Accurate measurement of the aneurysm neck size from diagnostic angiograms is crucial in the consideration and implementation of interventional embolotherapeutic procedures. Due to inherent problems in angiography, aneurysm morphology and location, and obstruction by overlying structures, accurate measurement of the aneurysm neck size is difficult. We are proposing a method for the angiographic measurement of aneurysm neck size based on a biomathematical model of an aneurysm. A biomathematical model of an intracranial saccular aneurysm was developed based on Laplace's law for a spherical elastic object, given by: Stress = Pressure x Radius/2 x Wall thickness. In addition, another biomechanical parameter used to describe an elastic sphere is the strain: Strain = delta R/Ri = (R-Ri)/Ri where R is the current aneurysm radius and Ri is the initial radius prior to aneurysm development. The stress and strain of an elastic structure are used to describe the elastic modulus, E: E = stress/strain = [PR/2h]/[(R-Ri)/Ri] = [PRRi]/[2hR-2hri]. It is assumed at this point that no additional tissue growth occurs through the developmental course of the aneurysm. The expression for E is now solved for Ri which, in essence, represents the radius of the aneurysm neck: Ri = [2hER]/[PR + 2hE]. Thus, the diameter of the neck, Dn, is given by Dn = 2 + i = 2 ([2hER]/[PR + 2hE]). During diagnostic angiography, the radius, R, and pressure, P, are easily obtained during the examination procedure. However, it is not possible to angiographically determine the elastic modulus, E, and the wall thickness, h. In this case, the following average values are used: E = 1.0 MPa and h = 50 microns. From the diagnostic angiograms and hospital records of 23 patients, the aneurysm neck size was determined using the biomathematical model and compared to the results obtained from the correlative relationship between the measured and accepted ratios of neck size to diameter of parent artery. The neck diameter as measured from the accepted ratios of neck size to parent artery diameter for the 23 patients ranged from 1.5 mm to 8.7 mm. The angiographically measured neck sizes were in excellent agreement with those obtained from the biomathematical model, particularly for the wide-necked aneurysms, as evidenced by the fact that all but two chi 2 values were < 1.0. We have described a simple yet accurate method for obtaining aneurysm neck size measurements from diagnostic angiograms using a biomathematical model. The model requires knowledge of only the aneurysm radius and blood pressure and becomes particularly important in characterizing wide-necked aneurysms [1].

1)
Hademenos GJ, Massoud TF, Viñuela F. Quantitation of intracranial aneurysm neck size from diagnostic angiograms based on a biomathematical model. Neurol Res. 1995 Oct;17(5):322-8. PMID: 8584121.