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Effect of system compliance and indenter geometry on puncture mechanics of soft materials SHRUTI RATTAN, SAMI FAKHOURI, ALFRED CROSBY, Univ of Mass - Amherst — Puncture mechanics in soft materials is critical for the development of new surgical instruments as well as new materials used in personal protective equipment. However, fundamental knowledge of how geometry and material properties control the nucleation of a crack, i.e. puncture, at large deformations in a soft material is currently limited. We describe a simple experimental method to study the resistive forces and failure of a soft gel being indented and punctured with a small needle. We show that puncture stresses can reach two orders of magnitude greater than the material modulus and that the force-deformation response is insensitive to the geometry of indenter at large indentation depths. We determine a transition between stress-limited and energy-limited failure modes, which is governed by the indenter size and the balance between fracture energy and cohesive stress. In addition, we examine the influence of system compliance on puncture of soft gels. It is well-known that system compliance influences the peak force in adhesion and traditional fracture experiments; however, its effect on crack nucleation is unresolved. We find that as the system becomes more compliant lower peak puncture forces were measured, which is associated with increased energy available for fracture.

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