A novel training and testing simulator for PTCA balloon catheters

Background

Percutaneous Transluminal Coronary Angioplasty (PTCA) balloon catheters are used to open blocked or narrowed (stenotic) coronary arteries to improve the blood flow to the heart muscle. During the minimal-invasive procedure a balloon catheter is advanced to the stenosis with the help of a guide wire and inflated to improve blood flow. Balloon catheters must combine different properties such as pushability (the ability to advance the catheter in coronary vessels), trackability (the ability to pass through tortuous vessel formations), crossability (the propensity to pass a stensosis) and re-wrap behavior (folding of the balloon after deflating). To investigate those properties a training simulator, which mimics in-vivo-like conditions, is necessary.

Aim

In this project, the student will develop realistic silicone models of the coronary system for training and testing purposes. The simulator will be used to test and evaluate PTCA balloon catheters and should therefore comprise different features as realistic friction, similar mechanical properties and possibly adjustable lesions.

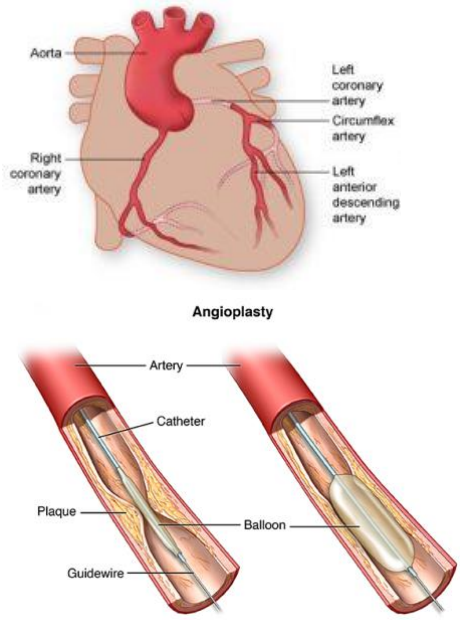

Fig.: Top panel: Coronary arteries including the right and left coronary artery. **Bottom panel:** During the angioplasty a balloon is advanced to a stenotic region and inflated to open the narrowed vessel.

Materials and Methods

The student will first familiarize with the concept of balloon catherization. Subsequently, an anatomical 3D model will be developed for the bench simulator using silicone moulding and additive manufacturing techniques. Realistic properties of the model (friction between catheter and vessel, temperature and mechanical properties of the tissue) can be achieved by careful selection of surface treatments and materials. These are validated through experiments and close collaboration with physicians. Further experimental tests will be performed to assess the behaviour of the simulator and evaluate its potential to support further improvement of PTCA balloon catheters.

Nature of the Thesis

Analytical: 15%
Hardware development: 45%
Experimental testing: 30%
Documentation: 10%

Requirements

Interest in applied development and tissue mechanics. Experience or interest in additive manufacturing and silicone molding is considered an advantage.

Supervisors

1.) Cornelia Amstutz
2.) Adrian Zurbuchen, PhD

Examiners

1.) Andreas Haeberlin, MD, PhD
2.) Adrian Zurbuchen, PhD

Institutes

- Dept. of Cardiology, Bern University Hospital
- Swiss Institute for Translational and Entrepreneurial Medicine

What we provide

We provide expertise in cardiovascular technology and device development. The candidate will work in a dynamic team of engineers and physicians, where creative and innovative work is highly appreciated.

References

- K. Takashima, R. Shimomura, Contact and friction between catheter and blood vessel, Tribol. Int. 40, 319 (2007)

Contact

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