
Liquid Silicone for Soft Tissue Augmentation

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BACKGROUND. The use of liquid silicone for soft tissue augmentation has been associated with a great deal of controversy and negative publicity. It is hoped that this monograph will clarify some of the substantive issues behind the controversy.

OBJECTIVE. To outline and discuss the history, legal status, indications, contraindications, technique, and complications associated with the use of liquid silicone for soft tissue augmentation.

METHODS. Impressions derived from a 22-year experience involving the treatment of over 3,000 patients using liquid silicone are

presented, along with data abstracted from the scientific and the lay literature.

CONCLUSION. Pure liquid silicone may be superior to any currently available agent in properly selected patients for permanent correction of certain types of defects. Physicians who use it, however, must be advised that the misuse of this agent or other materials masquerading as liquid silicone have created a pervasive climate of distrust and a veritable minefield of extraordinarily unpleasant medicolegal possibilities.

DAVID M. DUFFY, MD, HAS INDICATED NO SIGNIFICANT INTEREST WITH COMMERCIAL SUPPORTERS.

History

F. S. Kipping, a Nottingham chemist, coined the term *silicone* to describe polymers, which he synthesized based on the element silicon (atomic number 14), the second most abundant element in the earth's crust. Kipping referred to the materials he prepared as silicones because simple elemental analysis indicated that they may be analogues of organic ketones. Further reactions using elemental silicone resulted in a class of compounds referred to as *siloxanes*. This term is derived from "silicon," "oxygen," and "methane." These compounds, the viscosity of which is a function of the degree of their polymerization, can exist as solids (elastomers), gels, foams, and liquids. Silicones are used worldwide by the ton in applications as diverse as antifatulents, cosmetics, paint thinners, lubricants, scar dressings, cardiac valves, joint prostheses, contact lenses, and breakfast food. Silicone is also employed for penile, testicular, breast, and vocal cord implants and implantable binding matrices for drug-releasing capsules, artificial urethras, catheters, drains, and tubing. Liquid silicone, pure and adulterated, has been used for soft tissue augmentation worldwide for at least 40 years, and it is estimated that at least 200,000 patients have been treated in the United States alone.¹ The misuse of adulterated silicone and other agents purported to be silicone is still front-page news in this country, Mexico, and Asia.²⁻⁶ The availability and legality of US Food and Drug Administration (FDA)-approved silicone oils and the likelihood that other semi-permanent and permanent implants may be approved will

unquestionably lead to an increased use of both liquid silicone and other implants with similar complication profiles.⁷⁻¹⁷ Whether the new, more viscous silicone oils of documented purity will produce fewer complications is not known. I have, however, observed complications following the use of FDA-approved silicones.¹⁸

Legal Status

The enactment of the FDA Modernization Act on November 21, 1997, allowed any legally marketed FDA-approved device to be prescribed or administered for any condition or disease within a doctor-patient relationship.¹⁹ Accordingly, two forms of liquid silicone that have been FDA approved for retinal tamponade, AdatoSil (Bausch & Lomb, Claremont, CA, USA), a viscous compound of 5,000 centistokes (100 centistokes = viscosity of water), and Silikon (Alcon Labs, Fort Worth, TX, USA), a 1,000-centistoke fluid, may legally be used for soft tissue augmentation. Several large-scale studies employing FDA-approved silicones are currently under way that include the treatment of acquired immune deficiency syndrome (AIDS)-induced facial wasting and other cosmetic applications.^{2,7,13} For use in soft tissue augmentation, silicone has many of the qualities that would make it ideal. It is inexpensive, can be sterilized, will not support bacterial growth, and can be stored without refrigeration. In addition, it seems to be one of the least antigenic substances yet discovered.¹⁹ Despite what appears to be an ideal profile of biologic virtues, the history of silicone use has been fraught with violent controversy. Advocates are certain that pure liquid silicone used in small volumes in properly selected sites is safe and effective.¹⁸⁻²² Opponents are certain that liquid silicone is intrinsically unsafe and suggest

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that the advocates are not telling the whole truth.²³⁻²⁵ What is agreed on is that

1. Silicone is the most permanent of all FDA-approved tissue augmenting agents.
2. Good or bad results are often related to good or bad technique.²⁰
3. Small volumes of liquid silicone must be employed; correction is accomplished slowly using multiple treatments spaced at least 1 month apart.
4. The use of large volumes of liquid silicone-containing adulterants is frequently followed by serious complications.
5. Silicone has a high abuse potential (Figures 1 and 2).
6. Gross misuse of silicone led to legislation that criminalizes its possession in the state of Nevada.
7. Drift (migration) or excessive capsule formation may occur when large volumes of liquid silicone are employed but has never been reported using small volumes of pure liquid silicone.

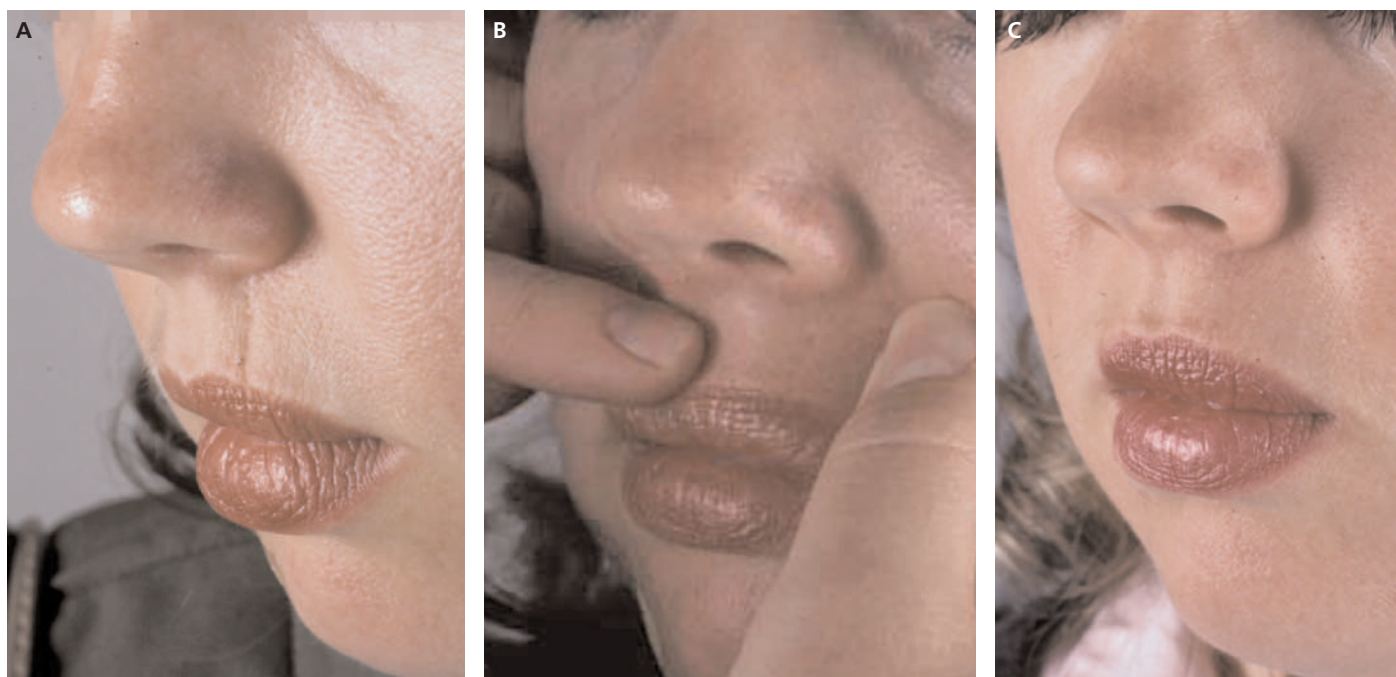


Figure 1. (A) Scars that can be easily effaced using gentle traction are often ideally treated with soft tissue augmenting agents. (B) This dog-bite scar responded to two treatments (estimated volume 0.3 cc) of liquid silicone. (C) Results at 8 years post-treatment.

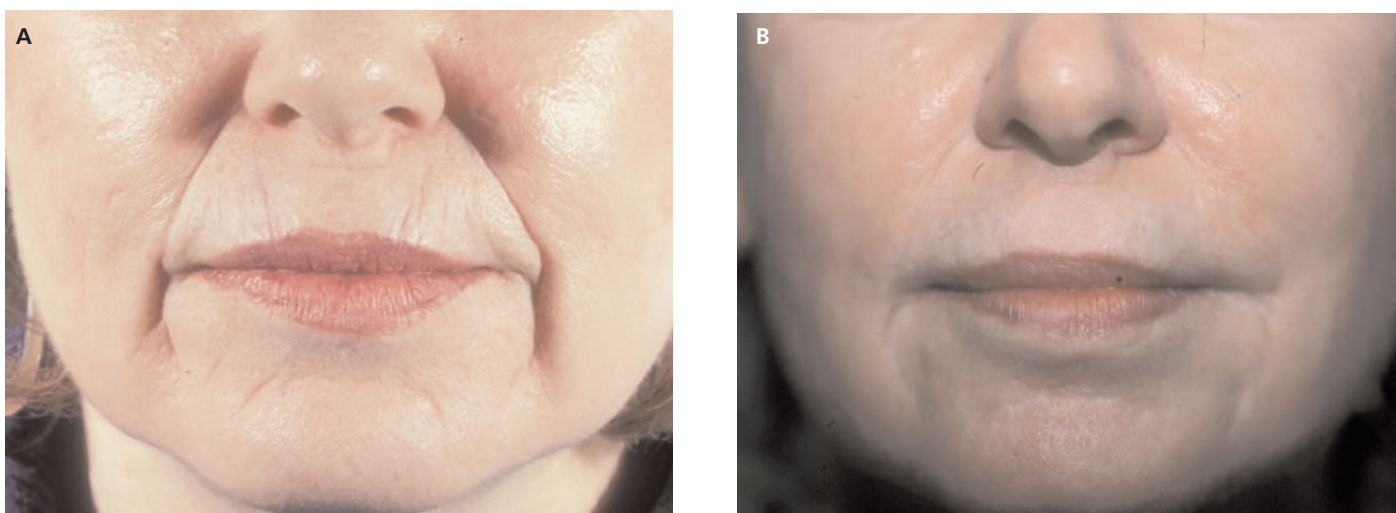


Figure 2. These before (A) and after (B) photographs taken 10 years apart reveal the long-lasting efficacy of liquid silicone for nasolabial and melolabial folds (estimated volume 2.5 cc).

8. Liquid silicone is noncarcinogenic, and silicones, in general, do not appear to be associated with systemic disease, particularly autoimmune syndromes.²⁶

Indications

Injected silicone is effective for the same conditions treated with other tissue augmenting agents, such as collagen. It is most useful for broad, distensible scars caused by acne, excoriation, trauma, microbial infections, and surgery, including skin grafts. Rhytids occurring as a consequence of aging or photodamage, glabellar frown lines, nasolabial folds, and the labial commissures can be treated effectively. Silicone is particularly useful in treating post-rhinoplasty nasal irregularities. Personal experience suggests that silicone complements other procedures extremely well; that is, patients who have undergone resurfacing procedures often have remaining contour defects, which are particularly suitable for silicone augmentation. Intralesional steroids and a vacuum device (Mighty VAC, Prism Enterprises, Inc. San Antonio, TX, USA) (unpublished data) have been employed to render scars more pliable before silicone augmentation or subcision.²⁷ Atrophy of the skin secondary to corticosteroid injections, linear scleroderma, neurotrophic or diabetic feet, painful corns, or callosities can also be treated effectively (Figures 3 to 11).

Contraindications and Precautions

Silicone should not be injected into the glandular portion of breast tissue. The large volumes employed will migrate along tissue planes or form thick-walled cystic spaces. Intravascular injection risks embolisms. Overcorrection and displacement of silicone lateral to the treated defect (beading, doughnutting) may follow the injection of silicone into inelastic scars or adherent rhytids, such as the horizontal creases of the face (forehead, mental line, and the philtrum). Injection of shallow, V-shaped "pucker" perioral rhytids involving the lips can also be followed by overcorrection, which may be promoted by muscular activity in this area. These types of wrinkles are best treated with resurfacing. Patients with multiple allergies or recurrent or chronic systemic or localized infections may be at greater risk of inflammatory or granulomatous complications. Patients with a personal or family history of autoimmune illnesses are probably at no greater risk of complications, but should autoimmune syndromes occur after treatment with liquid silicone, physicians who use it may face litigation, which may not be judged on the basis of scientific merit. Personal experience suggests that treating patients who received silicone injections from another practitioner carries with it the risk of blame for complications that result from other practitioners' improper use.



Figure 3. (A) Facial lipoatrophy occurred following an unspecified illness, as noted in the pretreatment photograph. (B) The second photograph taken 10 years after approximately 30 cc of silicone was employed shows an excellent correction that persists some 23 years after treatment.

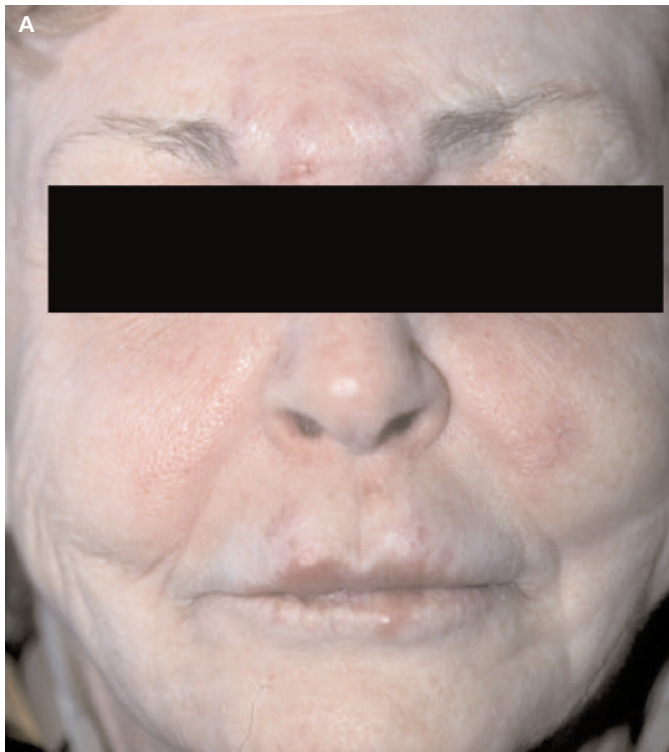


Figure 4. (A) Indurated nodules and facial swelling occurred approximately 12 years after treatment in Mexico with what the patient was told was "silicone." (B) Oral and intralesional corticosteroids and minocycline considerably reduced the swelling and nodularity, as shown in the second picture. This patient has required multiple courses of treatment.



Figure 5. (A, B) This patient was treated in a hotel room by an unlicensed practitioner who advertised in Vietnamese on the bulletin board of a supermarket. The patient was told that the material employed was silicone. Estimated volume was 40 cc.



Figure 6. Ten years after the injection of approximately 0.2 cc of liquid silicone, this patient developed nodularity after undergoing blepharoplasty.

Technique

I use the microdroplet technique in which very tiny volumes (0.01–0.03 cc) are deposited at each injection site in the deep dermis at 1 to 3 mm intervals, avoiding overcorrection. Treatments are repeated every 4 to 6 weeks to permit encapsulation and entrapment of miniscule volumes of implanted material. Assessing total volumes of silicone employed over long periods of time is sometimes difficult. It was not uncommon for patients to return for touch-up treatments 7 to 10 years after the completion of the first series of treatments when their records were no longer available. Generally, a patient who has been treated for nasolabial, glabellar, and melolabial folds will receive 5 to 10 cc of liquid silicone over a 20-year period. Although some patients request touch-up treatments, many are satisfied with their appearance and never seek further treatment. Facial size plays a role; men often require a much higher volume to produce desired results in commonly treated areas.

Orentreich and Orentreich have carefully outlined the methodology used to inject silicone in several excellent publications.^{20–22}

Complications

Most authorities agree that the incidence of serious complications following the proper use of liquid silicone (small

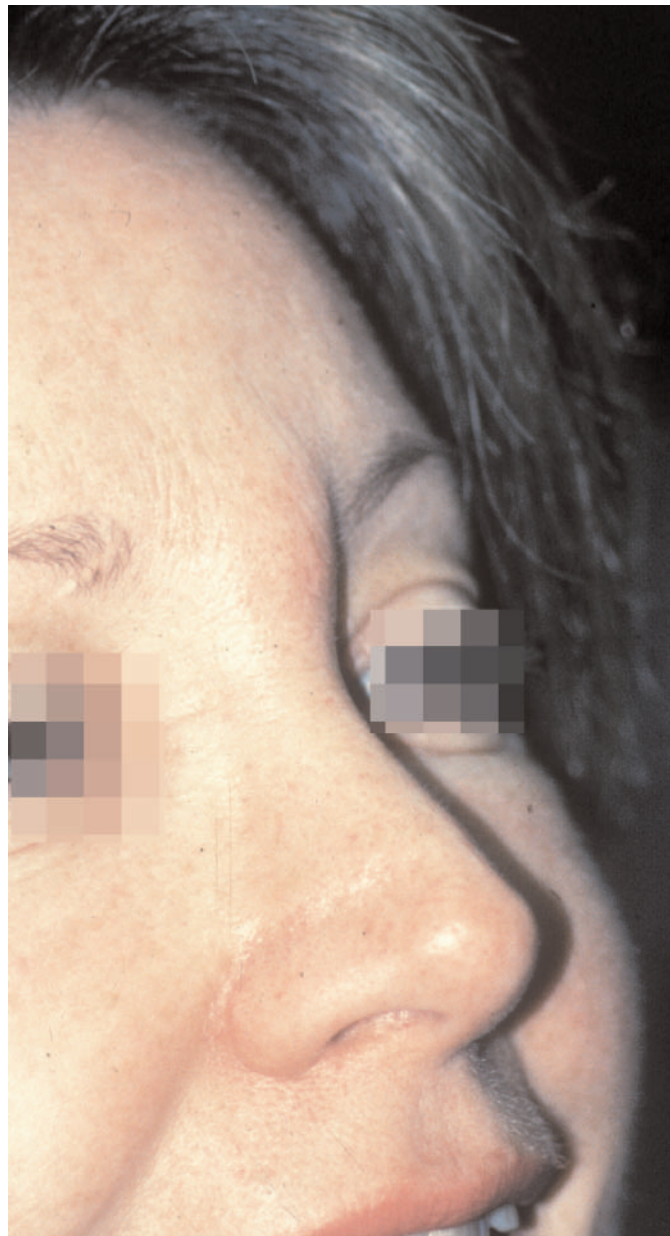


Figure 7. This patient developed severe edema following a blow from a car door some 10 years after treatment with estimated 0.2 cc liquid silicone. Intralesional steroids were effective. This type of swelling is not uncommon in association with sinus infections in this area.

volumes, pure silicone, carefully selected patients) is a fraction of 1%. Two serious cutaneous complications have occurred following the use of liquid silicone in an FDA-authorized study involving 1,400 patients over a 20-year period. Migration occurred in the leg of one polio patient who was treated with large volumes of silicone during the first phase of the study.²⁸ In the second phase, another serious reaction was reported to occur in a patient with Weber-Christian disease, rheumatoid arthritis, and an atypical mycobacterial infection who received at least

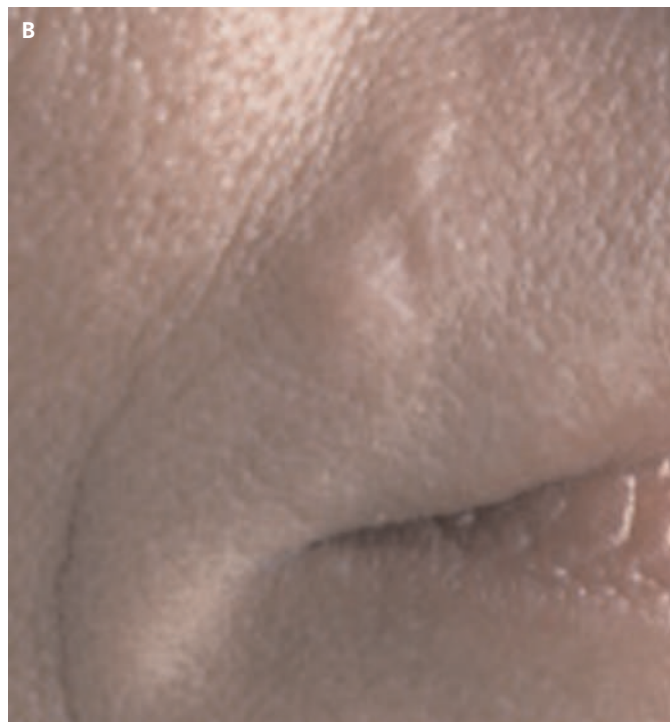


Figure 8. (A) A satisfactory correction of this dog-bite scar using an estimated 0.15 cc of liquid silicone persisted for 6 years. Note the hypertrophic scar-like elevation in the treated area, which may have followed trauma. (B) Intralesional steroids resulted in partial resolution.

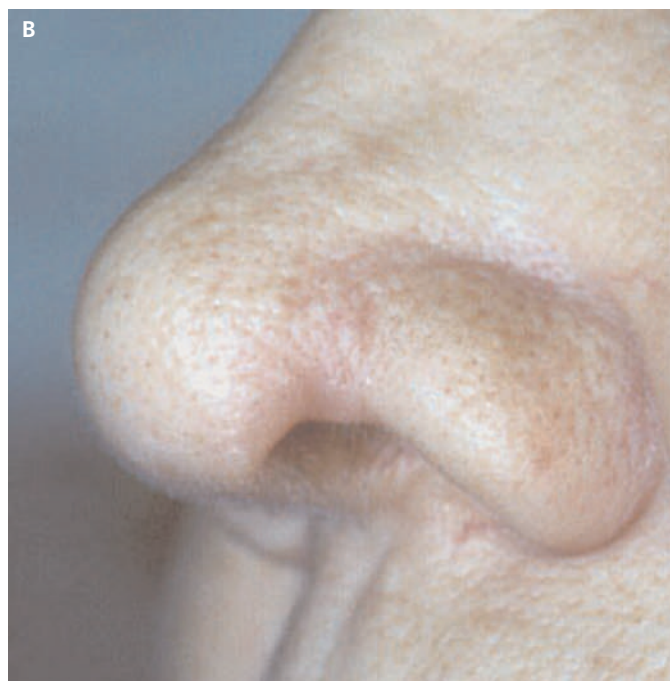
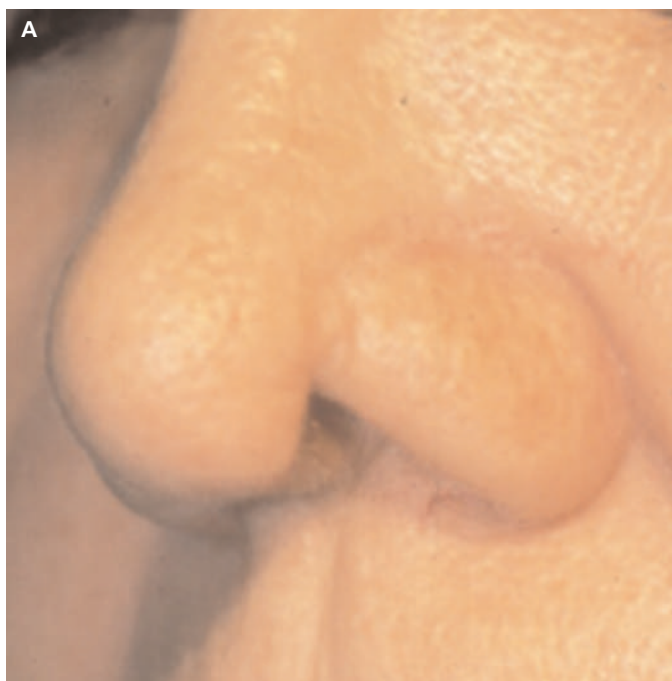


Figure 9. (A) This notch-like deformity in the ala nasi followed resection of a basal cell carcinoma. (B) This image reveals the effects of two treatments using an estimated volume of 0.1 cc of liquid silicone.

25 cc of liquid silicone for facial atrophy. In this case, massive facial necrosis and inflammation unresponsive to systemic steroids or antibiotics occurred some 11 years after her last injection of silicone. Achauer reported two similar

reactions occurring in one patient who was diagnosed with Weber-Christian disease and the other with no specific diagnosis.²⁹ Pearl and colleagues reported similar complications in patients with no apparent risk factors.³⁰ Histo-

logically, these patients revealed a chronic inflammatory reaction with foreign body cells. In one analysis of the complication that occurred during the FDA study, the author noted that it was impossible to be certain whether this condition was a reactivation of Weber-Christian disease or reaction to silicone.²⁹

Minor complications include bruising, edema, dyschromia (brownish-yellow pigmentation of the skin), and textural changes. Demarcation of implanted silicone associated with the aging process or loss of subcutaneous fat has been reported. There is general agreement that migration, ulceration, and many of the horrific sequelae of the improper use of adulterated silicone simply do not occur following the use of small volumes of pure liquid silicone in properly selected patients.

Delayed Reactions and Rosacea, Rosacea-Like Syndromes, and Granulomas

Granulomatous rosacea-like eruptions sometimes occurring years after treatment have been reported.³¹ Certain drugs may precipitate these reactions. Rapaport presented photographs demonstrating a widespread facial eruption triggered by etanercept in areas treated with liquid silicone some 36 years before. The clinical appearance was highly suggestive of granulomatous acne rosacea.²⁵ Granulomas that follow the injection of small volumes of pure liquid silicone are rare and are usually but not always small and easily treatable. Estimates of serious complications vary from 1 in 10,000²³ to 1 in 1,000.³¹ Granuloma-

tous complications can arise weeks to years after treatment (Figures 12 to 14).

Granulomas: Histology, Immunology, and the Impact of Infectious Processes

There is a dearth of studies using immunohistochemical techniques to analyze silicone complications following its implantation into human tissues. Large-scale epidemiologic analyses prompted by breast implant litigation suggest that

1. Granulomas can occur as a consequence of silicone-tissue interactions.²⁶
2. Granulomas are a generic possibility following any foreign body implant.³²⁻⁴⁰
3. Infectious processes that often trigger inflammatory granulomatous silicone reactions may act as adjuvants, converting a potentially haptenic compound such as silicone into a microbial mimic initiating T-cell activation, which appears to play an important role in silicone granulomas.^{41,42}
4. Inflammatory silicone granulomas share many clinical, histologic, and, presumably, immunologic characteristics with cutaneous sarcoidosis. These include the possibility of abnormalities in foreign body processing and infectious or traumatic activation. When the molecular mechanisms underlying the interaction of foreign bodies, infections, and sarcoidal tissue reactions are better understood, more precisely targeted therapies will inevitably become available. It is quite likely that ther-



Figure 10. (A) This flexible scar, which followed a postsurgical infectious process, responded well (B) to approximately 1 cc of liquid silicone injected over a 4-month period.

apies that are effective for cutaneous sarcoidosis will also be effective for silicone granulomata.

5. Baumann and Halem successfully employed topical immune therapy (imiquimod) for the treatment of granulomatous complications that followed the use of adulterated silicone.⁴³

Personal Experience with Liquid Silicone

Serious complications in my practice have been few and far between, often occurring in conjunction with infectious processes, particularly carious teeth and sinus infections, as well as an association with allergic flare-ups and as a consequence of herpetic activation periorally.³⁸



Figure 11. (A) Thumbprint depressions are an excellent indication for liquid silicone, as shown by the results (B) obtained following the use of 0.3 cc of liquid silicone.

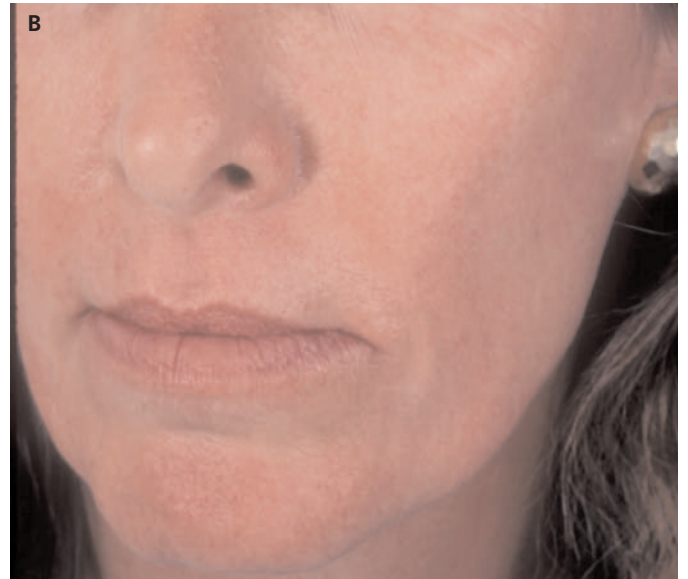


Figure 12. (A) Lipoatrophy associated with weight loss or aging responds very well to liquid silicone, as shown in results (B) obtained at 1 year following the injection of an estimated 1.5 cc of liquid silicone injected over several months.



Figure 13. (A) Pliable scars located on the temple are an ideal indication for liquid silicone as shown by these results (B) taken 2 years after implantation of an estimated 0.4 cc of liquid silicone injected over several months.

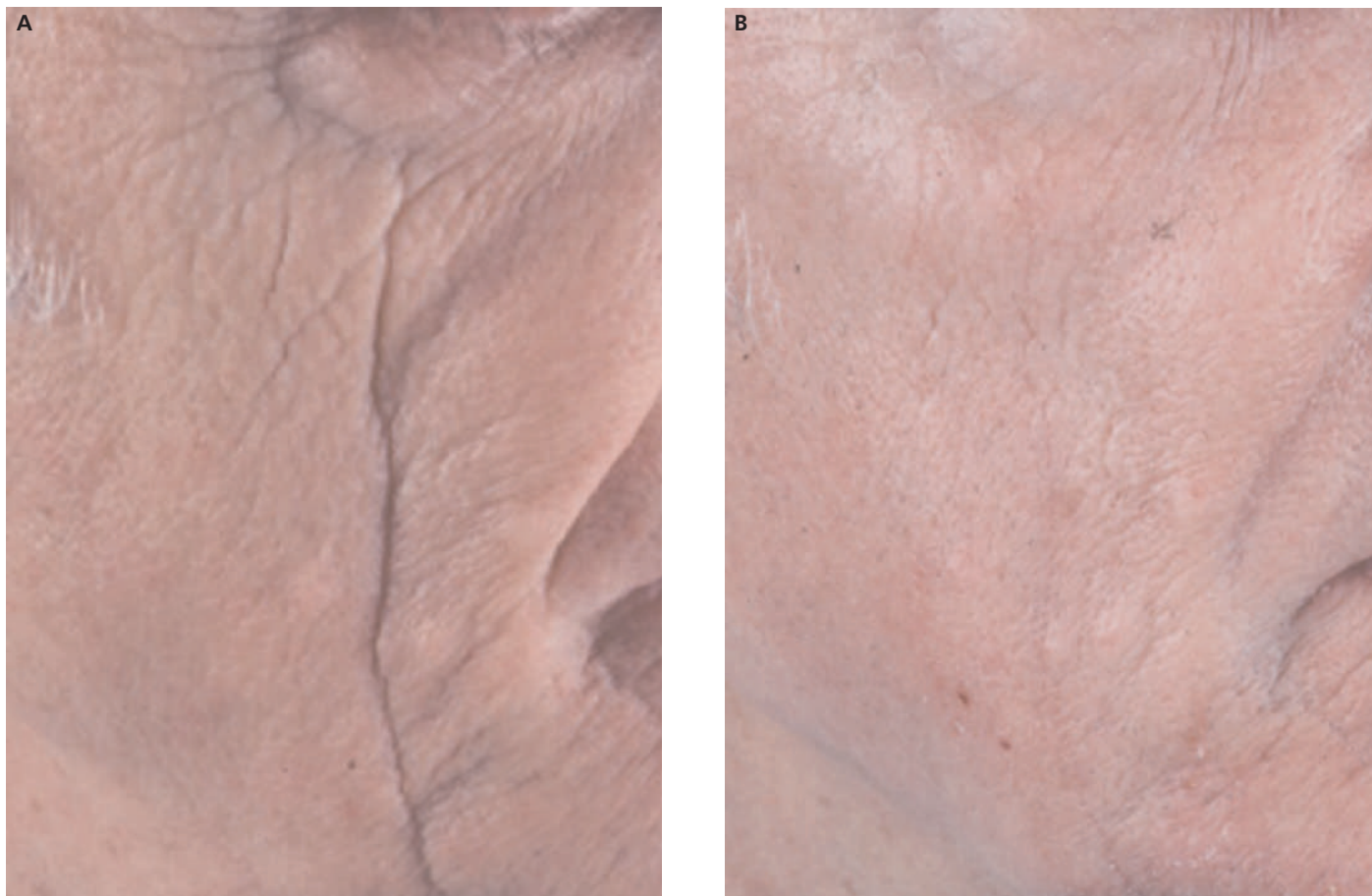


Figure 14. (A) The results following the injection of approximately 1 cc of liquid silicone over several months are shown in this follow-up photograph (B) taken 6 months post-treatment.

Personal Protocols

I prefer not to employ permanent implants in polyallergic patients, those with chronic dental or sinus infections, or patients involved in contact sports. I do not treat patients who have a history of autoimmune disease because I suspect that I will be blamed for a recrudescence of their problems. I rarely initiate treatment with permanent implants, except in individuals with disfiguring scarring, facial atrophy, or other suitable cutaneous defects. I believe that for these patients, permanent implants provide a fair and compassionate solution. I am extremely cautious when injecting lips. Complications following permanent implants in the lips have been the primary cause of patient dissatisfaction, particularly when nodules or severe swelling develops in association with herpetic outbreaks* or carious teeth.† In addition, I have observed asymmetric

enlargement of the lips following surgery or dental work years after silicone augmentation.³⁸

Treatment of Complications

For patients who have received labial injections of liquid silicone that have developed swelling, erythema, or induration in association with herpetic infections, I routinely employ oral antiherpetic agents such as valacyclovir. I have had my best results treating all types of inflammatory and granulomatous silicone complications combining antibiotics and oral and intralesional corticosteroids. I prescribe oral prednisone 20 to 40 mg daily on a tapered dose schedule while employing intralesional corticosteroids (Kenalog) starting at 2.5 mg/cc and increasing to 20 mg/cc as needed every 3 weeks. Minocycline (Minocin 100–200 mg daily) is prescribed at the same time.⁴⁴ One patient whose granulomas developed after “silicone treatment” in Mexico appeared to achieve some success using topical Aldara but discontinued its use when inflammation developed. Phonophoresis and allopurinol, which have been used to treat other types of granulomas, have not proved effective.^{11,45,46}

*I no longer employ permanent implants in the lips of patients with a history of herpes labialis.

†It may be useful to employ prophylactic minocycline when extensive dental procedures are carried out on patients who have received permanent lip implants.

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