Correction of Midface Deficiencies with Injectable Calcium Hydroxylapatite

John M. Nassif MD FACS
Director, Facial Sculpting Center, Naples, Florida

Robert S. Flowers, MD
Director Emeritus, The Flowers Clinic, Honolulu, Hawaii

Denise E. Merdich, MS, ARNP
Nurse Practitioner, NV Spa, Tampa, Florida
Corresponding Author:

John M Nassif, MD FACS

7955 Airport Pulling Road N, Suite 104, Naples, FL 34109

Tel: (239) 593-7747

Fax: (239) 593-6650

Email: DrJohnNassif@gmail.com
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**John M Nassif MD, FACS:** Main author of manuscript

**Robert S Flowers, MD:** Review, editing of manuscript, Drawings

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Structured Abstract

**Background:** In 1969, Flowers correctly realized that restoring midface volume with implants achieved the elusive results that surgery could not.

**Methods:** A total of 14 patients underwent bilateral injection with calcium hydroxylapatite to restore midface volume and results followed for a minimum of 6 months.

**Results:** The results were uniformly pleasing to the patients and the physician. Three patients requested, and received, touch-up injections to create more volume or to correct asymmetry.

**Conclusions:** In patients with midface deficiencies, it is difficult, if not impossible, to achieve maximal outcomes, and avoid creating more deformity, without some midface contour correction. In most cases, injectable calcium hydroxylapatite offers an excellent correction of a significant deformity if our recommendations are followed.

**Level of Evidence:** Therapeutic IV.

**Introduction**

Midface deformities are possibly the most ignored -- and therefore mistreated -- aesthetic facial deformity by patients and surgeons alike. Yet, it is (often unknowingly) the feature that brings patients to aesthetic surgeons -- and a common feature left uncorrected. In true midface deformities, it is difficult to achieve maximal aesthetics -- and avoid creating more deformity -- without midface volume and contour correction. The common practice of injecting fillers into the nasolabial folds or malar eminencies often yield inadequate midface results. Periorbital and facial surgery alone will often under correct or even exacerbate the problem.
Correcting midface deficiencies with injectable calcium hydroxylapatite (CaHA) is a highly successful technique with lasting results. Learning to identify midface deficiencies, and understanding how best to correct them, will provide a pleasant “lift” to your facial aesthetic corrections. Far too much disfiguring lower eyelid and midface surgery is performed when simple volume restoration will provide a superior result.

In this essay, we will review the various midface deformities and our technique for correcting them.

**Midface Deformities**

Midface deformities occur from a variety of causes: bone deficiency, cheek soft tissue atrophy, suspensory ligament elongation, cheek decensus, or any combination of the aforementioned. Fortunately, they are easily identified and nearly all can be well corrected with volume and contour augmentation.

*Tear Trough Deformity*

In 1969, Flowers noticed a common aesthetic problem in patient after patient: a deep diagonal groove at the junction of the eyelid and cheek. Noticing how a shed tear often tracks along the course of the groove, he labeled it the “tear trough deformity.” 1,2

The bony tear trough deformity can be seen in individuals of all ages. It becomes more prominent as the midface tissues age and “baby fat” atrophies. Loss of tissue volume causes the once full, youthful cheeks to become hollow and ptotic, allowing the underlying tear trough groove to become clearly visible (*Fig. 1*).
Through trial and repeated disappointment, it quickly became evident that removing fat from the lower lid failed to eliminate this deformity. In fact, it frequently made the whole midface complex appear more hollow and haggard.

Flowers correctly realized that restoring midface volume achieved the elusive results that surgery could not. He began custom carving implants for each patient out of silicone to specifically fill the tear tough depression -- with excellent results. Years of fine-tuning led to the commercially available tear trough implants (Implantech® 800-733-0833).

In those with a true tear trough deformity, no combination of fat removal, midface lifting or skin excision gives an acceptable long term result -- except filling the bony deficit. When placed properly, the tear trough implant finally offered a definitive solution and an excellent cosmetic result. Fillers have become the natural successor to implants, and can be used to temporarily create the results without the significant expertise needed -- and the recovery time to the patient -- for successful surgery.

*The nasojugal groove*

A similar appearing midface deformity has been referred to as the “*nasojugal groove*” or “*fold*.” The nasojugal groove is frequently confused with a tear trough deformity, and the two terms are often used (erroneously) interchangeably.

The nasojugal groove is a muscular void between the orbicularis muscle and the nasal head of the levator labii superioris muscle. It is exacerbated by decensus of the check, and fillers are also an excellent alternative to augment the nasojugal fold.

*Cheek decensus*
Decensus of the cheek is the most common midface deformity and the inevitable result of aging facial tissues. As the midface tissues atrophy and the suspensory ligaments elongate, the cheek drops. As the cheek sinks further below the orbital rim, the junction between the eyelid skin and cheek skin widens exposing (or exacerbating) the bags underneath the eyes and creating a deep groove in the midface (Fig. 2).

In many individuals, this drop can be significant and will certainly enhance the appearance of the nasolabial folds, which is a common presenting complaint. Yet in the presence of cheek decensus, injecting fillers in the nasolabial folds alone often exacerbates the deformity giving a “chipmunk” appearance to the face -- without actually correcting the problem.

Herniated lower lid fat

Herniated orbital fat often accompanies cheek decensus as both are the result of tissue laxity. Bulging orbital fat creates a groove located over the suborbital rim from the attachment of the arcus marginalis. The protruding fat can roll over the rim mimicking, or exacerbating, cheek decensus or a tear trough deformity.

However, the common surgical approach, skin and fat excision, will only create further deformity by hollowing out (and aging) the lower periorbital region and dropping the lid position against the globe (Fig. 3).

Anatomy

A brief review of the midface anatomy is necessary for proper -- and safe -- filler injection.9,10,11

Orbital Septum

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In the lower lid, the orbital septum attaches superiorly to the inferior border of the tarsus and inferiorly to the periosteum of the orbital rim -- forming a thickened perimeter known as the *arcus marginalis*. The septum serves as the anterior barrier to the orbital fat. When injecting into the midface, it is *essential* not to pierce the orbital septum to avoid injecting CaHA into the orbital fat.

*Infraorbital Foramen*

The infraorbital nerve, artery and vein commonly exit via the infraorbital foramen, located approximately 8 mm below the orbital rim, and directly below the supraorbital notch *(Fig. 4)*. When the eyelids are open and in primary gaze, the infraorbital foramen approximately lines up vertically with the medial limbus of the cornea.

The infraorbital foramen is often hooded and directed inferiorly -- making it possible for your needle to enter the foramen when injecting superiorly from the nasolabial fold. It is important to identify -- and avoid -- the infraorbital foramen when injecting. Injecting any filler into the infraorbital canal may result in compressive damage to the nerve and artery; injecting any filler intravascularly, including CaHA, could cause disastrous embolic damage.

*Facial Artery*

The facial artery is a branch off the external carotid and diagonally traverses the face from the lateral mandible to the medial canthus of eye. It travels superolateral to the nasolabial fold and generally superficial to the facial muscles. Injecting in the nasolabial fold and going deep to the muscles is the best, and safest, path to take for midface injections.

*Materials and Methods*
A total of 14 patients underwent bilateral midface injection with CaHA and results followed for a minimum of 6 months. Ages ranged from 23 to 63, and all were female except for one male.

Nearly any filler can successfully add volume to the midface.\textsuperscript{12,13,14,15} Our criteria for the ideal midface filler includes: Able to mold the filler after injection; adequate volume; superior longevity; and reasonable cost. Radiesse\textregistered filler (Calcium Hydroxylapatite, Merz Aesthetics) was chosen as the filler of choice for all the mentioned reasons. The large syringes of CaHA contain 1.5cc of filler which often is the minimum necessary to get any significant midface augmentation -- and 50\% to 87.5\% more filler than hyaluronic acid fillers at roughly the same cost. The consistency is excellent for moulding and feathering in the midface. CaHA lasts 1 to 2 years and will stimulate a collagen capsule to form around the material when injected into the midface which adds further volume and tightening to the midface tissues.

**Technique**

Our injection is based on Flowers' tear trough implant placement which emphasizes midface enhancement of the suborbital portion and its lateral submalar extension (Fig. 5). Although injecting CaHA without anesthesia is often well tolerated, we prefer to mix the 1.5 cc syringe with 0.2 cc of lidocaine without epinephrine -- a recently FDA approved technique -- using the included adapter and syringe.

All patients were injected using the same technique, but the amount was individualized to the patient. In general, the midface volume deficiency was categorized as mild, moderate or severe. Mild cases were initially injected with 0.3 cc of CaHA, moderate with 0.4cc and severe
with 0.5 cc. After injecting both sides, a second injection was added laterally as needed to create symmetry and feather the material laterally.

It is of the utmost importance that the product is placed in the correct location directly on the bone: Too superficially and it will leave a visible lumpy contour; too medially and you may endanger the infraorbital nerve, artery and vein; too superiorly and you could penetrate the orbital septum and inject into the orbital fat; too inferiorly or too laterally and you will not get a good correction and / or create more deformity.

The correct vertical injection plane is mid-pupil to avoid the infraorbital nerve and foramen which are roughly lined up with the medial limbus. If you pass the needle too medially, it has the potential of directly damaging the nerve/artery/vein, or the needle could enter the foramen which could occlude the canal and compress the nerve and vessels.

Prior to injecting, we first put our index finger on the superior orbital rim centrally under the pupil and push posteriorly to gently displace the orbital septum and orbital fat -- and the globe -- back into the orbit (Fig. 6). This makes it nearly impossible to inadvertently inject through the septum.

Next the needle is passed through the nasolabial fold and deep to the cheek musculature and down to the periosteum (Fig. 7). The needle will pass easily through this area which is relatively avascular. We know the angular artery travels superolateral to the nasolabial fold, so going through the fold and then deep to the cheek should keep you safe.

Using the provided 3/4 inch 27g Exel needle, you will have to lift the cheek a bit for the needle tip to reach your finger on the orbital rim. Prior to injecting, the tip of your needle should
be just below your finger and on the periosteum. Reaching your fingertip will be difficult with the 3/4" needle, but possible, so proceed slowly when advancing the needle.

You do not want to enter the arcus marginalis, or any other structure for that matter. There should be no resistance as you slowly start to inject, and you will actually feel the putty-like material flowing against your finger. If you do not feel the material being injected or if you feel any resistance to injecting, stop immediately and reposition the needle properly to insure you are injecting in the vertical plane of the pupil, and not more medial. While injecting, we use our finger to divert the CaHA medially and laterally along the orbital rim while insuring the orbital septum is displaced posteriorly and protected.

Once injected, the CaHA is massaged medially above the infraorbital nerve and superiorly towards the orbital rim. The concept is to spread the CaHA particles under the orbicularis to stimulate collagen formation and reduce the deep groove we get from decensus of the cheek.

The fellow cheek is injected and then compared. We often need to inject more CaHA (usually 0.1-0.2 cc) laterally to the original injection site (Fig. 8) to feather the CaHA into the malar eminence. In those with a true malar deficiency, the injections can be taken laterally to the zygomatic arch and up superiorly along the lateral orbital rim. In these areas, we either have to significantly lift the cheek if we wish to inject through the nasolabial fold, or insert the needle at a higher point in the cheek. The zygomaticofacial nerve is located on the malar bone under the lateral canthus and should be avoided.
We avoid injecting directly through the orbicularis muscle for a couple of reasons: The orbicularis is vascular and the overlying skin is thin, predisposing to periorbital ecchymoses. Also, injecting directly can allow CaHA to track back into the superficial layers above the orbicularis causing lumps and making the white CaHA visible through the skin.

Results

In post-injection exams, the results were uniformly pleasing to the patients and the physician. Three patients requested, and received, touch-up injections to create more volume or to correct asymmetry.

The many benefits of a midface injection can be seen throughout the entire midface: First, it minimizes the deep groove that defines the junction of the lower lid and midface; second, it reduces or eliminate the perception of a lower lid herniated fat pad (Fig. 9); third, it enhances the midface volume creating a youthful cheek and eliminating the midface deformity (Fig. 10); and fourth, it lifts the cheek tissue and reduces the severity of the nasolabial fold (Fig. 11). Perhaps most impressive of all, midface volume and contour enhancement creates a profoundly younger and more pleasing appearance -- without leaving any telltale signs of the aesthetic surgeon's handiwork (Fig. 12). Often the patient -- and surgeon -- will be amazed at the instant improvement that occurred after a simple injection.

Complications

Periorbital edema and / or bruises should be expected and are not considered complications. By using the technique described herein, getting a significant ecchymosis is rare.
and only occurred in one patient in this study -- and that patient had inadvertently taken aspirin
prior to the injection.

Transient parasthesia and numbness can occasionally occur from midface injections if the
infraorbital nerve is inadvertently damaged, but it should be short lived and certainly not
progressive. Significant progressive pain and parasthesia for several postoperative days should
be investigated. Motor nerve injury has never occurred in our hands, but nonetheless pain,
paresthesia and motor loss should be listed as potential complications on your consent form.

If the CaHA is injected through the orbital septum and into the orbit, you will likely get a
prolonged periorbital edema. We have not encountered this problem, and therefore do not know
how significant this potential complication can be. Of course, we take great lengths -- as you
should -- to avoid injecting through the septum.

Since the infraorbital foramen is often hooded and directed inferiorly -- it is possible to
inject into the foramen. Great care should be taken to locate -- and avoid -- the infraorbital
foramen when injecting. Injecting any filler into the infraorbital canal will certainly result in
compressive damage to the nerve and artery -- injecting any filler, including CaHA,
intravascularly could cause disastrous embolic damage.

An infection is possible after the injection of any filler, but it is extremely rare. The
periorbital region is quite vascular and therefore resistant to infections. However, any
progressive redness, warmth or pain should be considered as a possible infection and treated
immediately.
The most common complication in inexperienced hands is when the filler is injected too superficially. Superficial injections may leave visible and palpable lower lid lumpiness, discoloration and asymmetry. It is essential that all fillers injected into the periorbital region be injected directly on the bone and never subcutaneously. Using our technique of injecting through the nasolabial fold will insure that the injection misses the vessels and is placed on bone.

Discussion

Radiesse® is an FDA-approved injectable implant for the correction of moderate to severe facial wrinkles and folds such as nasolabial folds. Using Radiesse® for midface volume and contour augmentation would be considered an off-label use and that should be mentioned in your consent form. CaHA has a long track record of safety having been used for maxillofacial augmentation, vocal fold augmentation and radiographic tissue marking for decades.

Midface volume augmentation will often provide an excellent aesthetic alternative to a lower lid blepharoplasty by not only enhancing the volume of the cheek, but when performed properly, it can minimize the groove created by the herniated fat. In our hands, injecting fillers has drastically reduced the need for lower eyelid surgery -- much to the delight of our patients. It provides a quicker, less expensive and often far more aesthetically pleasing correction for one of the most common problems encountered by aesthetic surgeons.
However, it is important that the injection is done properly. Unlike hyaluronic acid fillers, it is not possible to reverse CaHA if it is injected improperly or too superficially leaving the patient with a highly visible iatrogenic deformity that may last months to years.  

Although it is not reversible, there are options to modify the injection. Injecting lidocaine directly into the CaHA, along with massage, can help break up the material. As a last resort, surgically excising the CaHA is possible, but may leave scarring. Severe complications can occur if the CaHA is injected intravascularly, into the infraorbital canal or through the orbital septum.

In our experience, the majority of lower lid and midface candidates should have midface volume restoration prior to or during their lower lid procedure. However, the surgeon must make the deformity clear to the patient in the mirror, and educate them on the suboptimal results that are likely if the volume is not placed.

Perhaps the most impressive aspect about correcting midface deficiencies is the profoundly rejuvenating results -- without any telltale sings of the aesthetic surgeons' handiwork. Midface volume and contour augmentation falls into the desirable category where people exclaim, "You look really good but I can't tell why." The results are natural, pleasing and very difficult to notice -- the goal of any aesthetic surgeon -- and certainly your patients.

Summary
Midface deficiencies are some of the most consistently ignored, and commonly mistreated, major deformity of the periorbital region. Yet it is one of the most bothersome features bringing patients to plastic surgeons, and the most common feature left uncorrected. In our experience, 50-70% of patients presenting for lower lid surgery or midface lifts have midface deficiencies that would benefit from volume replacement.

Midface volume and contour correction in most cases offers the definitive correction of a significant deformity. The aesthetic surgeon contemplating facial surgery should be alert to identify midface deformities and be prepared to correct it prior to, or at the time of, lower lid or midface surgery.

In patients with midface deficiencies, it is difficult, if not impossible, to achieve maximal outcomes, and avoid creating more deformity, without some midface contour correction. Learning to identify the tear trough deformity, and understanding how to correct it, will be a major boon to any facial aesthetic correction.
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**Figures**

**Figure 1.** The typical tear trough deformity has a prominent infraorbital rim (arrow) with an abrupt concavity beneath it centered around the infraorbital nerve. *(Illustration by R.S. Flowers)*

**Figure 2.** Decensus of the cheek widens the junction between the eyelid skin and cheek skin and exposing or exacerbating the bags under the eyes and creating a deep groove in the midface. *(Illustration by R.S. Flowers)*

**Figure 3.** The common skin and fat excision lower lid blepharoplasty will only create further deformity by hollowing out (and aging) the lower periorbital region and drop the lid posture against the globe. *(Illustration by R.S. Flowers)*

**Figure 4.** The infraorbital nerve, artery and vein commonly exit via the infraorbital foramen, which is approximately 8 mm below the orbital rim, and directly below the supraorbital notch. *(Illustration by R.S. Flowers, MD)*

**Figure 5.** Injecting CaHA into the midface is based on Flowers' tear trough implants which emphasize midface enhancement of the suborbital portion and its lateral submalar extension. *(Illustration by RS Flowers, MD)*

**Figure 6.** An index finger is placed on the orbital rim to displace the orbital septum and orbital contents posteriorly to avoid injecting through the septum.

**Figure 7.** The needle is passed through the nasolabial fold and deep to the cheek musculature and down to the periosteum. Using the 3/4 inch needle, you will have to lift the cheek a bit for the needle tip to reach your finger that rests on the infraorbital rim.
Figure 8. We often need to inject additional CaHA (often 0.1-0.2 cc) laterally to the original injection site to feather the material into the malar eminence.

Figure 9. Midface volume and contour enhancement minimizes the crease below the orbital rim, creates a youthful cheek eliminating midface deformity, and minimizes the nasolabial fold.

Figure 10. Filling the midface lifts the cheek tissue and reduces the severity of the nasolabial fold and cheek lines.

Figure 11. Midface enhancement can remove the deep groove that defines the junction of the lower lid and midface, and reduce or eliminate the perception of a lower lid herniated fat pad.

Figure 12. Perhaps most impressive of all, midface volume and contour enhance creates a profoundly younger and more pleasing appearance -- without leaving the telltale signs of the aesthetic surgeons handiwork.