Assessment of Arterial Function Recovery after Surgical Revascularization in PAD Patients with Micro-Vascular Insufficiency using Computational Model Analysis

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Peripheral arterial disease (PAD) is characterized by atherosclerotic blockages of the arteries supplying blood to the lower extremities, which cause a progressive accumulation of ischemic injury. Despite revascularization treatment intervention some PAD patients require follow up secondary treatment due to a continued decline in limb function, quality of life and walking parameters. Standard revascularization surgical procedures restore blood flow in the main arteries via bypass surgical grafting. Nutrient transport and oxygen transfer take place at the level of the microvasculature and capillaries. However, an assessment of the microvascular circulation is lacking. Microvascular dysfunction, a ‘no flow’ phenomena that may occur at the level of microvasculature, may impair tissue oxygenation as well as nutrient transport and may therefore be a contributor to the continued decline in limb function and walking parameters. Microvascular dysfunction may be one of the dominating factors to be studied to understand the failure of the arterial function recovery. Multi-physics simulation software was used to model the phenomena to assess the effectiveness of the standard lower limb revascularization treatment in PAD patients who may have microvascular dysfunction. Typical invasive revascularization surgery using artificial bypass grafts to restore blood flow may fail to be effective if the PAD patient has microvascular dysfunction. This model identifies the need to measure the microvascular circulation in the compromised limbs of PAD patients to optimize diagnosis and treatment strategies that reflect the underlying pathophysiology.