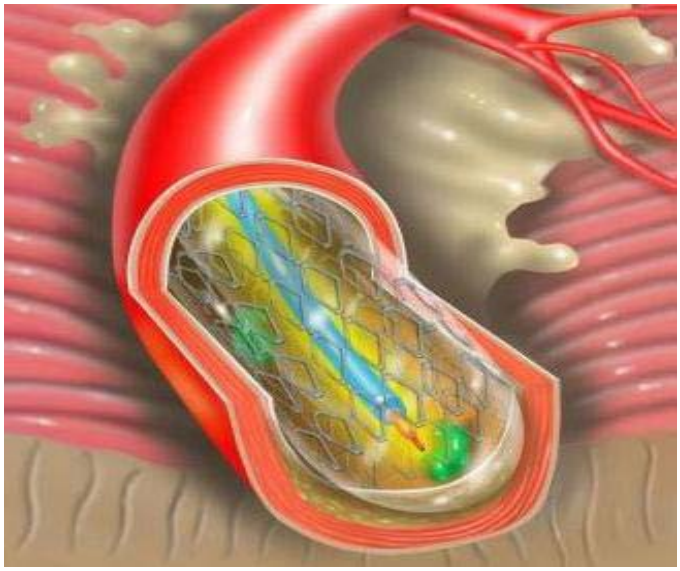
Endovascular Stents

Stent and Balloon Expansion using a Finite Element Analysis

Cadets: Isaac Cecil, Yau-ren Kuo, and Bart Payne

Client: Cordis Corporation (LTC Squire)

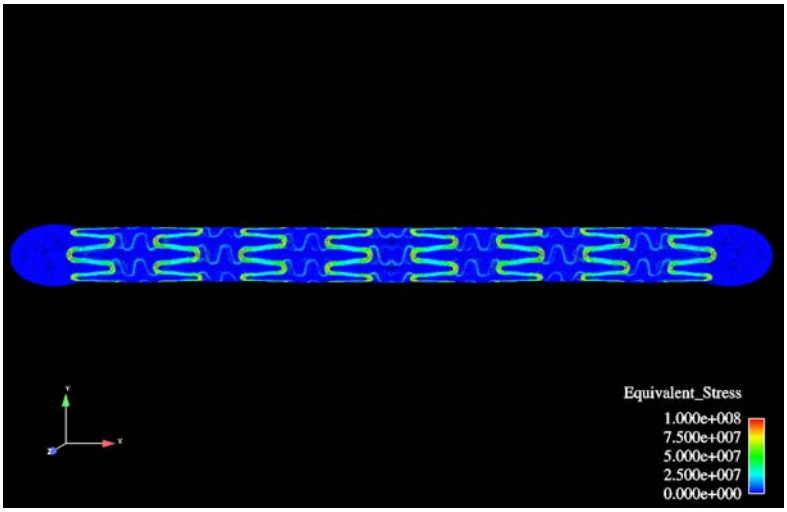
Faculty Advisor: LTC Matthew Hyre



During the past four months our team has been working for the largest endovascular stent manufacturing company in the world, Cordis Corporation. The purpose of an endovascular stent is to re-open a closed artery and help blood circulate better inside an artery. These stents have saved the lives of millions of people; however, there are problems with them at times. There have been cases where the stent placement has damaged the internal walls of an artery. One of these causes of damage to the arterial wall is end flaring. End flaring is defined as the non-uniform opening of the stent due to lack of support on the end struts.

Our team was asked to model the expansion of an endovascular stent and a balloon in a finite element program. In the past four months, the team has carried out these wishes. The finite element modeling process was broken into three sub-steps: material modeling, two-dimensional contact, and three dimensional contact modeling. Each process was carried out in a systematic manner. Once one phase was modeled and the team was confident in the results, the next phase was carried out.

Material modeling was done to verify the plastic and multi-linear elastic material could actually be modeled in ANSYS. It was determined that it was possible to model the stent and balloon material. The purpose of the two-dimensional contact analysis was to determine the contact parameters between the stent and balloon. The

contact parameters that were determined between the two components defined as a bonded contact behavior. These contact parameters were then used in the creation of a three-dimensional contact analysis. The initial three-dimensional contact analysis was created using concentric cylinders in order to simplify the geometry and minimize solution time. After achieving contact and reasonable results between the concentric cylinder models, the actual stent geometry was implemented into the analysis, taking place of the outside cylinder. Using balloon overhangs of zero millimeters and two millimeters, the contact and expansion between two linear-elastic materials in contact, were modeled.

After obtaining contact and reasonable results with the multi-linear elastic and non-linear plastic materials, our team brought all of the components together into one analysis. This final analysis consisted of the actual stent and balloon geometry and materials.