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Evaluating compressive properties and morphology of expandable polyurethane foam for use in a synthetic paediatric spine

Abstract

An expandable rigid PU foam can turns into complex shapes, with a shell like structure on the outside and honeycomb structure on the inside, which can be easily shaped to a vertebra form. The present study aims to determine whether expandable rigid polyurethane foam was an appropriate substitute for rigid block polyurethane foam to model the trabecular bone. Static compression tests were performed to determine compressive moduli and yield stresses on three polyurethane foam densities namely 0.16 g/cm^3, 0.24 g/cm^3 and 0.42 g/cm^3. Morphology of the PU foams for all densities was also observed. The compressive modulus for 0.16 g/cm^3 and 0.24 g/cm^3 were found varied from 40 to 43 MPa and 83 to 92 MPa while yield stress ranged from 2.1 to 2.3 MPa and 3.4 to 4.8 MPa respectively. As for 0.42 g/cm^3, the compressive modulus and yield stress varied from 240 to 256 MPa and 38 to 40 MPa. Based on these results, the compressive modulus and yield stress of 0.24 g/cm^3 compared favourably with rigid block PU foam and human cadavers presented in the literatures. Hence, the findings of this study could potentially be used in developing a synthetic vertebral trabecular bone of paediatric spine for biomechanical testing.

Keywords

Compressive properties; Polyurethane foam; Synthetic spine; Trabecular bone