Design of Novel Catheter Insertion Device

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Poor positioning of needles and catheters may result in repeated attempts at correct placement, injury to adjacent structures or infusions into inappropriate spaces. Existing catheter insertion methods do not uniformly provide feedback of the tip location, nor prevent the needle from going beyond the target space. The purpose of this research was to develop a design tool to be used to create a new catheter insertion device. This device would advance a needle in firm tissue but automatically release it upon entrance into the desired space. The system studied consisted of a flexible filament (OD ~0.9 mm) in compression passing through a tube (ID 1.22 mm) with both straight and curved sections. A mathematical model based on oil drilling methods was developed to predict the compressive force dissipated in the filament for any given tube geometry. A correction factor on one of the two terms in the model was necessary to achieve best results, but proved to be accurate for all 100+ tests completed. With it, this model accounted for the following parameters: Angular displacement of tube bends, radial clearance, coefficient of friction, lengths, tube and filament radii, number of bends, moment of inertia, and modulus of elasticity. Implementation of this model should allow for a more safe and effective catheter insertion device.