An Examination of Wall Shear Stresses in Curved Arterial Vessels using Bioresorbable Stents

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•**Introduction**: Bioresorbable stents are New generation of stents which providing temporary mechanical support to keep a narrowed or blocked coronary artery open and restore the blood flow and will be gradually degraded and resorbed after the healing and remodeling of arterial wall. These novel stents has lower rates of restenosis and in-stent thrombosis in comparison with permanently bare-metal stents. Since this new generation is still in the early stages of development, more study is needed on their mechanical properties, material, design and performance[1].

- **Computational Method**: Fluid-Structure Interaction Method applied to simulate an artery after stent deployment. The analysis consists of two coupled procedures: fluid dynamics simulation to calculate the pressure distribution in blood and mechanical analysis of stent and artery wall under blood pressure.

Fluid Equations

$$\rho\nabla.(u) = 0$$

$$\rho\frac{\partial u}{\partial t} + \rho(u.\nabla)u = \nabla.\left[-p2I + \mu\left(\nabla \mathrm{u} + (\nabla u)^T\right)\right] + F$$

Fluid-Structure Interaction Equations

$$\sigma_{solid}.n = \sigma_{fluid}.n$$

$$\sigma_{fluid} = -P_{fluid}I + \mu\left(\nabla U_{fluid} + \left(\nabla U_{fluid}\right)^T\right) - \frac{2}{3}\mu(\nabla.U_{fluid}\,I)$$

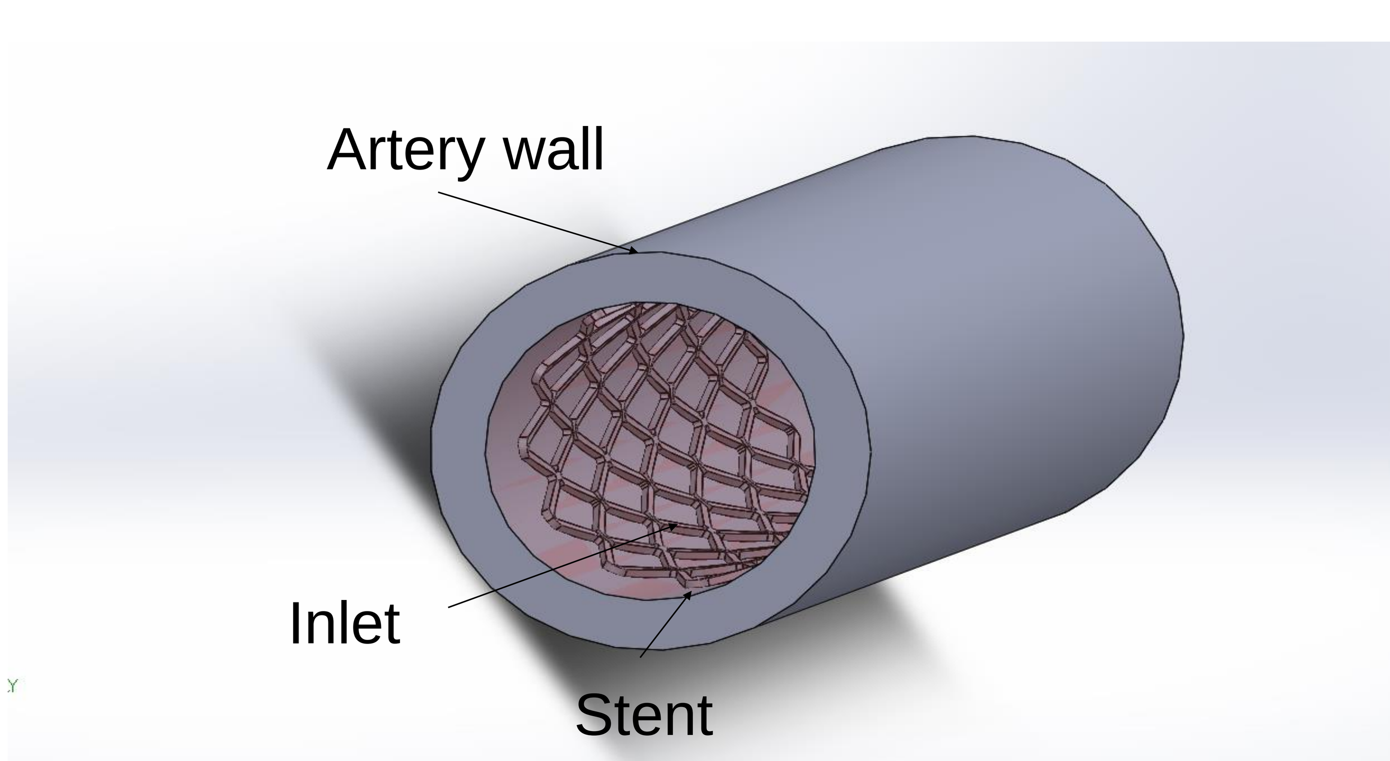

Figure 1. Schematic View of Artery , Stent and Blood

•**Results**: In this study, an analysis on the mechanical characteristics of bare-metal stents (e.g., Co-Cr (L 605) and Stainless steel) and bioresorbable stents (PLLA)after stent deployment are shown in following figures. As we expected, the deformation in bioresorbable stent is higher than bare—metal stent and stress distribution on bioresorbable stent is lower.

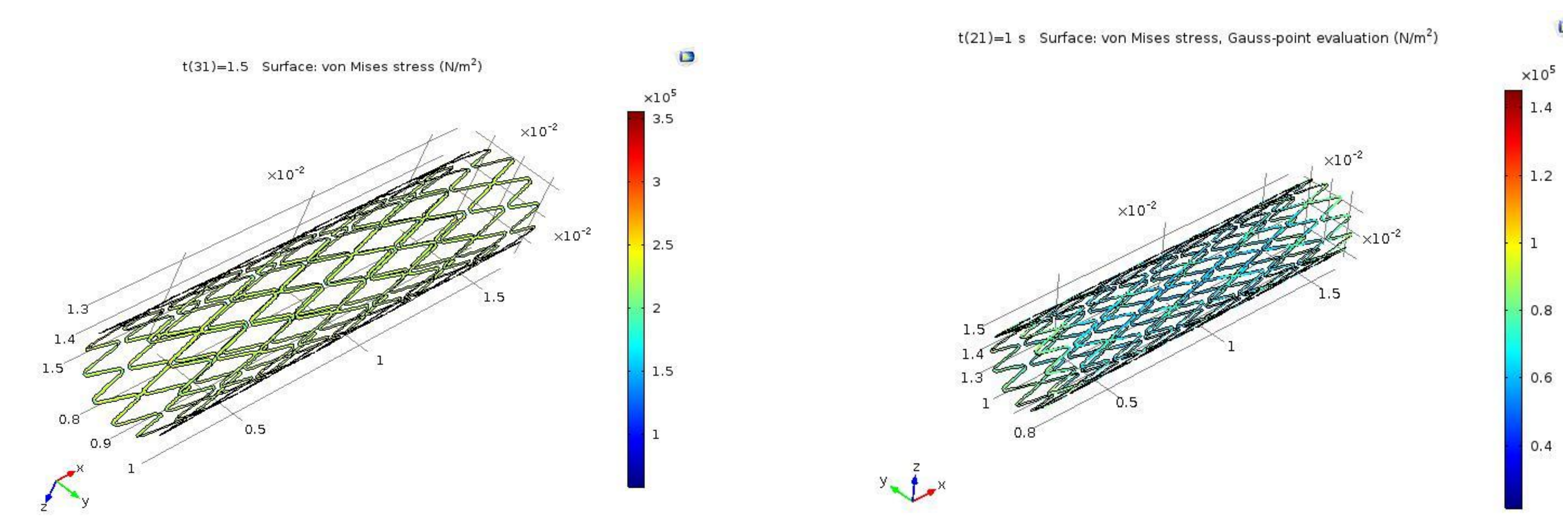

Figure 2. Stress 1)Bare-Metal Stent, 2)Bioresorbable stent

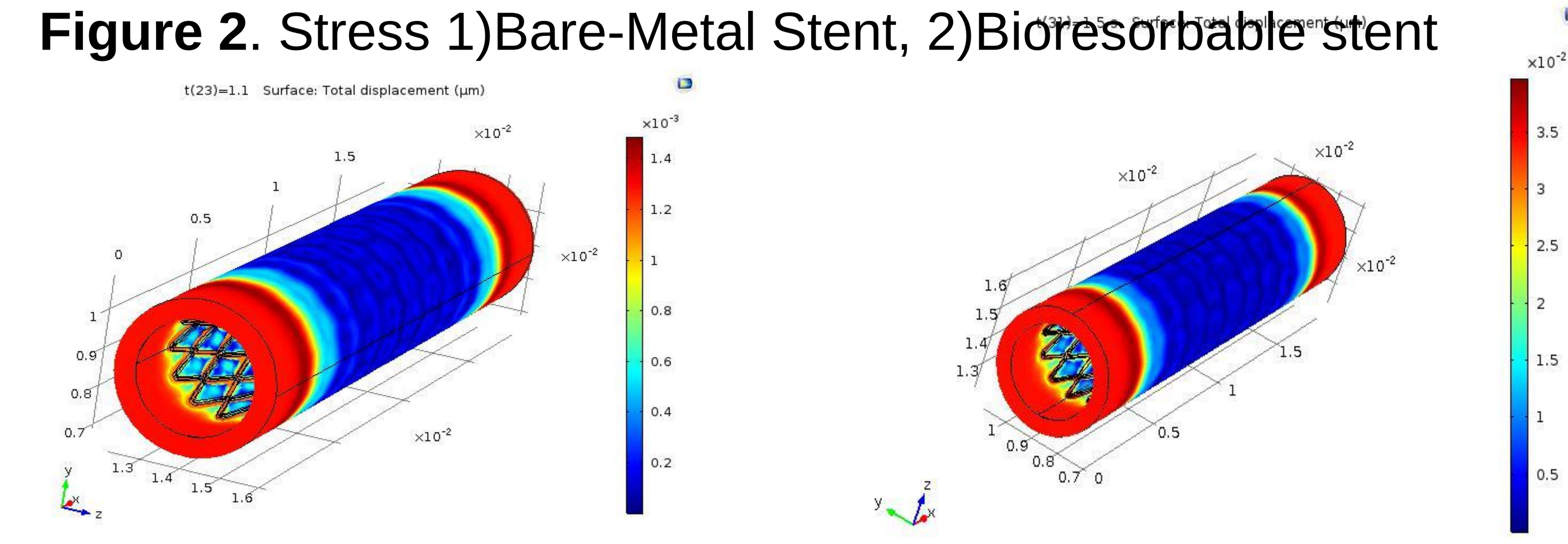

Figure 3. Deformation 1)Bare-Metal Stent, 2)Bioresorbable stent

•**Conclusions**: In our ongoing project, the FSI model is applied to curved artery after stent deployment for both commercial Bioresorbable (PLLA) and bare-metal stent Co-Cr (L 605). Applying metal stents in very tortuous coronary sections can produce high shear stresses at the edges while also impacting the geometry of the vessel. Since bioresorbable stents are conformable, the stresses should be less on the arterial walls. The purpose of this study is to examine the stresses on stents after deployment inside artery wall.

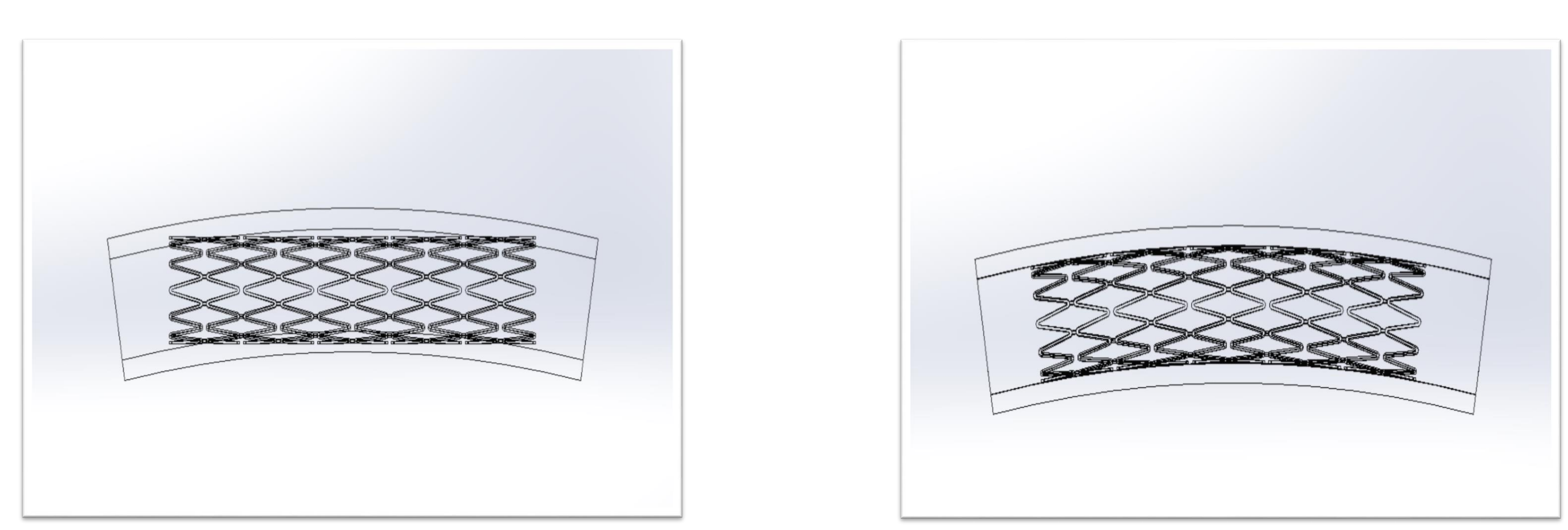

Fig.4 Schematic View of Artery,Stent and Blood 1) 1)Bare-Metal Stent, 2)Bioresorbable stent

References:

1. Schiavone, Alessandro, et al. "Computational analysis of mechanical stress–strain interaction of a bioresorbable scaffold with blood vessel." *Journal of biomechanics* 49.13 (2016): 2677-2683.