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Basics of Dermal Fillers

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Currently, soft tissue augmentation with fillers is widely accepted as a treatment that can improve quality of life. Fillers are prepared from diverse materials including autologous implants, collagens, hyaluronic acid (HA), and biosynthetic polymers, and are marketed for cosmetic purposes[1]. Among these fillers, HA fillers are the most popular because of their volumizing effect, biocompatibility, and easy correction after treatment.

HA Filler

Naturally occurring HA is a glycosaminoglycan uniformly present throughout all living species in connective tissue, vitreous humor, synovium, and the dermis. HA is a polysaccharide composed of the disaccharide units of D-glucuronic acid and N-acetyl-D-glucosamine with ß(1→4) glycosidic linkages. HA is major component of connective tissues, especially the human dermis[2,3]. However, natural HA is rapidly degraded by enzymes and radicals that are present in the body. The half life of HA in human tissues generally ranges from 1 to 2 days, therefore, treating defects such as wrinkles by injection of free HA into skin is effective for less than a week[4]. Despite the excellent biocompatibility of HA, its time-dependent degradation is a serious drawback. To overcome the lack of persistence of free HA, HA-based dermal fillers are produced by chemical modification, namely crosslinking. HA can be crosslinked by using diverse cross-linking reagents such as 1,4-butanediol diglycidyl ether (BDDE), divinyl sulfone (DVS), or diazomethane. Among these agents, BDDE is the most popular cross-linking agent because of its safety and convenience[2,3]. Although HA fillers appear to be similar, their physical characteristics and methods of manufacture are not the same. Different HA fillers have different concentrations of HA, free (unmodified) HA, types and extents of crosslinking, and particle sizes. These factors contribute to other gel properties such as cohesiveness, gel hardness, the swelling ratio, which affect the quality of the final product, including its resistance to degradation and usage[2,5,6].

Among them, G′, a measure of gel stiffness that increases with the degree of crosslinking, estimates resistance to deformation, which in turn influences ease of injection and tissue-residence time. Gels with higher G′ can resist dynamic forces better during facial muscle movement, thus providing better potential lift and duration for the filler. This is useful in areas such as the Nasolabial Folds (NLFs) and marionette lines. Those with lower G′ are best suited to more static and superficial wrinkles and perhaps lips[7]. However, the low level of G′ may reduce the incidence of undesirable events caused by the filler injection. Usually, a lower degree of cross-linking and a lower G′ value facilitate ease of injection, fewer occurrences of lumps and bumps, and a lower risk for immune reaction that may possibly progress to the formation of a granuloma ora sterile abscess.

HA dermal fillers typically fall under two categories, monophasic or biphasic, based on variations in cross-linking[8]. Monophasic HA fillers are more cohesive, may not migrate as much following its injection. However, biphasic HA fillers are more easily customized, to obtain the appropriate particle size to suit the indication and the anatomical area being treated[9]. By in vitro and in vivo study, biphasic HA fillers have some advantages in hyaluronidase resistance, syringe ability and lower risk for over correction, while monophasic HA fillers may be more suitable for volume augmentation due to swelling capacity[10].

Upper Face Fillers

In forehead volume augmentation, injection of biphasic fillers are recommended for central part of forehead and monophasic fillers on both lateral sides would make it looks natural. Also due to anatomical differences between man and woman, fillers which can make natural are recommended to man who have less convexity on forehead.

Midface and lower face fillers

Note that many experts avoid using fillers altogether in the crow's feet area because of the increased likelihood of lumping and beading when a filler is used to treat skin overlying a sphincter muscle. On those occasions when filler is used to treat the crow's feet area, stiffer products should be avoided.

From the rheological perspective, midface filler with sufficient elastic modulus (G′) to withstand shearing and medium to high cohesitivy to resist compression forces. Lower face is subjected to mostly shearing and some mild compression forces, the ideal filler would have moderate G′ and low to medium cohesivity.

Nose, Chin and Fine Wrinkles Fillers

Because of skin and tight muscle tension over the prominent bony structure, the filler would have high cohesivity and high G′. In fine lines fillers, a filler with low cohesivity combined with low to medium G′ will make an ideal outcome[11].

Conclusion

Viscoelasticity and cohesivity play an important role in HA filler design, selection and clinical outcomes, as these rheological properties can make facial correction more predictable when the right product is used in the right place. Fillers with moderate to high elastic modulus (G′) can withstand shear stress better than those with low G′. Fillers with high G′ usually are harder and need to be placed in deeper planes to reduce implant palpability. Cohesivity is measure of the ability of the gel to resist compression/stretching. This is an important concept because fillers are consisted of multiple units of cross-linked HA in the form of visible particles or discrete units that adhere through noncovalent bonds. Fillers with high cohesivity are better suited for bulk facial volumization, whereas fillers with low cohesivity are easy to mold and tend to form thin even layers in the skin. This type of filler creates natural-looking correction of small skin folds.

Therefore, clinicians must familiarize themselves with the properties and the clinical nature of each filler and possess the technical proficiency to deliver optimal outcomes.

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