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Establishment of a 3-D silicone model to facilitate realistic hands-on-training for diagnostic and interventional pediatric cardiac catheterization

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Introduction: Today, cardiac catheterization is still of great importance for diagnostic and therapeutic purposes in pediatric cardiology. Nevertheless there are currently no widely accepted training models for trainees or junior doctors to learn these techniques. Especially the manual management of long catheters and wires as well as balloon catheters and exchange wires may remains a hurdle in the rapid development of catheter skills.

Methods: We developed various silicon heart models including a normal heart and models with common congenital heart defects such as a patent ductus arteriosus (PDA), pulmonary and aortic stenosis, coarctation of the aorta and ASD. The models were built out of silicon tubes, then CT-scanned and finally printed with a 3D-Silicon printer.
To test the effectiveness of the models, a comparative training course with a manual was implemented. This training course was then offered to medical students with no previous catheter experience, residents and fellows with no and/or little catheter experience and pediatric cardiologists with high experience including interventional catheter treatment. After initial theoretical teaching, practical hands-on training was performed. There was a stepwise escalation in the skills required from purely diagnostic catheter investigation including hemodynamic assessment up to interventional therapy such as balloon dilatation of an aortic or pulmonic stenosis or coarctation stenting. The improvement of skills was assessed by timing of each procedure.

Results: After a short training period the training models enabled even completely unexperienced trainees to handle the fluoroscopy machine and catheters, wires, balloons and stents. The acceptance of the model by experienced cardiologists was high.

Conclusion: These preliminary results show that – like in other fields of medicine or industry – training models may help to improve technical skills and reduce a learning curve in managing complex procedures. Implementing a model based training of catheterization procedures might have a lasting learning effect on cardiologists. A reduction of hands-on training in animal models may be possible; even for experienced staff, a model based training in the handling of devices may be helpful before intervening in patients. We believe that model training should be further implemented in the future training of cardiology residents.