Does The Needle Size Modify The Rheological Properties Of Mannitol-Modified Hyaluronic Acid Viscosupplements During Viscosupplementation?

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BACKGROUND

Viscosupplementation (VS) by intra-articular (IA) injections of Hyaluronic Acid (HA) is widely used for treating osteoarthritis (OA) of the knee, the hip, ankle, shoulder and trapeziometacarpal joints. Thus, the needle size (diameter and length) has to be adapted to the joint in which HA will be injected. HA being a macromolecule, it might be structurally altered according to the needle size during IA injection.

OBJECTIVES

To assess the dynamic viscosity (η) of mannitol-modified HA viscosupplements after injection through different types of needle.

MATERIAL & METHOD

- A cross-linked HA (16 mg/ml) HANOX-M-XL (HAppyCross® LABRHA SAS, Lyon, France).
- A linear HA (MW: 1-1.5 MDa; 15.5 mg/ml) HANOX-M (HAppyVisc® LABRHA SAS, Lyon, France).
- Both combined with high concentration of mannitol (35 mg/ml).
- Three types of needles (21Gauges x 1.5” L40 mm; 22G x 3.5” L90 mm; 25G x 1” L25 mm) were compared. A measure without needle has been performed as a control.
- The dynamic viscosity η was measured according to the shear rate γ from 0.1 to 100 s^{-1} using a cone-plate rheometer (RheoWin HAAKE Viscotester iQ Air, Thermo Electron SAS) at 20° C.

RESULTS

The dynamic viscosity η was not statistically modified according to the needle length and diameter.

		w/o needle	21G x 1.5” L40 mm	22G x 3.5” L90 mm	25G x 1” L25 mm	p-value
HANOX-M-XL	**Mean η (Pa.s) γ = 0.5 s^{-1}**	**104.5**	**110.8**	**108.2**	**107.2**	**0.79**
	SD	*3.8*	*9.2*	*2.7*	*7.1*	
	Mean η (Pa.s) γ = 50 s^{-1}	**4.7**	**5.2**	**5.0**	**5.1**	**0.84**
	SD	*0.3*	*0.1*	*0.2*	*0.1*	
HANOX-M	**Mean η (Pa.s) γ = 0.5 s^{-1}**	**33.9**	**34.2**	**33.2**	**34.6**	**0.91**
	SD	*2.7*	*4.1*	*4.0*	*2.6*	
	Mean η (Pa.s) γ = 50 s^{-1}	**4.0**	**4.1**	**4.0**	**4.2**	**0.98**
	SD	*0.1*	*0.2*	*0.1*	*0.1*	

Table : Dynamic Viscosity of HANOX-M-XL and HANOX-M at a shear rate of 0,5 and 50 s^{-1} according to different types of needles

As expected, the cross-linked HA was much more viscous than the linear one.

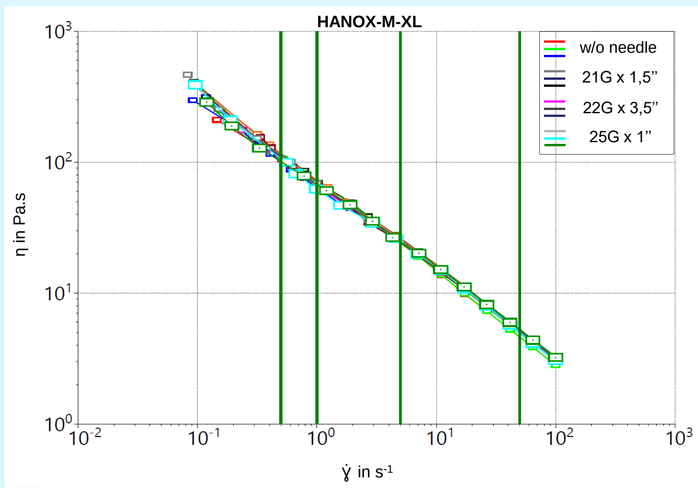

Figure 1 : Rheological Profile of HANOX-M-XL

HANOX-M-XL

- Mean η (SD) at a shear rate of 0.5 s^{-1} : **107.7** (*5.8*) Pa.s
- Mean η (SD) at a shear rate of 50 s^{-1} : **5.0** (*0.2*) Pa.s

HANOX-M

- Mean η (SD) at a shear rate of 0.5 s^{-1} : **34.0** (*2.1*) Pa.s
- Mean η (SD) at a shear rate of 50 s^{-1} : **4.0** (*0.1*) Pa.s

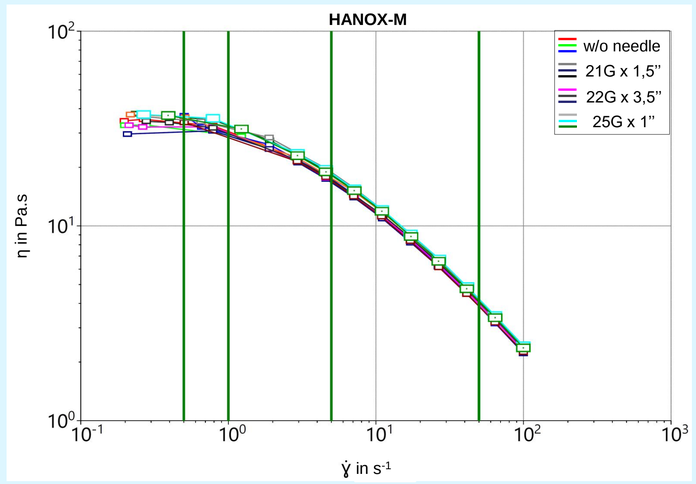

Figure 2 : Rheological Profile of HANOX-M

CONCLUSION

The needle length and diameter do not modify the rheological behaviour of HANOX-M-XL and HANOX-M. The viscoelastic properties depend on both HA MW and concentration. Since HA concentration is not modified, our results demonstrate that HA is not depolymerized during the injection procedure, regardless of the needle characteristics.