World Academy of Science, Engineering and Technology
International Journal of Mechanical and Materials Engineering
Vol:8, No:11, 2014

Haemodynamics Study in Subject Specific Carotid Bifurcation Using FSI

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Abstract : The numerical simulation has made tremendous advances in investigating the blood flow phenomenon through elastic arteries. Such study can be useful in demonstrating the disease progression and haemodynamics of cardiovascular diseases such as atherosclerosis. In the present study, patient specific case diagnosed with partially stenosed complete right ICA and normal left carotid bifurcation without any atherosclerotic plaque formation is considered. 3D patient specific carotid bifurcation model is generated based on CT scan data using MIMICS-4.0 and numerical analysis is performed using FSI solver in ANSYS-14.5. The blood flow is assumed to be incompressible, homogenous and Newtonian, while the artery wall is assumed to be linearly elastic. The two-way sequentially-coupled transient FSI analysis is performed using FSI solver for three pulse cycles. The haemodynamic parameters such as flow pattern, Wall Shear Stress, pressure contours and arterial wall deformation are studied at the bifurcation and critical zones such as stenosis. The variation in flow behavior is studied throughout the pulse cycle. Also, the simulation results reveals that there is a considerable increase in the flow behavior in stenosed carotid in contrast to the normal carotid bifurcation system. The investigation also demonstrates the disturbed flow pattern especially at the bifurcation and stenosed zone elevating the haemodynamics, particularly during peak systole and later part of the pulse cycle. The results obtained agree well with the clinical observation and demonstrates the potential of patient specific numerical studies in prognosis of disease progression and plaque rupture.

Keywords : fluid-structure interaction, arterial stenosis, wall shear stress, carotid artery bifurcation
Conference Title : ICCEM 2014 : International Conference on Computational and Experimental Mechanics
Conference Location : Venice, Italy
Conference Dates : November 13-14, 2014