The aorto-ventricular junction in aortic repair

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The surgical correction of aortic insufficiency by circumclusion

First subvalvular aortic annuloplasty
Beating Heart Right thoracotomy
11 patients, rheumatic disease (8/11)

Subcommissural plication stitches
(Cabrol stitches)

Plicating U stitches at the base of the interleaflet triangles

= partial subvalvular annuloplasty

Plicating U stitches at the commissures

= partial supravalvular annuloplasty

Plication of the interleaflet triangles impairing valve dynamics
especially for bicuspid valves

significant gradient

minimal reduction in aortic annular base diameter

Useful to protect a commissural repair or as a bailout technique
Subcommissural plication stitches
(Cabrol stitches-1966)

Risk factor of BAV and TAV repair failure

BAV repair + SCA

→ at 6 y AR 3+

Preop TEE

29 mm

Postop TEE

24 mm

Pre-redo TEE

29 mm

Useful to protect a commissural repair or as a bailout technique

Aicher Circulation 2011; Navarra EJTCVS 2013; Vallabhajosyula P ATS 2014
Aortic annuloplasty devices

Experimental

Duran 1993
Internal ring

In vivo (4 calves)

Calves roots

Reimold 1994
External ring

In vivo (5 sheep)

Porcine roots

6 months in vivo (1 calf)

Rankin 2011
Internal ring

Porcine roots

Gogbashian 2007
External band

Scharfschwerdt 2011
Internal or external ring

In vivo (18 sheep)

In vivo (5 sheep)

In vivo (4 calves)
Techniques for aortic annuloplasty
Isolated AI

Carpentier 1983
Frater 1986
Haydar 1997
Izumoto 2002
Hahm 2006

Lansac 2003
Schäfers 2009
Fattouch 2011
Rankin 2011

Need for standardization
Aortic annuloplasty and valve sparing root replacement?

Risk factor for failure of the Remodeling: Annulus dilation >25-28 mm

Remodeling of the aortic root

- Treatment of STJ dilation

Reimplantation of the aortic valve

+ Treatment of aortic annulus dilation

Remodeling alone is a contraindication if annulus >25 mm

Reimplantation performs a subvalvular annuloplasty
Physiological and standardized approach to Valve Sparing Root Replacement

Remodeling more physiologic
RF failure annulus > 25 mm

Remodeling + subvalvular annuloplasty
Dystrophy of the ascending aorta
pliable tricuspid valve

Aortic root aneurysm
Valsalva ≥45 mm

Supra-coronary aneurysm
Valsalva < 40 mm

Isolated AI
all Ø < 40 mm

Remodeling
+ subvalvular annuloplasty

Supra-coronary graft
+ subvalvular annuloplasty
(annulus > 25 mm)

Subvalvular annuloplasty
(annulus > 25 mm)

Cusp repair

Alignment of the cusp free edges

Resuspension of cusp effective height

Subvalvular external aortic annuloplasty
An Expansible aortic ring

- Reduces aortic annular base diameter in diastole (-15%)
- Increases cusp coaptation height (+130%)
- 10% systolic expansibility mimics natural annulus dynamics
- Protects the repair and reduces cusps’ stress
Pre implantation

6 months post op

Silicone properties remained stable at 6 months

Mechanical Properties of 5mm Explanted Sample vs. Non-Explanted Sample

- Load (N)
- Strain (%)

<table>
<thead>
<tr>
<th>Strain (%)</th>
<th>Control</th>
<th>Explant</th>
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<tbody>
<tr>
<td>10%</td>
<td>0.53</td>
<td>0.69</td>
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<tr>
<td>15%</td>
<td>0.47</td>
<td>0.65</td>
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<tr>
<td>25%</td>
<td>1.05</td>
<td>1.19</td>
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</table>
Standardization based on aortic annulus Ø

<table>
<thead>
<tr>
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<th>Valsalva graft® Ø (mm)</th>
<th>Extra aortic ring® Ø (mm)</th>
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<tbody>
<tr>
<td>Aortic annular base Ø (Hegar dilators, mm)</td>
<td>25-27</td>
<td>28-30</td>
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<tr>
<td></td>
<td>26</td>
<td>28</td>
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<tr>
<td></td>
<td>25</td>
<td>27</td>
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Subvalvular ring = down size from one size
Standardization step by step

6 subvalvular « U » stitches

Alignment of cusp free edges prior Remodeling

Suture of the Remodeling

Cusp resuspension after the Remodeling (effective height ≥9 mm)

Subvalvular ring implantation
Root aneurysms: Bicuspid valves
(Sinus Valsalva Ø ≥ 45 mm)

6 subvalvular « U » stitches

Aligment of cusp free edges

Comissures at 180°

Effective height measurement

Subvalvular aortic annuloplasty
Dystrophy of the ascending aorta pliable bicuspid valve

- **Aortic root aneurysm**
  - Valsalva ≥45 mm

- **Supra-coronary aneurysm**
  - Valsalva < 40 mm
  - Supra coronary Aorta > 45 mm

- **Isolated AI**
  - Valsalva < 40 mm
  - Supra coronary Aorta < 40 mm

- **Remodeling**
  - + sub-valvular annuloplasty

- **Supra-coronary graft**
  - + sub-valvular annuloplasty
  - (annulus > 25 mm)

- **Supra-valvular annuloplasty**
  - (STJ > 35 mm)

- **Subvalvular annuloplasty**
  - (annulus > 25 mm)

**Cusp repair**

- Alignment of the cusp free edges
- Resuspension of cusp effective height
- Subvalvular external aortic annuloplasty
Supra-coronary aneurysms
Bicuspid R-L (sinus $\varnothing$ 40 – 45 mm)

- 6 subvalvular «U» stitches
- Aligment of cusp free edges
- Commissures at 180°
- Effective height measurement
- Subvalvular aortic annuloplasty
Dystrophy of the ascending aorta pliable bicuspid valve

Aortic root aneurysm
- Valsalva ≥45 mm

Supra-coronary aneurysm
- Valsalva < 40 mm
- Supra coronary Aorta > 45 mm

Isolated AI
- Valsalva < 40 mm
- Supra coronary Aorta < 40 mm

Remodeling + sub-valvular annuloplasty

Supra-coronary graft + sub-valvular annuloplasty (annulus > 25 mm)

Supra-valvular annuloplasty (STJ > 35 mm)
Subvalvular annuloplasty (annulus > 25 mm)

Cusp repair
- Alignment of the cusp free edges
- Resuspension of cusp effective height
- Subvalvular external aortic annuloplasty
Isolated aortic insufficiency
(all diameters ≤ 40 mm)

6 subvalvular « U » stitches

Alignment of cusp free edges

Placement of the open subvalvular ring below the coronaries

Cusp resuspension (effective height ≥ 9 mm)

Final aspect

Isolated aortic insufficiency (all diameters ≤ 40 mm)