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Transient numerical modelling of impact driven needle-free jet injectors[1] YATISH RANE, JEREMY MARSTON, Texas Tech University — Instead of using a thin metal rod i.e., needle to puncture the skin, intradermal needle-free jet injectors (NFJI) use the liquid drug itself to pass the skin barrier. The impact driven NFJIs generate a high-speed liquid jet using an actuation sources such as compressed spring, pressurized air, or explosive charge. There are two phases of jet injection i.e., initial high-pressure impulse phase and constant jet speed injection phase. The high-pressure (10^6 Pa) impulse can adversely affect needle-free jet injector components such as plastic cartridges/nozzles and reduce their lifespan. This high-pressure impulse can also cause cavitation and damage the drug sample or device slippage from the targeted delivery area. Transient simulations are performed to study the role of nozzle geometry and fluid rheology on system properties such as jet exit velocity, peak stagnation pressure. We observe that the peak stagnation pressure increases significantly with increasing fluid viscosity. By studying a range of nozzle geometries such as multi-tier tapers and asymmetric sigmoid contractions, we see that the power of actuation sources and nozzle geometry can be tailored to deliver drugs with different fluid viscosities in the intra-dermal region of skin.

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