Flow analyses of microvascular bifurcation using laser Doppler anemometry.

Abstract:
Vascular surgery affects, among other factors, vessel geometry and might result in significant flow changes. For this reason a basic understanding of flow behavior at bifurcations plays an important role for microsurgeons. The aim of the present work was to establish an experimental model that enables rheological analyses of microvascular techniques. Laser Doppler anemometer (LDA) measurements in a total of four cross-sections of a true-to-scale silicone model were performed. The model was installed in a circulatory experimental setup that simulates the physiologic human blood flow. The flow velocity data measured with the LDA system was processed and analyzed with an image-processing system. The flow curve at each cross-section was recorded for seven cycles. A physiologic flow separation at bifurcational level was seen. Maximal and minimal horizontal velocities of all measurement points were between 0.32 and -0.15 m/s. No signs of turbulent-like flow were seen in the cross-sections distal to the bifurcation. A total, centrally located backflow in the diastolic phases in all four cross-sections was registered, resembling an oscillatory-like flow. The LDA analysis represents a valid experimental method for rheological evaluation of microvessels. Due to its unique high spatial and temporal resolution, it represents a worthwhile alternative to other flow investigations.