Viscoelastic Properties and Molecular Weight of Hylan G-F 20 Compared with Other Commercial Hyaluronan Based Viscosupplements

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Purpose: Viscosupplementation with hyaluronan (HA)-based products has been used clinically to provide relief of pain due to osteoarthritis. This study compared the rheological properties and molecular weight (MW) of hylan G-F 20 (Synvisc® or Synvisc-One®) to several commercially available HA containing viscosupplements (VS). The percent elasticity was evaluated as a function of molecular weight. Analgesic properties of VS products are believed to be at least partially a function of elasticity within the joint space.

Methods: Rheological properties were characterized using a controlled stress rheometer. The viscosity at shear rate 1 sec^-1 (η(1)) was also determined. Size exclusion chromatography (SEC) with multi-angle laser light scattering (MALLS) was used to provide a direct determination of average molecular weight (MW) and concentration of soluble HA. Each VS was diluted and centrifuged to separate the gel phase (if any), then the supernatant was analyzed by SEC/MALLS.

Results: The viscoelastic properties, percent elasticity, gel/liquid concentrations, and soluble HA MW for the VS products are listed in the table below. Values for human synovial fluid, obtained from the literature, are also listed. Hylan G-F 20 shows much higher viscoelasticity as demonstrated by its low crossover frequency (<0.01 Hz), low phase angle (<25°), and high shear viscosity and percent elasticity. Of the products tested, Synvisc also showed the highest percent elasticity, being similar to healthy young synovial fluid. All products, except Monovisc®, have similar total HA concentrations; however, hylan G-F 20 showed the highest percent elasticity, as demonstrated by its low crossover frequency (<0.01 Hz), low phase angle (<25°), and high shear viscosity and percent elasticity. Of the products tested, Synvisc also showed the highest percent elasticity, being similar to healthy young synovial fluid. All products, except Monovisc®, have similar total HA concentrations; however, hylan G-F 20 showed the highest percent elasticity, as demonstrated by its low crossover frequency (<0.01 Hz), low phase angle (<25°), and high shear viscosity and percent elasticity. Of the products tested, Synvisc also showed the highest percent elasticity, being similar to healthy young synovial fluid.