Robotic surgical repair of mitral regurgitation

Creating a unified dataset to compare neo-chord creation and leaflet resection

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Background

Mitral regurgitation (**MR**) is the **most common** valvular disease worldwide.

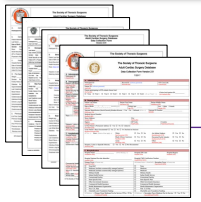
Three possible **approach**es for repair:
- Standard sternotomy – large wound
- Minimally invasive – small wound | 2D imaging
- **Robotic** – smallest wound | 3D imaging

Two possible **technique**s for repair:
- Leaflet resection – older
- Neo-chord creation – newer

What's the best technique for robotic surgical repair of MV regurgitation?

Method

1. STS DATA COLLECTION



3,193
Pre-, peri-, and post-op variables

x

1,481
Registered patients

=

4,728,833
Data points collected over 20 years

2. LITERATURE SEARCH

26 pre-op covariates
Noted from 20+ prior studies

Sex	Prior myocardial infarction
Patient age	Diabetes
Smoker	Moderate or severe chronic lung disease
Recent heart failure	Moderate or severe aortic regurgitation
Hypertension	Aortic stenosis
Peripheral arterial disease	Moderate or severe mitral regurgitation
Cerebrovascular disease	Mitral stenosis
Prior cerebrovascular accident	Previous valve surgery
Body surface area	Reoperative status
Ejection fraction	Urgency classification
Most recent creatinine level	Mitral Repair
Dialysis	Preoperative arrhythmia
Coronary artery disease	Preoperative atrial fibrillation

Result

A **unified dataset** of **cardiac surgery** variables was created to assess the best **robotic surgery** technique.

Now, we have the **framework** to analyze **30k+ remaining STS datapoints** to perform future studies in cardiac surgery.

Baseline Characteristics	Minimally Invasive (n = 1481)	Leaflet Resection (n = 416)	Neo-Chord Creation (n = 147)
Male	852 (57.5%)	291 (69.9%)	99 (68.1%)
Age median (IQR) [y]	62 (52-70)	60 (52-68)	61 (53-69)
Smoker (current)	95 (6.4%)	18 (4.3%)	16 (10.8%)
History of heart failure	1168 (78.8%)	317 (76.2%)	125 (85.0%)
History of hypertension	842 (56.9%)	209 (50.2%)	74 (50.3%)
Peripheral arterial disease	80 (5.4%)	13 (3.1%)	3 (2.0%)
Cerebrovascular disease	139 (9.4%)	25 (6.0%)	8 (5.4%)
Body surface area [m²]	2.0 (1.8-2.1)	2.0 (1.9-2.1)	2.0 (1.9-2.1)
Preoperative LVEF [%]	60 (53-63)	60 (55-63)	60 (56.3-63)
Most recent creatinine level	1 (0.8-1.1)	1 (0.8-1.1)	1 (0.8-1.1)
Renal failure on dialysis	6 (0.4%)	2 (0.5%)	0
Coronary artery disease	489 (33.0%)	60 (14.4%)	85 (57.8%)
Prior myocardial infarction	122 (8.2%)	10 (2.4%)	5 (3.4%)
History of diabetes	193 (13.0%)	30 (7.2%)	19 (12.9%)
Lung disease (moderate/severe)	31 (2.1%)	3 (0.7%)	2 (1.4%)
Aortic stenosis	25 (1.7%)	1 (0.2%)	3 (2.0%)
Mitral stenosis	46 (3.1%)	3 (0.7%)	3 (2.0%)
Mitral insufficiency (moderate/severe)	1249 (84.3%)	412 (99%)	145 (98.6%)
Prior valve surgery	42 (2.8%)	1 (0.2%)	0
Urgency classification (urgent)	53 (3.6%)	3 (0.7%)	5 (3.4%)
Preoperative arrhythmia (nonspecific)	529 (35.7%)	98 (23.6%)	29 (19.7%)
Preoperative atrial fibrillation	488 (33.0%)	72 (17.3%)	29 (19.7%)

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Method

3. DATA TRANSLATION

7+ STS format changes
Variables have been redefined multiple times over 20 years

+

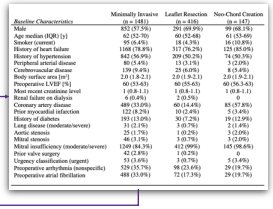
Variance in data entry
due to user inconsistency & error

Result

MATLAB pattern recognition code
written to increase number of usable data points

4. ANALYTICS

Descriptive statistics
To quality check compiled data



Propensity scoring
Via *logit* function with *binomial distribution*

$$logit(x) = \log\left(\frac{p}{1-p}\right) = e^{\beta_0+\beta_1+\cdots\beta_n x_n}$$

5. FUTURE WORK

This Project

Pre-/Post-PSM Comparison
to assess covariate balance

Are any of the variables confounders?

Pre-PSM Cohort Testing via
1) Mann-Whitney U test and
2) X^2 test

Post-PSM Cohort Testing via
1) McNemar's test and
2) Signed rank test

Which robotic surgical technique is best for MR repair?

Future Projects

Supervised Machine Learning
such as a (convolutional) neural network

Can we train a neural network to predict which surgical approach to use based on pre-op LVEF and intra-op TEE?

Unsupervised Machine Learning
such as *dbscan*

Can specific pre-op variables help us anticipate complications we can prepare for?