Facial Rejuvenation: An Evolving World

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Abstract
The demand for facial rejuvenation has now spread from celebrities to common man. Complete facial rejuvenation not only refers to surgery, but also skin optimization. This is achieved via resurfacing to revitalize skin texture (using cosmeceuticals, lasers, chemical peels, dermabrasion), refilling depressions with fillers and fat transfer, and relaxing the muscles with botox to smooth wrinkles. The surgical component entails releasing and redraping descended facial tissues back to their original anatomical positions. In this article we shall discuss some of these minimally invasive modalities of facial rejuvenation.

Keywords: facial rejuvenation, aging, skin care, lasers, botox, fillers, surgery, wrinkles, cosmetic procedure

Introduction
Facial rejuvenation, the hypothetical reversal of the aging process, encompasses any cosmetic procedure, surgical or non-surgical, that restores a youthful appearance to the face. With continually advancing knowledge and refinement in surgical techniques, the oculofacial plastics field has become less invasive, keeping pace with the changing world of surgery to the mini or nano world.

Why do we need facial rejuvenation?
What is facial aging?
The basic shape of the face is determined by the hard tissues (bone, teeth, cartilage), while the overlying skin and soft tissues (fat, muscle, connective tissue) determine facial youthfulness. These cephalometric parameters change and descend with age and environmental influences. Specific tissues (fat, muscle, connective tissue) determine facial youthfulness. These cephalometric parameters change and descend with age and environmental influences. Specific changes, initially appearing in the upper face followed by the lower face and neck, can be considered within three different zones (upper, middle, and lower) of the face. In the upper third, the lateral eyebrows descend (brow ptosis) below the supraorbital rim, and further exacerbates upper lid skin hooding (dermatochalasis). Weakening of the orbital septum permits intraorbital fat prolapse, which manifests as eyelid fat bags. The levator aponeurosis becomes attenuated, resulting in upper eyelid ptosis. In the midface, fat absorption diminishes the smooth cushion between the lower lid and malar prominence, resulting in infra-orbital hollowing. The superficial musculoaponeurotic system (SMAS) becomes lax, and the malar fat pad, located over the zygomatic bone, descends inferiorly over the SMAS. It bulges against the fixed nasolabial crease and creates the illusion of deepening it. The corner of the mouth droops and develops a downward orientation. Labiomandibular folds (marionette lines) and jowls also become prominent. In the lower facial zone, there is descent of the chin and loss of the well-defined angle between the submandibular line and the neck. The anterior edge of the platysma separates and loses tone, creating anterior vertical bands. Fat is deposited in the submental area, leading to blunting of the cervicomental angle. In addition to the anatomic changes above, there is continuous aging at the skin level. The skin becomes dry, dull, thin, wrinkled, pigmented, and lax. Overexposure to sunlight and inadequate skin protection in the early years of life can accelerate this aging process.

How can we achieve facial rejuvenation?
Complete facial rejuvenation not only refers to surgery, but also skin optimization. This is achieved via resurfacing to revitalize skin texture (using cosmeceuticals, lasers, chemical peels, dermabrasion), refilling depressions with fillers and fat transfer, and relaxing the muscles with botox to smooth wrinkles. The surgical component entails releasing and redraping descended facial tissues back to their original anatomical positions.

The surgical options are:
Forehead and eyebrow lift: Long-lasting elevation of the eyebrows and the elimination of forehead rhytids are the ideal. In the endoscopic lift, dissection is carried out over the frontal bone down to the supraorbital rim to release the arcus marginalis. Resection of hyperdynamic corrugator and procerus muscles is performed if indicated. Care is taken to avoid dissecting the periorbital attachments between the corrugators that may lift the medial brow and result in a surprised look. Advantages of the endoscopic approach are minimal scars, decreased alopecia, less scalp sensory changes compared to conventional coronal lifting, and allows simultaneous rejuvenation of the forehead and eyebrows. The transpalpebral or internal browlift, ideal for mild to moderate brow ptosis, is a natural extension of eyelid surgery in which the descended lateral brow is secured above the supraorbital rim through the blepharoplasty incision. Lateral brow fat sculpting is less often performed as maintaining or restoring volume is crucial to creating a more youthful appearance, as opposed to a hollow look. Suborbicularis dissection is performed to 1.0-2.0 cm above the superolateral orbital rim. The retroorbicularis oculi fat (ROOF) at the level of the inferior brow hairs is anchored with suture to the frontal periosteum. Placement height to the periosteum is adjusted according to gender and the amount of brow ptosis.

Blepharoplasty: Blepharoplasty is derived from Greek “Blepharon” (eyelid) and “Plastos” (formation). Typical lid crease markings are 9-11 mm centrally from the lid margin in women, and lower at 8-10 mm above the margin in men.
respecting the rounder contour of the female lid crease as opposed to the flatter contour in males. After a skin-muscle flap is removed, any prolapsed orbital fat may be debulked by opening the orbital septum. However, with considerations of volume loss in the aging face, often it is more favourable to thermally sculpt mild to moderate fat prolapse with a radiofrequency or monopolar tip over an intact septum. Not only does this less invasive approach expedite surgery time and minimizes orbital hemorrhage as the septum is not violated, but it also creates a fuller youthful look to the eyelids by minimizing excess fat removal. (Figure-1).

For lower eyelid dermatochalasis with fat prolapse, the optimal minimally invasive technique entails transconjunctival resection or repositioning of fat pads, with or without skin excision and lateral suspension of the orbicularis oculi. The transconjunctival approach avoids an external scar and is optimal for younger patients with fat prolapse and negligible dermatochalasis. The everted palpebral conjunctiva of the lower lid is incised with several 4-5mm openings over the areas of prolapsed fat. Through these small pockets, the desired fat pads are isolated and debulked. These smaller incisions allow for faster recovery, less chance for eyelid retraction, and decreased postoperative chemosis and swelling. Again, the hollow look should be avoided by conservative removal of fat. In some cases, the fat pads can be isolated as pedicles that are transposed supraperiorly over the orbital rim to augment deep tear trough deformities. If there is associated skin laxity, excision of skin with lateral suspension of the orbicularis muscle is recommended. A subciliary skin incision extending to the orbital rim results in elevation of the cheek over the malar prominence. Face lifting has evolved significantly, from the era of total and composite rhytidectomy to minimally invasive techniques to plicate/resect the SMAS, and cannot be adequately covered in this overview. In the MACS (minimal access cranial suspension) lift, vertical suspension of the descended SMAS is achieved through plication with small incision external levator repair and internal conjunctivomullerectomy surgery. Involutional ptosis is corrected by levator advancement or resection via external or internal approaches. Small incision external levator surgery has the benefits of less scarring, decreased operative time, and maximum tissue preservation. This technique is ideal for ptotic lids with minimal dermatochalasis, and incorporates all the steps for external levator surgery through a minimal 8-12 mm crease incision. This minimal approach is technically more challenging and requires adequate prior experience with full incision levator surgery. For mild ptosis ranging 1-3 mm, aponeurotic surgery may be unpredictable or difficult. Posterior conjunctival and Muller muscle resection is ideal in such cases. It is based on the principle that levator plication occurs with advancement of Muller’s muscle. The eyelid is everted over a retractor and a predetermined amount of conjunctiva and Muller’s muscle excised using a Putterman clamp. The amount of resection is based on several available algorithms and a positive 2.5% phenyepherine test (increase in MRD1 by 1.5mm). This minimally invasive approach results in rapid healing, no scarring, and an excellent eyelid contour (Figure 3).

**Midface and small-incision face lifting:** Midfacial ptosis can be corrected in conjunction with eyelid surgery or with small-incision face lifting. Both open and endoscopic approaches have been well-documented. A simple technique of lateral suborbicularis oculi fat (SOOF) lifting and orbitomalar ligament suspension can be particularly useful when combined with eyelid surgery. This technique is simple, with less risk to surrounding neurovascular structures compared to techniques requiring periosteal elevation. Through a 10 mm lateral canthotomy incision, the inferior limb of the lateral canthal tendon is released, as well as the orbitomalar ligament in the preperiosteal plane over the inferolateral orbital rim. Superolateral suspension of the SOOF to the periosteum of the zygoma lateral to the orbital rim results in elevation of the cheek over the malar prominence. Face lifting has evolved significantly, from the era of total and composite rhytidectomy to minimally invasive techniques to plicate/resect the SMAS, and cannot be adequately covered in this overview. In the MACS (minimal access cranial suspension) lift, vertical suspension of the descended SMAS is achieved through plication with
purse string sutures and anchoring to the temporalis fascia through preauricular and temporal hair line incisions. Two to three purse string sutures are typically placed for correction of neck and lower face descent. For midfacial ptosis, an additional suture suspends the malar fat pad. For patients with severe facial aging and descent, minimally invasive approaches may not be adequate.

**Autologous Fat Transfer:** Similar to dermal fillers, fat transfer provides volume to areas of relative atrophy due to facial aging. It is natural, safe, and long lasting compared to some fillers. Fat is harvested from donor sites such as the flank, abdomen, or gluteal areas. The fat is allowed to sediment, rather than centrifuged, to separate intact fat cells from the ruptured fat cells (top oily layer) and serosanguinous layers. Small aliquots of 0.1-0.2 cc per site are then injected with 1 cc syringes to recreate fullness in the temples, upper and lower lids, glabella, cheeks, nasolabial folds, lips, and jaw line. Fat can also be harvested from the back as stem cell face lifting. Non surgical options are:

**Botox and fillers:** These non-invasive options for facial rejuvenation are extremely popular and essential in any cosmetic practice. They are quick office procedures with minimal downtime and high satisfaction rates. Facial lines from aging can be static or dynamic creases, or a combination of both. Botulinum toxin A (Botox) inhibits the release of acetylcholine at the neuromuscular junction and hence blocks muscle contraction to relax the dynamic facial lines.7,8 Botox is most commonly used in the upper face, and dermal fillers in the lower face. Botox diminishes the dynamic horizontal wrinkles in the forehead by targeting the frontalis muscles, the vertical glabellar rhytids by targeting the corrugator, depressor supercilii, and procerus muscles, and the periorbital “crow’s feet” lines by weakening the orbicularis oculi (Figure 4, A,B). Other uses are for correction of platysmal bands, brow ptosis, and perioral lines. Botox is often used in conjunction with dermal fillers, peels, and lasers for optimal results. Absolute contraindications are coagulopathies, neuromuscular disorders, and pregnancy. Dermal fillers, in contrast, address static facial rhytids. Fillers have progressed from the early collagen fillers to hyaluronic (Juvaderm, Restylane, Perlane) fillers, semi-permanent fillers like poly L-lactic acid (Sculptra), calcium hydroxyapatite (Radiesse), and beta TCP (Atlean), and permanent fillers like polymethylmethacrylate (PMMA) and silicone oils.7,9 The choice of filler depends on the location of the crease, as well as the severity, with deeper rhytids augmented with fillers of larger molecule size. Common areas treated are the glabellar rhytids, nasojugal folds, oral commissure, marionette lines, vertical lip lines, prejowl sulcus, and lip augmentation (Juvaderm, Restylane), nasolabial folds (Radiesse, Juvaderm, Restylane), midface atrophy (Radiesse), and HIV lipodystrophy (Radiesse, Sculptra). Injection should be intradermal with smaller particle fillers and subdermal with larger particle fillers. The average duration for hyaluronic fillers is 6 (Restylane) to 12 months (Juvaderm), 9-18 months for Radiesse, and up to 2 years for Sculptra. Common filling techniques are linear threading, cross-hatching, and puncture filling.

**Other noninvasive options:** Skin resurfacing involves de-epithelialization of the epidermis and controlled damage to different levels of the dermis, depending on the amount of correction required, for enhancement of skin texture and pigmentation. Re epithelialization results in a smoother epidermis, and regeneration of collagen and elastin tightens and strengthens the damaged dermis.

**Microdermabrasion:** Dermabrasion was initially performed with a metal, diamond, or ruby grinder to resurface the skin. In contrast, microdermabrasion exfoliates only 10-15 microns off the epidermis. The open crystal system uses a hand-held device to propel a high-speed flow of aluminum oxide/sodium bicarbonate or sodium chloride crystals onto the skin, and the vacuum system sucks away dirt, dead cells, and used crystals (ie. Parisian peel). The closed system superficially abrades the skin, and is under negative pressure (closed loop) with the contaminated crystals collected in the canister for disposal. More recently, hydrafacial machines mechanical exfoliation with infusion of peptides and antioxidants into the skin.

**Chemical peels:** Peels can be a useful adjunct to surgery to improve skin texture and tone, but also can be well utilized for rejuvenation when a patient is not yet interested in...
surgery. Various chemical combinations are applied to the skin to incite epidermal and dermal injury. Depending on the concentration and depth of application of the agent, the peel can be superficial (epidermis and dermoepidermal junction), or medium to deep extending into the papillary or reticular dermis, respectively. After the surface layers are removed, there is increased fibroblastic proliferation, decreased melanocyte proliferation and uniform distribution, and increased dermal regeneration of new collagen and elastin. Peels are often comprised of alpha and beta hydroxyl acids, trichloroacetic acids (15-50%, higher concentration for deeper peels), phenol (Baker-Gordon formula), among others. The cosmeceutical market today carries a vast array of different formulations, with some popular lines being Obagi, Biomedics, Cellex-C, SkinCeuticals, SkinMedica, and Neostrata. Selection of which cosmeceutical therapy to use for home skin care should be individualized for each patient, and can be determined with the assistance of a licensed aesthetician.

Lasers: Laser resurfacing is one of the fastest evolving modalities in the cosmetic industry. Lasers can be divided into ablative and nonablative lasers, and are used for overall skin rejuvenation as well as selective lesion treatment. Ablative lasers heat and vaporize the water in the superficial skin layers in contrast to nonablative treatments that coagulate deeper epidermal and dermal tissues without removing superficial tissue. This preserves vital nutrients and glands within the skin layers, which facilitate healing and more rapid regeneration while also minimizing downtime. The gold standard ablative laser is the CO2 1060nm. However, as ablative lasers increase downtime, cost, and possible complications, nonablative lasers have risen to greater popularity. Nonablative lasers include Nd:YAG 1064, 1450nm, Diode 810nm, Q switched ruby 694nm, Erb:YAG 294nm, and Er:Glass 1540nm. Fractional photothermolysis delivers light in a matrix array of microbeams or pixels to create narrow beams or deep columns of tissue coagulation while sparing the tissue surrounding the columns. The preserved tissue between the coagulated columns facilitates more rapid healing and accelerates the regeneration of new collagen, in contrast to ablative lasers in which healing proceeds only from the periphery of ablated tissue. The Rhytec Portrait® PSR laser transfers nitrogen plasma energy to the skin using a non-contact technique. Palomar lasers include the Lux fractional photothermolysis laser (LUX 1540, 1440), Lux Deep IR, Fractional infrared laser, and Stralux IPL (intense pulsed light therapy). IPL uses high intensity pulses of visible light (xenon) and delivers multiple wavelengths in each pulse of light rather than a single wavelength. This allows the procedure to target several conditions simultaneously.

Radiofrequency energy: Radiofrequency systems deliver concentrated energy at the periphery of the electrode. ThermaGed delivers 225 J/cm² of energy, reaching temperatures of 55-70°C celsius, with uniform energy distribution across the entire electrode. Tissue heating occurs evenly at 2-3 mm beneath the skin surface. Disadvantages of ThermaGed were cost and risk of pain and burns from high temperatures at the skin surface. More recently, the FDA approved Radiage, which is inexpensive and easy to use. The Ellman Surgitron unit is used with special dome-shaped skin tightening probes that deliver 4 MHz high energy radiofrequency between 12-25 J/cm². Advantages are its safety for all skin types, and better control of skin surface temperature, thereby lessening the risk of burns. In summary, facial rejuvenation is a complex but exciting art dealing with individual layers of the face, yet refining them as a whole facial system.

Conclusion
The world of minimally invasive facial rejuvenation is vast and constantly changing. Through continued research and surgical refinement, a more advanced understanding of facial aging will greatly benefit our care of patients.

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