN, USA); Twelve valve (Twelve, Inc., Redwood City, CA, USA).

Common features: Nitinol self-expanding frames, Trileaflet valves, Bovine pericardial leaflets (Tendyne porcine), Fabric sealing skirt (CardiAQ is pericardial) Transapical delivery (CardiAQ also transseptal)
Transcatheter mitral valve replacement - Limitations

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(A) The valve consists of a self-expanding nitinol frame that carries 3 leaflets of bovine pericardial tissue. Implantation sequence of CardiAQ valve: (B) coaxial alignment, (C) opening of the ventricular anchors, (D) opening of the atrial anchors, and (E) final release of the CardiAQ valve before removal of the delivery system. F, Left ventriculogram.
The D-shape of the valve, with atrial skirt and saddle-shaped valve. B, Transapical 32F delivery system. Implantation sequence (C) the coronary sinus wire outlines the mitral annulus; delivery system is through the mitral annulus into the left atrium; (D) opening of the atrial (E) the atrial skirt is open (F) final release of the Tiara valve, before removal of the delivery system.
Self-expanding metal alloy frame made of an inner stent containing a trileaflet porcine pericardial valve and an outer stent. (B) access of left atrium with dilator and sheath; (C) advancement of valve within sheath, deploying valve in left atrium; tether traction is used to position the valve in native annulus; (D) the polymer tether allows the valve to be captured for repositioning.
The Endovalve system is a foldable nitinol structure that is designed to conform to the mitral annulus and attaches to the native valve with specially designed grippers.
HighLife transcatheter mitral
Neocord transapical
Coronary sinus devices Carillion Monarc Coapsys

Percutaneous Annuloplasty devices

**Cardioband**

**Mitralign**
Durabilité
Durabilité

Gold bracelet with animal-heads, from the Hellenistic cemetery Europos. Dated to late 4th-early 3rd c. BC.
Easy to get in but more difficult to get out
Sélection des patients
Durability of Mitral Valve Surgery: Repair, Replacement or simply a clip?