Biostimulating Soft Tissue Fillers : An Update

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Introduction

Biostimulating soft tissue fillers have gained significant traction in aesthetic medicine due to their ability to enhance facial volume and stimulate collagen production. Among the most prominent fillers in this category are calcium hydroxyapatite (CaHA), poly-L-lactic acid (PLLA), poly-D,L-lactic acid (PDLLA), and polycaprolactone (PCL). These fillers not only provide immediate volumization but also promote long-term skin rejuvenation through biostimulation of collagen synthesis. This literature review aims to explore the properties, rheological characteristics, and clinical applications of these fillers, with a focus on brands with biggest market share.

Calcium Hydroxyapatite (CaHA)

Calcium hydroxyapatite, particularly in the form of Radiesse, is a widely used biostimulator in aesthetic treatments. It is composed of calcium hydroxylapatite microspheres suspended in a gel carrier, which facilitates its injection and immediate volumizing effect. The high viscosity and elasticity of CaHA allow for effective lifting and contouring of facial tissues, making it a preferred choice for deeper injections, such as in the cheeks and jawline (Schnorr et al., 2022; Aguilera, 2023).

Research indicates that CaHA not only provides immediate volume but also stimulates collagen production, leading to longer-lasting results compared to hyaluronic acid fillers (Adel, 2023; Bravo et al., 2023).

The rheological properties of CaHA are characterized by its high viscosity, which contributes to its ability to maintain structural integrity post-injection. Studies have shown that CaHA exhibits a unique sonographic pattern, appearing as hyperechoic bands on ultrasound, which can be useful for assessing filler placement and longevity (Urdiales-Gálvez et al., 2021; Wortsman et al., 2023). Additionally, the filler has been noted for its biocompatibility and low incidence of adverse reactions, although there are reports of granulomatous reactions in some cases (Ilaria, 2023; Chou et al., 2015).

Poly-L-Lactic Acid (PLLA)

PLLA, marketed primarily as Sculptra, is another prominent biostimulator known for its ability to induce neocollagenesis. Unlike traditional fillers that provide immediate volume, PLLA works gradually, stimulating collagen production over time. This property makes it particularly effective for treating volume loss in areas such as the temples and cheeks (Othman et al., 2019; Christen, 2022). The rheological profile of PLLA is distinct, as it is typically less viscous than CaHA, allowing for smoother injection and distribution within the tissue (Chen et al., 2020; Lin & Lin, 2021).

Clinical studies have demonstrated that PLLA can lead to significant aesthetic improvements, with effects lasting up to two years post-treatment (Chen et al., 2015; Zhao et al., 2019). The filler is often diluted with a sterile diluent before

injection, which can affect its rheological properties and the overall outcome of the treatment (Chen et al., 2020). Importantly, PLLA has been associated with a low incidence of complications, although some patients may experience delayed onset nodules, which can be managed with appropriate techniques (Strawford, 2017; Chen et al., 2015). PLLA as Sculptra has particles with sharp edges which will stimulate scar tissue more than native collagen. More recent spherical PLLA formulations are coming to market to mitigate this drawback. Overall PLLA has higher collagen stimulating effect than CAHA or HA

Poly-D,L-Lactic Acid (PDLLA)
PDLLA is a variant of PLLA that has been explored for its potential in aesthetic applications. While less commonly used than PLLA, PDLLA shares similar properties in terms of biostimulation and collagen induction. The filler is designed to provide gradual volume restoration and improve skin texture over time (Christen, 2022; Lin & Lin, 2021). Its rheological characteristics are comparable but more subtle to PLLA, allowing for effective injection and integration into the surrounding tissues. Research on PDLLA is still emerging, but initial findings suggest that it may offer many similar benefits to PLLA in terms of longevity and patient satisfaction (Chen et al., 2020; Zhao et al., 2019). However, further studies are needed to fully establish its efficacy in aesthetic applications. The open sphere structure of emerging PDLLA formulations may open new avenues for enhanced collagen stimulation and addition of regeneration promoting agents.

Polycaprolactone (PCL)

PCL, particularly in the form of Ellanse, represents a newer generation of biostimulating fillers. It is composed of a PCL polymer matrix that provides both immediate volume and long-term collagen stimulation. Ellanse is unique in that it offers a range of formulations with varying durations of effect, allowing practitioners to tailor treatments to individual patient needs (Ding, 2023; Park et al., 2022; Chen, 2024).
The rheological properties of PCL fillers are characterized by their elasticity and ability to maintain shape, which is crucial for achieving natural-looking results (Goodwin, 2018; Chen, 2024). Clinical studies have highlighted the effectiveness of PCL in treating various facial areas, with results lasting up to two years or more (Zhao et al., 2022; Angelo-Khattar, 2022). The filler has been associated with minimal downtime and a favorable safety profile, although some patients may experience mild pain and or swelling at the injection site (Ortiz-Álvarez et al., 2021; Huang & Ng, 2022). Higher G prime versions may be associated with capsule formation.
The versatility of PCL makes it an attractive option for practitioners seeking to provide comprehensive facial rejuvenation. PCL has it’s biggest marketshare in Asia

Comparative Analysis of Rheological Properties
The rheological properties of these biostimulating fillers play a critical role in their clinical applications. CaHA exhibits high viscosity and elasticity, making it suitable for deeper injections and providing significant lifting effects. However, diluted CAHA is an excellent option for the superficial areas such as neck , decollete and hands.

In contrast, PLLA and PDLLA are characterized by lower viscosity, allowing for smoother injection and gradual volume restoration (Schnorr et al., 2022; Chen et al., 2020).
PCL fillers, while also exhibiting elasticity, offer a unique combination of immediate volume and long-term collagen stimulation, making them versatile for various aesthetic treatments (Ding, 2023; Goodwin, 2018).
Understanding the differences in rheological properties and safety profile is essential for practitioners when selecting the appropriate filler for specific indications.
For instance, CaHA may be preferred for immediate of volumizing deeper facial structures and superficai structures in diluted form, while PLLA and PDLLA may be more suitable for areas requiring gradual enhancement and skin texture improvement (Adel, 2023; Christen, 2022; Chen, 2024).

Clinical Applications and Popular Fillers

Radiesse, as a CaHA-based filler, is widely used for facial contouring and volumization, particularly in the cheeks and jawline. Its ability to stimulate collagen production makes it a popular choice for patients seeking long-lasting results (Aguilera, 2023; Santos et al., 2020).
Sculptra, on the other hand, is favored for its gradual approach to volume restoration, making it ideal for treating age-related volume loss in the temples and cheeks (Othman et al., 2019; Christen, 2022).
Ellanse, with its customizable duration of effect, has gained popularity for its versatility and effectiveness in various facial areas (Ding, 2023; Park et al., 2022), especially in Asia

Estefil, while less discussed in the literature, is another filler that combines biocompatibility with effective volumization. It is often used in conjunction with other fillers to achieve optimal results in facial rejuvenation (Santos et al., 2020; Zhevlakova, 2024).

The choice of filler ultimately depends on the patient's aesthetic goals, the specific area being treated, and the practitioner's expertise.

Conclusion

In summary, biostimulating soft tissue fillers such as calcium hydroxyapatite, poly-L-lactic acid, poly-D,L-lactic acid, and polycaprolactone offer diverse options for facial rejuvenation. Each filler possesses unique rheological properties and clinical applications, making them suitable for different aesthetic goals.

As the field of aesthetic medicine continues to evolve, ongoing research will further elucidate the efficacy and safety profiles of these fillers, ultimately enhancing patient outcomes.

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