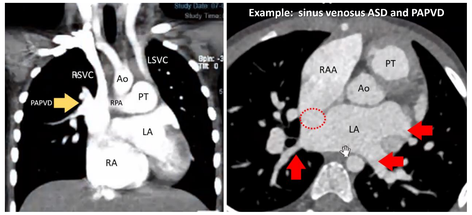
# Minimal Incision And Less Invasive Techniques In Congenital Cardiac Surgery

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## The problem:

- Minimal incision ≠ minimally invasive
- Congenital heart surgery (CHS): constraint space, multiple compartments, difficult visualization
- Gain virtue out of necessity; i.e., to lessen biological aggression *("fac virtus de necessitate"* – St. Jerome)





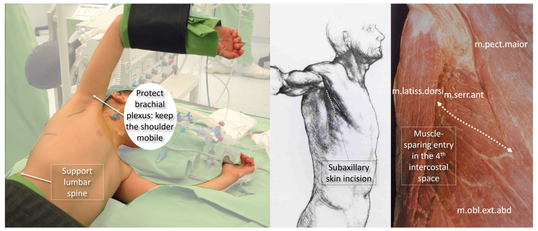


**Preoperative imaging includes 2D echocardiography and CT-angiography…** Abbreviations: Ao: ascending aorta, LA: left atrium, LSVC: left superior vena cava, PAPVD: partially anomalous pulmonary venous drainage (yellow arrow), PT: pulmonary trunk, RA. Right atrium, RAA: RA appendage, RPA: right pulmonary artery, RSVC: right superior vena cava, red-arrows: left-sided pulmonary veins and right lower lobe drains to LA, dotted circle: sinus venosus ASD

**and in recent days more and more 3D-printed models.** 3D-printing significantly contributes to preoperative planning, surgical emulation, cohesion of the multidisciplinary team.



### Right subaxillary muscle-sparing thoracotomy

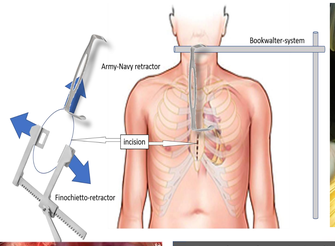


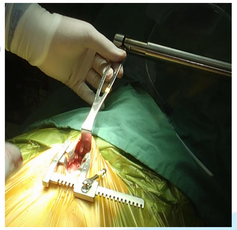


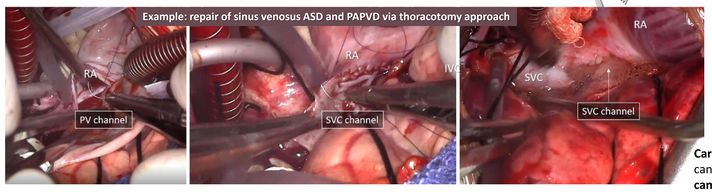


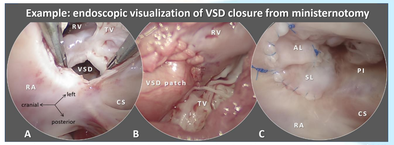



### Median ministernotomy with limited skin incision

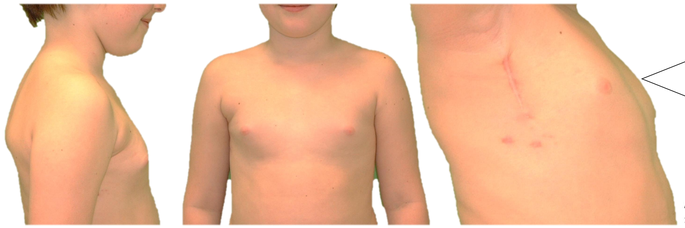





**Cardiopulmonary bypass** is implemented via the operative area (IVC cannula is introduced through an incision for the pleural drain). **Headlight-camera** and **endoscopic visualization** grossly enhances team-participation.



**Cosmetic result** is appealing after

right thoracotomy and median ministernotomy



*Patients' pictures are presented with the written consent of the guardians*

**Objective:** Minimal incision and less invasive techniques derive from adult cardiothoracic surgery and they gradually find their application in congenital cardiac surgery. The final aim is a cosmetically more appealing result without jeopardizing quality of the repair and patient-safety. Our bi-institutional experience is presented as a team-learning and program developmental process.

**Methods:** Preoperative preparation included advanced imaging to establish full segmental diagnosis and spatial anatomy to identify the exact site of entry. Surgical approach was discussed in close communication with and consented by patients/guardians. Solitary anomalies (ASD, SV-ASD, VSD, subaortic membrane, MV surgery, PVR, etc.) were approached by a muscle-sparing minithoracotomy. Multi-compartment anomalies (e.g., complete repair of tetralogy of Fallot, aortic arch anomalies associated with intracardiac repairs) were addressed by ministerotomy. Intraoperative visualization was helped by superimposed 3D virtual models and endoscopy. Peripheral cannulation for CPB was employed above 30kg of bodyweight. Endoscopic instruments and additional analgesia catheters were utilized in the thoracotomy group.

**Results**: Patients ranged from 3 months – 64 years (median ages, thoracotomy: 14.5 years; ministernotomy: 28 months, p=0.001). No major morbidity/mortality occurred. In the thoracotomy group a transient brachial plexus neuropraxia prompted for a change in patient-positioning. Superimposed images improved direct access to region-of-interest, the use of endoscopic imaging and instruments accelerated the learning curve and broadened the scope of eligible anomalies. Limited midline incision with/without full opening of the sternum with the use of special retractors allowed adequate visualization of all areas-of-interest and complete repair. **Over 85% of eligible patients are now routinely undergo even complex congenital cardiac surgery with minimal incision and less invasive techniques at our institutions.**

**Conclusions:** Diffusion of minimal incision and less invasive techniques into congenital cardiac surgery has so far been restricted due to complexity, need to access multiple segments in a constraint operative field. These techniques require a dedicated team acquiring new skills, working in cooperation with the allied disciplines, using specialized instruments. Advanced pre- and intraoperative visualization could offer uncompromised view and access that translates into improved quality of the repair and patient-safety and more appealing cosmesis.

**Patient and procedural characteristics of minimal incision and less invasive congenital cardiac surgery**

Abbreviations: ASD: atrial septal defect, AVSD: atrioventricular septal defect, DORV: double outlet right ventricle, MV: mitral valve, n/a: non-applicable, N/S: non-significant, SAS: subaortic stenosis, SV-ASD/PAPVD: sinus venosus type atrial septal defect and partially anomalous pulmonary venous drainage, ToF: tetralogy of Fallot, VSD: ventricular septal defect

| | Mini-thoracotomy | Mini-sternotomy | Statistical difference |
|---|---|---|---|
| Patient numbers | 104 | 125 | n/a |
| Age (median; range) | 14.5 years; 8 months- 64 years | 28 months; 3 months-9 years | 0.001 |
| Weight (kg, median; range) | 46.1; 5.3-74 | 8.1; 3.4-39 | 0.01 |
| Diagnoses | ASD, SV-ASD/PAPVD, VSD, SAS, MV anomaly, pulmonary regurgitation | VSD, AVSD, ToF, DORV, aortic arch anomaly with intracardiac defect | n/a |
| Procedural duration (mins, median; range) | 164; 122-248 | 155; 98-199 | NS |
| Cardiopulmonary bypass (mins, median; range) | 64; 18-88 | 69; 29-164 | NS |
| Aortic cross-clamp (mins, median; range) | 26; 14-112 | 44; 21-128 | NS |
| Length-of-stay (days, median; range) | 4.8; 3-8 | 5; 4-11 | NS |
| Morbidity | 2: transient brachial plexus neuropraxia, transient phrenic nerve palsy | 2: pleural effusion | n/a |
| Mortality | 0 | 0 | n/a |
| Reoperation | 0 | 0 | n/a |

**Take-home messages:**

- Minimal incision → less invasive CHS
- New techniques find their niche into CHS

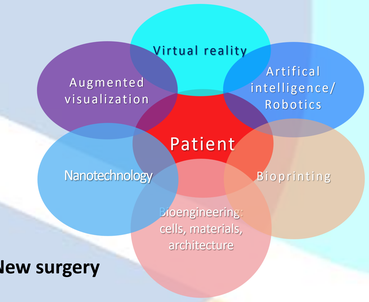
PREREQUISITES OF SUCCESS

- Preop preparation:
  - Evaluation/imaging/CT/3D printing
  - Adequate patient selection
- New skillset; learning curve; coaching by experts
- Specialized equipment/tools
- Dedicated multidisciplinary team/
- Cooperation with adult MICS teams
- Uncompromised view

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**ISMICS 2022 Annual Meeting**: **ismics2022.035002f**

**Minimal incision/less invasive methods** promote combination of evolving modalities in CHS:




**New surgery**

