MITRAL VALVE REPAIR
CURRENT STATUS AND THE MODERN STERNOTOMY

David L Saint MD, FACS
Tallahassee Memorial Hospital
Clinical Assistant Professor
Florida State University School of Medicine
HISTORY OF MITRAL REPAIR

- Early Efforts at Mitral Valve Surgery
- The development of Mitral Prosthesis
- The Problems of the Underdeveloped World
- The French Correction – Alain Carpentier
- The Modern Era
- Less invasive approaches
- Percutaneous approaches
Before CPB

- Tubbs valvulotome in closed position
- Left atrial appendage
- LV
- Fused commissure
- Mitral valve
- Separation of mitral leaflets

In open position
EARLY EXPERIENCE WITH OPEN HEART SURGERY

- First efforts with open repair
- Development of Artificial Valves
- Development of Tissue Valves
- The Concept of Chordal Sparing
TISSUE VALVES
RESULTS PRIOR TO MITRAL REPAIR

• Results
  • Highly Reproducible
  • Mortality rates
    • 3 – 4% Short Term Mortality
  • Long term outcomes
    • Thrombo-embolic complications are low
    • Reduced Ventricular Function post replacement
  • Limitations
    • Reserved for end stage Patients

• Problems
  • Need for anticoagulation
  • Limited longevity of tissue valves
  • LV EF reduction with chordal resection
  • Lack of a solution for young patients that can’t take Coumadin (Under-Developed World)
  • Need for earlier intervention, prior to the onset of CHF, to improve long term outcomes
A) All diagnoses of mental retardation (B) Wilms' tumor (C) open cardiac defects (D) congenital anomalies of the heart and (E) congenital anomalies of the kidneys.

B) Congenital anomalies of the heart and (C) congenital anomalies of the kidneys.

C) Congenital anomalies of the heart and (D) congenital anomalies of the kidneys.

D) Congenital anomalies of the heart and (E) congenital anomalies of the kidneys.

E) Congenital anomalies of the heart and (F) congenital anomalies of the kidneys.

F) Congenital anomalies of the heart and (G) congenital anomalies of the kidneys.

G) Congenital anomalies of the heart and (H) congenital anomalies of the kidneys.

H) Congenital anomalies of the heart and (I) congenital anomalies of the kidneys.

I) Congenital anomalies of the heart and (J) congenital anomalies of the kidneys.

J) Congenital anomalies of the heart and (K) congenital anomalies of the kidneys.

K) Congenital anomalies of the heart and (L) congenital anomalies of the kidneys.

L) Congenital anomalies of the heart and (M) congenital anomalies of the kidneys.

M) Congenital anomalies of the heart and (N) congenital anomalies of the kidneys.

N) Congenital anomalies of the heart and (O) congenital anomalies of the kidneys.

O) Congenital anomalies of the heart and (P) congenital anomalies of the kidneys.

P) Congenital anomalies of the heart and (Q) congenital anomalies of the kidneys.

Q) Congenital anomalies of the heart and (R) congenital anomalies of the kidneys.

R) Congenital anomalies of the heart and (S) congenital anomalies of the kidneys.

S) Congenital anomalies of the heart and (T) congenital anomalies of the kidneys.

T) Congenital anomalies of the heart and (U) congenital anomalies of the kidneys.

U) Congenital anomalies of the heart and (V) congenital anomalies of the kidneys.

V) Congenital anomalies of the heart and (W) congenital anomalies of the kidneys.

W) Congenital anomalies of the heart and (X) congenital anomalies of the kidneys.

X) Congenital anomalies of the heart and (Y) congenital anomalies of the kidneys.

Y) Congenital anomalies of the heart and (Z) congenital anomalies of the kidneys.

Z) Congenital anomalies of the heart and (AA) congenital anomalies of the kidneys.

AA) Congenital anomalies of the heart and (BB) congenital anomalies of the kidneys.

BB) Congenital anomalies of the heart and (CC) congenital anomalies of the kidneys.

CC) Congenital anomalies of the heart and (DD) congenital anomalies of the kidneys.

DD) Congenital anomalies of the heart and (EE) congenital anomalies of the kidneys.

EE) Congenital anomalies of the heart and (FF) congenital anomalies of the kidneys.

FF) Congenital anomalies of the heart and (GG) congenital anomalies of the kidneys.

GG) Congenital anomalies of the heart and (HH) congenital anomalies of the kidneys.

HH) Congenital anomalies of the heart and (II) congenital anomalies of the kidneys.

II) Congenital anomalies of the heart and (JJ) congenital anomalies of the kidneys.

JJ) Congenital anomalies of the heart and (KK) congenital anomalies of the kidneys.

KK) Congenital anomalies of the heart and (LL) congenital anomalies of the kidneys.

LL) Congenital anomalies of the heart and (MM) congenital anomalies of the kidneys.

MM) Congenital anomalies of the heart and (NN) congenital anomalies of the kidneys.

NN) Congenital anomalies of the heart and (OO) congenital anomalies of the kidneys.

OO) Congenital anomalies of the heart and (PP) congenital anomalies of the kidneys.

PP) Congenital anomalies of the heart and (QQ) congenital anomalies of the kidneys.

QQ) Congenital anomalies of the heart and (RR) congenital anomalies of the kidneys.

RR) Congenital anomalies of the heart and (SS) congenital anomalies of the kidneys.

SS) Congenital anomalies of the heart and (TT) congenital anomalies of the kidneys.

TT) Congenital anomalies of the heart and (UU) congenital anomalies of the kidneys.

UU) Congenital anomalies of the heart and (VV) congenital anomalies of the kidneys.

VV) Congenital anomalies of the heart and (WW) congenital anomalies of the kidneys.

WW) Congenital anomalies of the heart and (XX) congenital anomalies of the kidneys.

XX) Congenital anomalies of the heart and (YY) congenital anomalies of the kidneys.

YY) Congenital anomalies of the heart and (ZZ) congenital anomalies of the kidneys.

ZZ) Congenital anomalies of the heart and (AAAA) congenital anomalies of the kidneys.

AAAA) Congenital anomalies of the heart and (BBBB) congenital anomalies of the kidneys.

BBBB) Congenital anomalies of the heart and (CCCC) congenital anomalies of the kidneys.

CCCC) Congenital anomalies of the heart and (DDDD) congenital anomalies of the kidneys.

DDDD) Congenital anomalies of the heart and (EEEE) congenital anomalies of the kidneys.

EEEE) Congenital anomalies of the heart and (FFFF) congenital anomalies of the kidneys.

FFFF) Congenital anomalies of the heart and (GGGG) congenital anomalies of the kidneys.

GGGG) Congenital anomalies of the heart and (HHHH) congenital anomalies of the kidneys.

HHHH) Congenital anomalies of the heart and (IIII) congenital anomalies of the kidneys.

IIII) Congenital anomalies of the heart and (JJJJ) congenital anomalies of the kidneys.

JJJJ) Congenital anomalies of the heart and (KKKK) congenital anomalies of the kidneys.

KKKK) Congenital anomalies of the heart and (LLLL) congenital anomalies of the kidneys.

LLLL) Congenital anomalies of the heart and (MMMM) congenital anomalies of the kidneys.

MMMM) Congenital anomalies of the heart and (NNNN) congenital anomalies of the kidneys.

NNNN) Congenital anomalies of the heart and (OOOO) congenital anomalies of the kidneys.

OOOO) Congenital anomalies of the heart and (PPPP) congenital anomalies of the kidneys.

PPPP) Congenital anomalies of the heart and (QQQQ) congenital anomalies of the kidneys.

QQQQ) Congenital anomalies of the heart and (RRRR) congenital anomalies of the kidneys.

RRRR) Congenital anomalies of the heart and (SSSS) congenital anomalies of the kidneys.

SSSS) Congenital anomalies of the heart and (TTTT) congenital anomalies of the kidneys.

TTTT) Congenital anomalies of the heart and (UUUU) congenital anomalies of the kidneys.

UUUU) Congenital anomalies of the heart and (VVVV) congenital anomalies of the kidneys.

VVVV) Congenital anomalies of the heart and (WWWW) congenital anomalies of the kidneys.

WWWW) Congenital anomalies of the heart and (XXXX) congenital anomalies of the kidneys.

XXXX) Congenital anomalies of the heart and (YYYY) congenital anomalies of the kidneys.

YYYY) Congenital anomalies of the heart and (ZZZZ) congenital anomalies of the kidneys.

ZZZZ) Congenital anomalies of the heart and (AAAAA) congenital anomalies of the kidneys.

AAAAA) Congenital anomalies of the heart and (BBBBB) congenital anomalies of the kidneys.

BBBBB) Congenital anomalies of the heart and (CCCCC) congenital anomalies of the kidneys.

CCCCC) Congenital anomalies of the heart and (DDDDD) congenital anomalies of the kidneys.

DDDDD) Congenital anomalies of the heart and (EEEEE) congenital anomalies of the kidneys.

EEEEE) Congenital anomalies of the heart and (FFFFF) congenital anomalies of the kidneys.

FFFFF) Congenital anomalies of the heart and (GGGGG) congenital anomalies of the kidneys.

GGGGG) Congenital anomalies of the heart and (HHHHH) congenital anomalies of the kidneys.

HHHHH) Congenital anomalies of the heart and (IIIII) congenital anomalies of the kidneys.

IIIII) Congenital anomalies of the heart and (JJJJJ) congenital anomalies of the kidneys.

JJJJJ) Congenital anomalies of the heart and (KKKKK) congenital anomalies of the kidneys.

KKKKK) Congenital anomalies of the heart and (LLLLL) congenital anomalies of the kidneys.

LLLLL) Congenital anomalies of the heart and (MMMMM) congenital anomalies of the kidneys.

MMMMM) Congenital anomalies of the heart and (NNNNN) congenital anomalies of the kidneys.

NNNNN) Congenital anomalies of the heart and (OOOOG) congenital anomalies of the kidneys.

OOOOG) Congenital anomalies of the heart and (PPPPP) congenital anomalies of the kidneys.

PPPPP) Congenital anomalies of the heart and (QQQQQ) congenital anomalies of the kidneys.

QQQQQ) Congenital anomalies of the heart and (RRRRR) congenital anomalies of the kidneys.

RRRRR) Congenital anomalies of the heart and (SSSSS) congenital anomalies of the kidneys.

SSSSS) Congenital anomalies of the heart and (TTTTT) congenital anomalies of the kidneys.

TTTTT) Congenital anomalies of the heart and (UUUUU) congenital anomalies of the kidneys.

UUUUU) Congenital anomalies of the heart and (VVVVV) congenital anomalies of the kidneys.

VVVVV) Congenital anomalies of the heart and (WWWWW) congenital anomalies of the kidneys.

WWWWW) Congenital anomalies of the heart and (XXXXX) congenital anomalies of the kidneys.

XXXXX) Congenital anomalies of the heart and (YYYYY) congenital anomalies of the kidneys.

YYYYY) Congenital anomalies of the heart and (ZZZZZ) congenital anomalies of the kidneys.

ZZZZZ) Congenital anomalies of the heart and (AAAAAA) congenital anomalies of the kidneys.
THE DEVELOPMENT OF MITRAL VALVE REPAIR

• While many have contributed, the primary impetus for widespread adoption came from Alain Carpentier, MD, PhD, Hospital Broussais, Paris

• One of the major factors propelling development was a large population of patients from North Africa, where long term Coumadin was not feasible

• Trying to determine who was a candidate for repair required more precise definitions and characterization of Mitral Valve disease
CLASSIFICATION OF TYPES OF MITRAL DYSFUNCTION

Type I

Type II

Type IIIa

Type IIIb
Finding a Shoe That Fits: Matching Repair Choices to Valve Abnormalities

- **Type 1 – Normal Leaflet Mobility**
  - Annular Dilation – Ring Annuloplasty

- **Type II – Leaflet Prolapse**
  - Myxomatous Degeneration, Mitral Valve Prolapse
  - Fibro-Elastic Deficiency
  - Wide variety of techniques employed, Quadrangular resection, Chordal transfer, sliding annuloplasty techniques and NeoChords

- **Type III – Restricted Leaflet Motion, Chordal Tethering**
  - Ventricular Dilation with papillary muscle dislocation
  - Post-Infarct asyymetric ventricular dilation
  - Remodeling Annuloplasty rings – GeoForm Ring, McCarthy Ring
TYPE I MITRAL REGURGITATION

Annular Dilation

Echo – Central Jet
TYPE II – PROLAPSED P2 SEGMENT

FED

FED+

Forme fruste

Barlow’s

++

+++  

++++

Leaflet tissue
CLASSIC REPAIR

- Left atrial aspect of aortomitral septum
- Region of central fibrous body
- Posterior leaflet
- Line of sliding plasty
- Ruptured chordae tendineae
- Lines of quadrangular excision
QUADRANGULAR RESECTION AND SLIDING ANNULOPLASTY
CLASSIC REPAIR
WHY A RING?

- Fix the geometry at the correct dimensions – AP - Lateral
- Return Annulus size to normal, based on Anterior leaflet size
- Prevent Future Dilation
- Support Repaired Tissue, which is often delicate

Physio II
Average saddle height: 5.0 mm
• The Annulus is fixed in the geometry seen during Systole

• The ring returns the valve to its normal “Saddle Shape” ensuring better leaflet coaptation.

• The ring is specifically shaped to be anatomically correct in 3 dimensions

• The Mitral valve is functionally a mono-cusp valve, and the ring sizing is based on Anterior Leaflet size

• Limiting future dilation prevents small leaks from becoming big ones
FUNCTIONAL MR

- Severe MR associated with diminished LV function
- Leaflets and Chords are Normal
- Dilation of LV results in:
  - Papillary muscle dislocation
  - Tethering of Secondary Chords
- Difficult to Repair – standard rings don’t work
- Progressive LV failure may result in poor long term outcomes
• Reduction of the AP dimension

• Shortening of the papillary muscle to annulus distance

• Increasing coaptation surface
MITRAL REPAIR RESULTS

• Lower Mortality
  • Short Term
  • Long Term

• More Durable

• Better LV Function

• Fewer long term problems

• Reduced need for Anticoagulation

• Technically Difficult

• Less Predictability of Outcome

• Much Longer Learning Curve

• Potentially Longer Operation

• Failures are Bad for Patients, Doctors and Hospitals
MITRAL REPAIR HAS CHANGED THE MANAGEMENT OF MITRAL REGURGITATION

• Severe MR vs. Severe Symptoms
• Mortality of CHF associated with MR
• The Asymptomatic Patient
• Current Mortality Rates
• Current Indications
CURRENT INDICATIONS

Myxomatous Degeneration

- Severe Regurgitation
- Chordal Elongation
- Leaflet Billowing and Redundancy
- Excess leaflet tissue
- Frequent Chordal Ruptures
- Marked Annular Dilation

Fibro-Elastic Deficiency

- Severe Regurgitation
- Normal Chordal Length
- Normal Leaflet size
- P2 Chords Ruptured
- Normal or Mildly dilated annulus
## Current Indications

### Endocarditis
- Severe Regurgitation
- Recurrent Emboli on Treatment
- Resistant Organisms
- Persistent Sepsis
- Chordal Rupture
- Leaflet Perforation

### Annular Dilation
- Severe Regurgitation
- Central Regurgitant Jet
- Normal Leaflets and Chords
- Abnormal Ring Geometry
- Annuloplasty Ring alone needed for repair
- Simplest repair to accomplish
The Modern Era

The Contemporary Sternotomy
Gore-Tex Neochords

Alternative Incisions
Percutaneous Solutions
Future Directions
THE CONTEMPORARY STERNOTOMY

8–10 cm skin incision

Median sternotomy
GORE-TEX NEOCHORDS

- Scott Rankin from Vanderbilt publishes Landmark paper at 2007 STS Meeting

- 100% repair rate when using Neochords for Myxomatous Degeneration and Fibro-Elastic Deficiency

- Prior repair rate had been 40% to 70%, depending upon institution

- Removed a great deal of uncertainty from decision making process
NEOCHORD REPAIR OF ANTERIOR LEAFLET
WHY THE IMPROVED REPAIR RATE?

For valves with Myxomatous Degeneration, resection of large portions of the posterior leaflet led to SAM from pushing the floppy anterior leaflet into the LVOT.
WHY THE IMPROVED REPAIR RATE?

For valves with Fibro-Elastic Deficiency, many have more than 40% of the P2 leaflet unsupported due to multiple chordal ruptures.
ALTERNATIVE INCISIONS
What kind of incision to use?

- Traditional Sternotomy
- Contemporary Sternotomy
- Partial Sternotomy
- Right Thoracotomy – Video Assisted or Robot Assisted
- Port Access – Robotic
ROBOTIC MITRAL REPAIR

• More costly in terms of resources, time and expertise
• Longer Bypass Times
• Multiple incisions
• Different kinds of Complications
• Smooth procedure is more volume dependent
• Limits some types of repairs
ROBOTIC MITRAL REPAIR

- Can be done with excellent results in some centers
- Not universally reproducible
- Does not eliminate need for CPB
- Myocardial protection and de-airing are more difficult
- Fewer options for handling problems

- Patient Advantages
  - Mentally easier to accept for some patients
  - Reduced discomfort compared to a “Traditional Sternotomy”
  - Potential for reduced blood utilization

- Institutional Advantages
  - Perception of a higher level of care
  - Used to drive Market Share in Large Markets
Robotic Mitral repair is the future of cardiac surgery, and always will be…

Robert Guyton M.D.
Emory University
WHAT IS ON THE HORIZON?

Transapical NeoChords

Percutaneous valves
QUESTIONS TO BE ANSWERED

- Do all Mitral Repair patients need some form of A-Fib treatment, and how does that affect choice of approach?
- Does groin cannulation and bypass lead to higher stroke rates in older patients?
- Are flexible annuloplasty rings as durable over the long term?
- Is a Partial Sternotomy less painful than a Contemporary Sternotomy?
- What Institutional volume is needed to be proficient at Robotic Heart Surgery?
- How do we value incisional issues vs long term success?
- What will be the ultimate role of MitraClip, Transapical NeoChords, and Percutaneous Valves?

Treatment of Mitral Regurgitation is evolving faster than at any time in the past.
FIVE YEARS FROM NOW.....?

The questions will remain largely the same:

- When to intervene?
- Who is a candidate for intervention?
- What is the best method for this individual patient?
- In which patients is it better to pursue conservative therapy?

The answers will all be different