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LETTER TO THE EDITOR

Reply: Comparative Rheology of Hyaluronic Acid Fillers, Poly-L-lactic Acid, and Varying Dilutions of Calcium Hydroxylapatite

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Dear Sir,

Thank you for the opportunity to address the commentary by Hicks and Öhrlund[1] regarding our recently published study "Comparative Rheology of Hyaluronic Acid Fillers, Poly-L-lactic Acid, and Varying Dilutions of Calcium Hydroxylapatite."[2] Although we appreciate their engagement with our work, the authors seem to misunderstand the very physicochemical nature of viscoelasticity and selectively offer a reductionist view of the importance of viscoelastic parameters on the broad clinical application of dermal fillers, dilute or otherwise.

Hicks and Öhrlund's assertion that the biphasic nature of approved calcium hydroxylapatite-carboxymethylcellulose (CaHA-CMC) products precludes their classification as gels/viscoelastic materials, or as being suitable for rheometric analysis, is fundamentally incorrect and, in fact, contradicts the authors' own work.[3] CaHA-CMC is a composite gel with inherent viscoelastic properties that are key to its performance as an injectable implant. The authors' characterization of CaHA-CMC mixtures as "adding rocks to a gel" overlooks the complex electrostatic and physical interactions that occur between entangled CMC polymers and CaHA microspheres. These interactions enhance the mechanical strength and cohesion of composite gels, directly impacting their viscoelasticity.[4] Resultantly, not only is rheometric testing appropriate for the evaluation of these products—just as it is for particulate hyaluronic acid (HA) gels consisting of viscoelastic solid particles within a fluid carrier—but also represents a standard for the evaluation of composite gels in biomaterials research across the medical, pharmaceutical, and cosmeceutical industries. We invite the authors to also consider viscoelasticity in other composite and noncolloidal systems, such as filled polymer melts and glass-forming fluids, given their suggestion that it is exclusive to simple gels.

Additionally, it is concerning that the authors chose to deride as "irrelevant" the value of our rheometric characterization of product mixtures involving product dilution—a growing clinical practice—due to the temporary nature of a product component. Viscoelastic parameters, rheometrically or haptically characterized, have served as a guide to clinicians in the immediate periprocedural period, governing a material's injectability, moldability, and tactile qualities. The authors' particular focus on CaHA-CMC's carrier phase degradation intentionally overlooks the comparable degradation of uncrosslinked/extractable hyaluronic acid in HA, and collagen in collagen/polymethylmethacrylate composites, with all filler products ultimately behaving as particulate additives to the extracellular matrix. Their suggestion that clinicians should overlook the rheometric parameters of filler products because they undergo physicochemical alterations postimplantation ignores the procedural importance of these parameters to practitioners.[5]

Finally, the authors' criticism of our use of published rheometric data on HA gels, labeling it as misleading and biased, is unfounded. The comparative assessment of rheometric parameters has been a standard in dermatological research for 2 decades, aiding clinicians in discerning between product attributes. Our inclusion of HA product parameters serves as a physical reference framework for comparison with the mechanical properties of various dilutions of CaHA-CMC, which already have shown clinical applicability, efficacy, and longevity.[6,7] This use of HA gel comparisons is intended as a guide and does not claim biochemical equivalence between products, serving instead to highlight the attenuation in gel strength and cohesion through dilution. This rationale also underlies our inclusion of poly-l-lactic acid solutions—not because they are viscoelastic mixtures, as the authors suggest—but because they are noncohesive and nonelastic. The dilutional reduction of product cohesion is relevant, as it is known to enhance CaHA-CMC biointegration, favoring its biostimulatory capabilities.[6] Given these aspects, we find that our characterization of diluted product parameters is both clinically relevant and objectively informative.

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DISCLOSURES

Dr. Soares is a speaker and trainer for Revance Therapeutics, Inc. and conducts research with Merz Aesthetics. Dr. McCarthy is employed by Merz Aesthetics, Inc. Dr. Chadawarkar is a paid clinical consultant and shareholder for Cypris Medical and Allergan Aesthetics, an Abbvie Company, and is a paid speaker for Merz

Aesthetics. The other authors have no financial interest to declare in relation to the content of this article.

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