In this study, we introduce a new experimental approach to characterize the forces emerging from simulated catherization. This setup allows for a linear translation of urinary catheters in vertical direction as controlled by an actuator. By employing silicone-based elastomer with a duct of comparable diameter with catheters as urethra model, sliding contacts during the translation of catheters along the duct is generated. A most unique design and operation feature of this setup is that a digital balance was employed as the sensor to detect emerging forces from simulated catherization. Moreover, the possibility to give a variation in environment (ambient air vs. water), clearance, elasticity, and curvature of silicone-based urethra model allows for the detection of forces arising from diverse simulated catherization conditions. Two types of commercially available catheters varying in tubing materials and surface coatings were tested together with their respective uncoated catheter tubing. The first set of testing on the catheter samples showed that this setup can probe the combined effect from flexural strain of bulk tubing materials and slipperiness of surface coatings, both of which are expected to affect the comfort and smooth gliding in clinical catherization. We argue that this new experimental setup can provide unique and valuable information in preclinical friction testing of urinary catheters.