

Polylactic Acid the holy grail of anti-aging?

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Abstract

Polylactic acid is an effective safe and long-lasting product. It produces significant neo-collagen in extra cellular matrix. A large variety of aesthetic concerns can be addressed with these products. Currently in the UK there are four products available and licensed. Sculptra and Lanluma (Poly-L-lactic acid). Lenisna and Juvelook (Poly-D-L-lactic acid). There are significant differences between the two enantiomers and each product has its own characteristics. Despite some bad publicity in the past these products used properly are safe and significant side effects are rare.

Discussion

Natural long-lasting results are the holy grail of anti-aging. Polylactic acid is a product that might be classed as a “holy grail” treatment

Polylactic acid is a synthetic alpha hydroxy acid polymer, biodegradable, biocompatible, and immunologically inert [Narins et al 2010]. It causes stimulation of neo-collagenases by triggering a foreign body reaction to the injected material, resulting in a controlled cellular inflammatory response, which activates fibroblasts to produce autologous collagen [Bohnert, Dorizas, Lorenc Sadick 2019]. This results in a natural and semi-permanent correction of facial volume loss associated with aging.

Polylactic Acid is recommended for increasing skin tightness secondary to aging. It is effective for improving wrinkles, creases, scars, and other changes caused by aging and volume loss. It is injected into supraperiosteal, subcutaneous, and subdermal layers to produce optimal results in facial rejuvenation by improving skin quality, firmness, and facial contour (Akinbiyi et al 2020)

Are all Polylactic acid products the same?

Polylactic Acid is available in the UK as injectable products Lanluma, Sculptra (poly-L-lactic acid) and Lenisna and Juvelook (poly-D-L-Lactic acid). There are some differences in the two substances PLLA is an irregular shaped particle 40-65um across and is combined with methylcellulose. PDLLA is a spherical particle with micropores 10-70um across and is combined with hyaluronic acid. (Chen SY, Lin JY, Lin CY. 2020). PDLLA has a more significant volume-restoring effect because PDLLA occupies a larger volume than PLLA for the same weight due to its microporous spherical structure (Oh S, Seo SB,

Kim G, et al.. 2023). PDLLA demonstrates superior mechanical stability and biocompatibility compared to poly(D-lactic acid) (PDLA) and poly(L-lactic acid) (PLLA), primarily due to its unique structure. Firstly, it prevents the formation of large crystalline regions typical of PDLA and PLLA. Crystalline regions can render polymers brittle and prone to cracking under stress. In contrast, the lack of crystallinity in PDLLA results in a more uniform and flexible material, enhancing its mechanical stability and reducing susceptibility to mechanical failure.

Secondly, PDLLA degrades in a more controlled and predictable manner compared to the more crystalline PDLA and PLLA. The homogeneous distribution of D- and L- monomers in PDLLA allows for a uniform hydrolytic degradation process. This controlled degradation is crucial in biomedical applications where the timing of polymer breakdown affects the release of therapeutic agents and the healing process.

Thirdly, the amorphous nature of PDLLA also contributes to its better biocompatibility. Crystalline polymers can elicit more significant inflammatory responses due to the presence of sharp crystalline fragments during degradation. In contrast, a more gradual and uniform degradation of PDLLA produces smoother degradation products, less likely to provoke an adverse immune response. Additionally, PDLLA's degradation products, primarily lactic acid, are naturally metabolized by the body, further enhancing its biocompatibility. (Lee KWA, Chan LKW, Lee AWK, Lee CH, Wong STH, Yi K-H 2024)

Juvelook has a smaller particle size 20-50um and can be used peri ocularly and intradermally as a skin booster. This makes it unique.

Lin J. Y., Fu J. P., Hsu N. J., and Lin C. Y. (2023) described difference in the volumisation effect of PDLLA compared with PLLA. PDLLA due to its structure creates earlier volume effect which after several months stays static. PLLA has less early effect but "catches" up PDLLA over time. Later results although no comparative studies have been performed are probably fairly similar.

Polylactic acid preparations are not exactly the same and it seems likely that PDLLA may confer some clinical advantages although as yet this has not been demonstrated by comparative studies.

Does Polylactic acid work?

Polylactic acid is proven to create collagen and there are numerous studies which demonstrate aesthetic improvements as a result.

There have been high levels of patient satisfaction with the results of PLLA (Sculptra) treatment in both in both healthy (Fabi, S et al 2024) and HIV infected individuals (Moyle et al 2006).

Initially used in HIV patients its use was extended to include healthy patients. There have been many studies demonstrating its safety and efficacy of PLLA (Brant et al 2011) (Bohnart et al 2019). Indeed most of the studies have been conducted using Sculptra.

One study showed an increase in type 1 collagen after six and nine months following 3 sessions at monthly interval of PLLA (Goldberg et al 2013). Another split study on the upper knee demonstrated increased collagen at day 56 after 3 treatments lasting at least until day 168 (Kollipara et al 2020). Another study showed results of volumisation of sunken cheeks in Asians 24 months after treatment with PLLA 3 sessions with a high degree of patient satisfaction (Suh et al 2014). Interestingly in a split face study there was no difference in collagen production at twelve weeks between one cheek being injected at weeks 0,4,8 and one at 4,8. (Byun et al 2015).

One study (Ting et al 2024) found the effect of PDLLA equal to that of HA filler after 24 weeks. Ma et al 2024 showed significant improvement in dorsum of hands with PDLLA. Another study using PDLLA showed the biostimulatory effect increasing elastic and collagen fibres after one week and increasing more later (Perez Willis, K.2024)

Juvelook (PDLLA) one study showed (Seo et al 2023) showed significant improvement with 2-3 sessions creating increased collagen and elastic fibres with superficial dermal injections.

It appears that all poly lactic acid products have significant effect on skin rejuvenation usually requiring 2-3 sessions of treatment. There are more studies relating to Sculptra than Lanluma or the PDLLA products which is related to its significantly longer existence in the market.

There are no comparative studies of the products nor consistency of method of administration or treatment protocol. For these reasons further research is required to develop protocols.

What dilution should I use?

Currently there are no comparative papers comparing dilution of products. However dilution recommended for Sculptra is 9ml (8ml water and 1ml lidocaine) and Lenisna (PDLA) 16-20ml (15-19ml water + 1ml-2ml lidocaine). Juvelook a smaller particle size PDLA is 8ml (7ml water plus 1ml Lidocaine). Lanluma 16ml -20ml (15ml water plus 1-4ml lidocaine). Saline may be preferable to dilute PDLLA due to the osmolarity of the product.

More concentrated (less than 8ml) appears to increase the risk of nodule formation with Sculptra. Rossner, F., Rossner, M., Hartmann, V., Erdmann, R., Wiest, L.G. and Rzany, B. (2009).

What techniques should be employed?

There have been consensus papers suggesting techniques employed to inject polylactic acids (Lin MJ, Dubin DP, Goldberg DJ, Khorasani H.2019.) (Avelar L, Ong A, Ong D, et al. 2023)

There are a number of considerations. The age of the patient and the amount of volume loss are important. Most treatments of volume products are using a cannula. Juvelook is often delivered with a needle or mesogun or with a 27g cannula for the periocular area.

Over Sixties

For the over sixties a multi-layered approach is best that is to restore bony structure and treat both the deep fat and sub-dermal layers. For heavy faces is best to look for areas of volume loss and concentrate on lifting the mid and upper face behind the ligament line.

Forties and fifties

The areas to be concentrated on are patient dependant but injection into the temple and malar fat often provides lift and volume with a mixture of products such as PLLA and hyaluronic acids to rejuvenate the neck and décolletage

Younger patients

There is less volume loss in these patients. Most injections will be sub-dermal to subcutaneous and will be more targets to specific areas dictated by patient requirements.

What are the applications of these products?

Facial rejuvenation

Sculptra, Lanluma and Lenisna are all products designed to be used for volumisation of face by creating a subclinical inflammatory response leading to collagen deposition in the extra cellular matrix creating a controlled long lasting volumisation and reduction of fine wrinkles. (Herrmann JL, Hoffmann RK, Ward CE, Schulman JM, Grekin RC 2018). Juvelook is used mainly as a skin booster and for the periocular area due to its smaller particle size.

Neck and décolletage

These areas are often difficult. In patients with thin skin it is sometimes useful to treat initially with Juvelook intradermally then follow up with a more volumising product using a cannula. Wilkerson and Goldberg (2018) described successful treatment with polylactic acid (PLLA) in the décolletage area. Bolton et al (2011) also described treatment with good satisfaction in the décolletage area.

Use of cannulae is likely to lead to less bruising and are favoured treatment also Juvelook can be introduced intradermally with a needle.

Other body areas

These products(Sculptra, Lanluma and Lenisna) can be used for a variety of body areas to create more volume and improved elasticity. The dilution is usually 20ml in most large areas such as the buttocks. Shridharani SM et al 2021 and others have described treatment using polylactic acid for body contouring.

Commonly treated areas are buttocks, abdomen, upper arms, knees and hands.

Acne scarring

The treatment of atrophic acne scars using both PLLA (E. Forbat, F. R. Ali, F. Al-Niaimi, 2018) and PDLLA is well established.

Using a needle to inject under the scar is effective usually 2-3 sessions at 6-8 week intervals although there is no consensus on what is the best protocol.

Rho et al (2023) described the treatment of atrophic acne scars with a needle free injection with PDLLA in acne scars with high level patient satisfaction and this is likely to be the future direction of travel.

An MK et al (2020) used polylactic acid combined with RF microneedling to produce superior results to RF microneedling alone in atrophic acne scars

Whilst polylactic acid alone is useful in treating acne scarring the use of combination treatments is likely to produce optimal results.

Stretch marks

Seo et al (2023) described the successful use of PDLLA using laser induced microjet injection to improve stretch mark appearance. Ribero et al (2018) described the successful use of PLLA in stretch marks.

Cellulite

Cellulite is characterized by topographic alterations of the surface relief of the skin with depressed areas due to thick subcutaneous septae and raised zones due to the projection of underlying fat to the surface of the skin. This can be treated with subcutaneous injection of polylactic acid Shridharani SM, Tisch GM, Ebersole TG, Moak TN, Edwartz C. 2021

Is polylactic acid safe?

No product is 100% safe but with correct techniques and dilutions unwanted effects can be reduced. In a Brazilian study complication rates with polylactic acids (Poly-L-lactic acid) were found to lower than that for HA fillers with the main issue to be nodules. The

rate of nodule formation was 3 times greater in non-physicians compared with physicians (Ilanhez M, Souza MB, Miot HA. 2022). This might suggest that technique is important.

Vascular occlusion

This remains a concern with both fillers, calcium hydroxyapatite and polylactic acid. Only hyaluronic acid fillers can be dissolved which reduces their risk of long-term sequelae. Use of large cannulae and careful slow injection are the best policy. There have been no reports of vascular occlusion with Juvelook due to its small particle size.

Nodules

There are two main types of nodule. Both are seen rarely following injection of polylactic acid.

Granuloma which is an exaggerated inflammatory response and occurs 6-24 months after injection. It tends to grow and cause skin discoloration. Histological confirmation is required. (Vleggaar D., Fitzgerald R., and Lorenc Z. P., 2014)

True nodules are anomalous accumulation of product due to bad technique or the action of muscles leading to accumulation. They tend to occur 1-2 months after injection. Narins (2008) described the techniques to avoid nodules with PLLA, namely massage for several days and deeper injection. It is not necessary to massage either Juvelook or Lenisna although directly after injection it is sensible to ensure even distribution of product by gentle massage. Wu, Goldman (2016) found no difference in treatment effect or nodule formation in PLLA following massage

Treatment of nodules is usually injection with saline, 5 FU and steroids (O'Daniel G. 2017) or surgical removal. PDLLA has a glass transition (when a substance becomes malleable) temperature of 38-39 degrees Celsius whereas PLLA it is 60 degrees Celsius. Use of RF microneedling can create a 39 degree environment in the skin. G. Jeong, J. Park, S. Shin, et al 2022 demonstrated resolution of a PDLLA (Lenisna) using an RF device.

Conclusion

Polylactic acid in its various forms is an effective safe and long-lasting product. It produces significant collagen within the extra-cellular matrix and has multiple uses within aesthetic medicine. It takes 8-12 weeks to start to produce collagen. Each product on the UK market differs. PLLA in the form of Sculptra has a longer track record of use. PDLLA may confer some advantages being more biocompatible and producing volume earlier. No comparative studies have been performed.

The glass transformation temperature of PDLLA should make nodule resolution easier. There is no consensus as to the volume of diluent required but 16-20ml may be

optimum. Proper reconstitution of the product and correct technique and placement will help to reduce nodule formation.

Juvelook is a product unique in the UK being a smaller particle it can be used intradermally and periorcularly and has no reported nodules.

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