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Impact energy absorption of three mouthguard materials in an aqueous environment

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Abstract — High impact energy absorption is an essential property for mouthguard materials. The impact test performance of three popular mouthguard materials was evaluated, using the procedure in American Society for Testing and Materials (ASTM) Standard D3763. Conventional ethylene vinyl acetate (EVA; T&S Dental and Plastics, Myerstown, PA, USA) served as the control. Pro-form™ (Dental Resources Inc., Delano, MN, USA), another EVA material, and PolyShok™ (Sportsguard Laboratories, Kent, OH, USA), an EVA product containing polyurethane were also evaluated. Specimens having dimensions of 3 inch × 3 inch × 4 mm were prepared from each material. After processing that followed manufacturer recommendations, specimens were conditioned for 1 h in 37°C deionized water and loaded at 20 mph by a 0.5 inch diameter indenter containing a force transducer (Dynatup Model 9250 HV; Instron Corp., Canton, MA, USA). Both large-diameter (3 inches) and small-diameter (1.5 inch) support rings were used. For comparison, two specimens of each material were tested in the dry condition. Energy absorption was determined from the area under the force–time curve at 30 ms, and results for the water-conditioned specimens were compared using ANOVA and the Kruskal–Wallis test. For the large-diameter support ring, energy absorption (mean ± SD in ft·lbf inch⁻¹), normalized to specimen thickness, was: EVA ($n = 5$), 110.2 ± 48.4 ; Pro-form™ ($n = 4$), 110.0 ± 11.3 ; PolyShok™ ($n = 5$), 105.7 ± 16.5 . For the small-diameter support ring, energy absorption was: EVA ($n = 6$), 140.5 ± 13.9 ; Pro-form™ ($n = 5$), 109.0 ± 26.0 ; PolyShok™ ($n = 6$), 124.4 ± 28.4 (1 ft·lbf inch⁻¹ = 0.534 J cm⁻¹). Because of substantial variation within some specimen groups, there was no significant difference in energy absorption for the three water-conditioned mouthguard materials and the two support ring sizes. The energy absorption for each material was much greater for other specimens tested in the dry condition.

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