Abstract:

BACKGROUND: Peripheral intravenous catheter placement is frequently unsuccessful at the first attempt. One suggested risk factor is a small vein size, because of the consequences of mechanical forces generated by the needle tip. We developed short bevel needles with a very thin tip and evaluated their puncture performance in two in vitro models.

METHODS: Peripheral intravenous catheters with a new needle ground using the lancet method (experimental catheter (L)) or backcut method (experimental catheter (B)) were compared with a conventional peripheral intravenous catheter (Surshield Surflo®) in a penetration force test and a tube puncture test. Penetration forces were measured when peripheral intravenous catheters penetrated a polyethylene sheet. The tube puncture test was used to evaluate whether the peripheral intravenous catheters could puncture a polyvinyl chloride tube at two positions, at the center and at 0.5 mm from the center of the tube.

RESULTS: Mean penetration forces at the needle tip produced by experimental catheters (L) (0.05 N) and (B) (0.04 N) were significantly lower than those produced by the conventional catheter (0.09 N) (p < 0.01). At the catheter tip, mean forces produced by experimental catheter (B) and the conventional catheter were 0.16 N and 0.26 N, respectively (p < 0.05). In the tube puncture test, the frequency at which the conventional catheter punctured the center-shifted site on the tube at an angle of 20° and speed of 50 mm/min was low (40%). In contrast, experimental catheters (L) and (B) were 100% successful at puncturing both the center and center-shifted sites at 20°.

CONCLUSION: Puncture performance was comparable between the lancet-ground and backcut-ground needles except for penetration forces at the catheter tip. The experimental catheters produced lower penetration forces and induced puncture without target displacement at smaller angles compared with the conventional catheter. Therefore, optimization of the needle can prevent vein deformation and movement, which may increase the first-attempt success rate.

Reference: