Volume loss versus gravity: new concepts in facial aging

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Purpose of review

The earliest techniques of facial rejuvenation have been continuously adapted to reflect changes in the understanding of the aging face. Significant, paradigm-shifting advances in this understanding have been made in recent years which have allowed application of specific therapeutic modalities, resulting in dramatically improved results over those achieved with traditional facial rejuvenation.

Recent findings

Pioneering work by several authors has shown that gravity is not the sole determinant of the aging face. These authors have demonstrated that volume loss, including that of soft tissue and bone, is at least equally important in the pathogenesis of the stigmata of aging. Rejuvenative techniques developed to reverse these atrophic changes have exhibited outstanding results. The consequence is an increasing emphasis on the use of volume restoration procedures to address the aging face.

Summary

Recent improvements in the understanding of the facial aging process have brought about newly refined techniques for facial rejuvenation, ushering in a new era of plastic surgery for the aging face which is being manifested by increasingly natural results.

Keywords

autologous fat grafting, gravity, lipoatrophy, volume loss

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Introduction

The recent years have born witness to some of the most exciting advances in the field of facial plastic surgery in modern times. The relentless quest for the ideal reversal of the stigmata of aging has led to observations which have challenged, and indeed largely overturned, traditional tenets of aging face theory. Armed with these observations, pioneers in the field have developed and honed novel, imaginative techniques in an attempt to provide the most natural rejuvenation ever achieved. Following a review of the current concepts in the aging face, including its bony foundation, muscular structure, ligamentous support, and skin, we focus on the changes in subcutaneous tissue with age. An overview of volume restoration is then presented, and we conclude with the approach now utilized in our practice – complementary use of volume restoration with more traditional procedures [1••] – and discuss how this approach reflects recent changes in understanding of facial aging.

Bone

Intriguing work has been put forth by Pessa and colleagues [2,3], which implicates a contribution of bony remodeling in the pathogenesis of the aging face. Using computed tomography, these studies demonstrated a posterior–inferior rotation of the facial skeleton toward the cranial base with age. This posterior remodeling is thought to further undermine midfacial support and projection, including that of the inferior orbital rim, and to contribute, therefore, to malposition of the lower eyelid with lateral bowing and scleral show.

In addition to the generalized bony remodeling described by Pessa *et al*., a particular area of bony atrophy which has been previously described by Mittleman [4] is the anterior mandibular groove. This area lies between the mentum and the body of the mandible, just anterior to the soft tissue of the jowl region. The corresponding soft tissue depression over the anterior mandibular groove has thus been termed the prejowl sulcus. Soft tissue atrophy occurs in the prejowl sulcus as well, exacerbating the depression caused by bony atrophy; neither is addressed by traditional facelifting techniques.

Muscle

Pervasive in the literature is the concept that muscle undergoes relaxation with aging. The orbicularis oculi and zygomaticus muscles have been among the most frequently cited, being credited in the past with roles in descent of the midface and having procedures developed

warranted to further elucidate the relative role of colloidal fluid loss in cutaneous aging.

Volume restoration

While the degree to which specific structures outlined above undergo atrophy in the face remains the subject of some debate, what has become increasingly clear is that volume loss plays a pivotal role in the development of stigmata of the aging face [1••,6,29,30•,31•,32]. No longer is there a domination of the dogma that the primary event is a gravity-induced sagging of all facial structures. Indeed, it is our position that gravity does nothing more than determine the direction in which the atrophic, deflated soft tissues hang. The effect is exaggerated by the lengthening of the skin envelope, secondary to the histologic changes outlined above. With this appreciation, the surgeon is able to choose from an increasing number of materials for soft tissue augmentation, both temporary and permanent [1••,29,31•,33].

Autologous fat grafting

Fat grafting has been used successfully for soft tissue augmentation since 1893 [34]. The early experiences, however, were such that, while fat produced more natural results than other available fillers [35], the longevity of the graft was disappointing. Even as recently as the late 1980s and early 1990s, well respected plastic surgeons were publicly denouncing fat transfer through injection [36–39]. Fortunately, with additional experience they adjusted their technique and obtained more encouraging results [40,41]. Surgeons have now been able to demonstrate qualitatively that fat grafting can create not only excellent changes in contour, but also long-lasting results [41–44]. There is, however, a relative paucity of quantitative data to support these findings. As a result, our group is currently evaluating the long-term volumetric changes in the face quantitatively with three-dimensional imaging analysis (Vectra 3D Imaging System; Canfield Imaging Systems, Fairfield, New Jersey, USA). Much of the credit for the improved success and longevity of autologous fat belongs to Coleman, who has encouraged atraumatic handling and methodical layering of the material to improve survivability [33,42,45••,46–49]. Current applications include not only cosmetic facial enhancements, but also traumatic deformities, hemifacial atrophy, HIV-associated lipodystrophy, postliposuction irregularities, and others [50].

In the senior authors' practice, fat transfer has been utilized for facial rejuvenation with very satisfying cosmetic results and longevity for the past 10 years, with minimal complications [1••]. Primary areas of treatment include the infraorbital region, anterior and lateral cheek, brow and upper eyelid, prejowl sulcus, and mandibular angle (Fig. 1). The use of fat grafting in these areas, in a complementary fashion with facelifting and blepharoplasty, has afforded rejuvenative results previously unattainable with standard techniques.

Figure 1 Pre- (left) and 4-year postoperative (right) images of a 56-year-old patient who underwent autologous fat grafting to the inferior orbital rims, cheeks, buccal regions, and prejowl sulci

A deep-plane facelift was performed 2 years following fat transfer to enhance the rejuvenative effect. Readily apparent is the volume restoration in the midface and jawline. Reproduced with permission from Lam *et al.* [1••].

In addition to the outstanding results of lipotransfer for volume restoration, surgeons have become increasingly interested in the apparent rejuvenative effects on the skin itself. Coleman [45••] has noted improved skin quality, with softening of wrinkles, decreased pore size, and improved pigmentation during the first year post-treatment. Topographical skin analysis systems such as the recently developed VISIA system (Canfield Imaging Systems) may determine whether the effect from fat grafting is an effective skin rejuvenation technique in comparison to chemical peels and laser resurfacing. Aside from effects on normal, aged skin, when fat has been grafted beneath depressed scars there was improvement not only in the depression, but also in the character of the scar itself, with an apparent transformation to normal-appearing skin [33]. Other authors have reported a diverse range of improvements in soft tissue conditions, including radiation damage, breast capsular contracture, damaged vocal cords, and chronic ulceration, as well as regrowth of calvarial bone [51–55]. While many of the exact mechanisms for these effects remain to be described, what seems to be at the center of these changes is the presence of stem cells in human adipose tissue. This has proven the most abundant source of stem cells in the body [56–57], and the coming years will undoubtedly yield further applications as our understanding improves.