

Review Article

Optimal Practices in the Delivery of Aesthetic Medical Care to Patients on Immunosuppressants and Immunomodulators: A Systematic Review of the Literature

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Abstract

Nonsurgical aesthetic procedures have been steadily growing in popularity among patients of all ages and ethnicities. At present, the literature remains devoid of guidelines on optimal practices in the delivery of aesthetic medical care to patients on immunosuppressant medications. The authors of this review sought to determine the physiologic responses of immunocompromised patients related to outcomes and potential complications following nonsurgical aesthetic procedures, and to suggest recommendations for optimal management of these patients. A comprehensive systematic review of the literature was performed to identify clinical studies of patients who had undergone nonsurgical aesthetic procedures while immunosuppressed. Forty-three articles reporting on 1690 immunosuppressed patients who underwent filler injection were evaluated, of which the majority (99%; 1682/1690) were HIV patients, while the remaining 8 were medically immunosuppressed. The complication rate of filler in this population was 28% (481/1690), with subcutaneous nodules the most frequently reported adverse event. A detailed synthesis of complications and a review of the inflammatory responses and impact of immunosuppressants and HIV infection on filler complications is presented. The authors concluded that patients on immunomodulatory medications may be at increased risk of filler granuloma relative to the general population, while patients on immunosuppressants may be at increased risk of infectious complications. Rudimentary guidelines for optimal preprocedural patient assessment, aseptic technique, injection technique, and antibacterial and antiviral prophylaxis are reviewed. Ongoing advancements in our understanding of the mechanisms underlying these inflammatory processes will undoubtedly optimize management in this patient population.

Level of Evidence: 3

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Minimally invasive aesthetic procedures have been steadily growing in popularity over the past decade.^{1,3} According to the most recent survey by members of The Aesthetic Society, over 3.9 million neuromodulator injections, 649,000 soft tissue filler injections, and 2.7 million laser and energy device treatments were performed in 2022, with the popularity of these treatments increasing every year.¹ Our group has previously reported on and defined the unique considerations in the treatment of patients of

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various ethnicities seeking nonsurgical aesthetic rejuvenation procedures, including North American, Latin American, African, Middle Eastern, European, and Asian patients.⁴⁻⁹ Aside from diverging age and ethnicities, patients seeking aesthetic procedures may also present with varying medical backgrounds and comorbidities. Of particular interest are patients on immunosuppressant medications, representing patients with a wide range of conditions such as autoimmune diseases, psoriasis, atopic dermatitis, malignancy, and organ transplant recipients.¹⁰⁻¹³ At present, the literature remains devoid of guidelines on optimal management of these patients for nonsurgical aesthetic procedures.

The objectives of the present systematic review were to evaluate the available literature to determine the physiologic responses of immunocompromised patients, with regard to outcomes and potential complications, following soft tissue filler injections as well as ablative and nonablative laser treatments. With the available evidence, the authors aim was to suggest recommendations for management of immunosuppressant medications, and/or aesthetic treatments, to ensure the best aesthetic outcomes while minimizing complications.

METHODS

A search of the National Library of Medicine to survey the available literature between October 2023 and March 2024 was performed, using search terms presented in the [Appendix](#), located online at www.aestheticsurgeryjournal.com. Retrieved articles were evaluated for inclusion with adherence to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.¹⁴ Nonduplicate titles were screened initially by title and abstract, and then by full text. Inclusion criteria comprised all studies reporting on patients who had either undergone aesthetic procedures while on immunosuppressant medications, or patients who were started on immunosuppressant medications postprocedure. Studies reporting on patients with human immunodeficiency virus (HIV) infection were also included. Aesthetic procedures of interest included botulinum toxin injections, filler and biostimulator injections, intense pulsed light (IPL), laser, radiofrequency, microfocused ultrasound, cryolipolysis, dermabrasion, and thread lift.

A total of 182 articles were excluded from the full-text article review. Exclusion criteria consisted of review articles and basic science, animal, or cadaveric studies. Studies describing applications of technologies, such as laser, in non-aesthetic fields, including applications in ophthalmology or dentistry, were excluded. Studies descriptive by nature, without adequate reporting on patient-related information, medications, interventions, outcomes, and complications, were excluded. Many studies describing aesthetic procedures in healthy patient populations, or studies that did not comment on the past medical history of the patients,

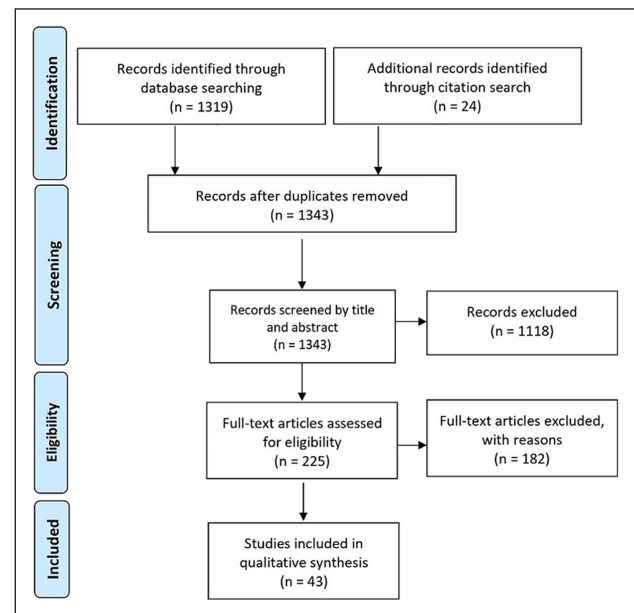


Figure 1. PRISMA search flowchart. A search of the National Library of Medicine was performed to survey the available literature using search terms presented the [Appendix](#). Retrieved articles were evaluated for inclusion with adherence to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. A total of 1319 articles were identified, of which 43 met the criteria for analysis.

were excluded. Finally, given that the majority of included studies discussed the use of fillers in the immunosuppressed population, with only 7 studies reporting on laser, and no included studies reporting on the other studied modalities, a total of 43 articles concerning filler were retained for analysis. Data extraction pertained to all patient-related information, aesthetic intervention details, outcomes, and complications. A synthesis of the evidence was devised, as were recommendations to ensure optimal outcomes in this population.

RESULTS

A flowchart of the literature search is presented in [Figure 1](#). A total of 1319 articles were identified, of which 43 met the criteria for analysis, reporting on 1690 immunosuppressed patients who had undergone filler injection. Further details concerning each paper, including specific treatment details (eg, filler reconstitution and laser settings) are available in [Supplemental Tables 1 and 2](#), located online at www.aestheticsurgeryjournal.com, and will be summarized here.

Patient Information

Seven studies reported on a total of 8 patients who had been treated with filler and who subsequently initiated various immunomodulating medications; 88% (7/8) of patients were

female, and the mean age was 53 years. The most frequently reported comorbid medical condition, in 50% (4/8) of patients, was chronic hepatitis C infection (HCV), requiring treatment with interferon α -2a and ribavirin.¹⁵⁻¹⁷ Comorbidities for the remaining 4 patients included metastatic melanoma, with the patient on a cytotoxic T-lymphocyte-associated protein 4 (CTLA-4) inhibitor (ipilimumab/Yervoy, Bristol Myers Squibb, NJ); a patient with severe allergic asthma on a monoclonal anti-immunoglobulin E (IgE) antibody (omalizumab/Xolair, Genentech, CA), a glossotonsillar squamous cell carcinoma patient on an epidermal growth factor (EGFR) inhibitor (cetuximab/Erbitux, Eli Lilly, IN), and chronic myeloid leukemia with the patient taking a tyrosine kinase inhibitor (imatinib, Novartis, Switzerland).¹⁸⁻²¹ Fitzpatrick phototype was not reported in any studies.

Thirty-six studies reported on a total of 1682 patients who were treated for HIV-associated lipoatrophy with filler injections. Eighty-six percent of patients were male, and the mean age was 50 years. Patients had a mean CD4 count of 420 cells/ μ L, and the majority had a low viral load of <200 copies/mL, with some studies including patients with up to 5000 copies/mL. Patients were on antiretroviral therapy for a mean duration of 10 years before the procedures. Fitzpatrick skin types were described in 3 studies and ranged from I to VI.

Procedure

A total of 38% (3/8) patients with drug-related immunosuppression were injected with hyaluronic acid (HA) filler, 25% (2/8) were injected with polymethyl methacrylate (PMMA), and 13% (1/8) received a combination of HA and calcium hydroxyapatite (CaHA). Studies on the final 2 patients did not report on the type of filler these patients received, however biopsies revealed that silicone was most likely. Injection sites were reported in 63% (5/8) patients, and included the nasolabial folds (3/8), and lips, cheeks, glabella, nasal dorsum, and peribuccal regions (1/8 each).

A total of 189 (11%) patients in the included investigations evaluating filler use in the HIV-positive population were injected with HA, 252 (15%) with CaHA, and 1241 (74%) with poly-L-lactic acid (PLLA). All patients received injections to the cheeks for correction of HIV-associated lipoatrophy. The mean number of treatment sessions was reported in 69% (25/36) of studies and was between 1 and 2 sessions for patients receiving HA, 2 sessions for those receiving CaHA, and 4 sessions for those receiving PLLA injections. Mean total injection volume was reported in 47% (17/36) of studies and was 8 mL for patients receiving HA, 13 mL for CaHA, and 24 mL for PLLA. In studies reporting on PLLA, reconstitution methods were provided in 86% (18/21) of cases. In 22% (279/1241) patients, at least 5 mL (range: 5–6 mL) of sterile water was employed for reconstitution. In 68% (842/1241), volumes of <5 mL (range: 2–4 mL) were reported. Reconstitution volume was unspecified in 10% (120/1241) of patients.

Outcomes and Complications

Complications were reported in 6 of the 7 studies concerning patients with drug-related immunosuppression, representing a cumulative complication rate of 88% (7/8). Localized complications included appearance of subcutaneous nodules in 75% (6/8) of patients, facial edema in 63% (5/8), facial erythema in 13% (1/8), and purpura of the lips in 13% (1/8). Additional systemic symptoms were reported in 1 study of 25% (2/8) patients, which included pulmonary sarcoidosis with lymphadenopathy in the first patient, and decreased DCLO (carbon monoxide diffusing capacity) in the second.¹⁵ In all patients, the above-mentioned immunomodulating medications were initiated after filler injection had been performed; mean reported time between filler injection and treatment initiation, reported on in all studies, was 8.9 years (range: 6 months to 25 years). All reported filler-related complications arose in patients after the initiation of these medications; mean reported latency between starting the medication and the development of complications, reported on in all studies, was 6 weeks (range: 2 hours to 4 months). A biopsy was performed in 75% (6/8) of patients, revealing a granulomatous foreign body reaction in 67% (4/6) and sarcoidal granuloma in 33% (2/6). The sarcoidal granulomas developed in 1 patient who had been treated with HA filler and PMMA filler, respectively, in the context of interferon therapy for HCV.

Complications were reported in 61% (22/36) of studies in the HIV population, comprising 4 studies reporting on 112 patients who receive HA filler, 1 study of 41 patients who received CaHA, and 18 studies of 1187 patients who received PLLA. In the population who received HA, within the first 12 months of follow-up, 22% (25/112) of patients developed subcutaneous nodules, while less than 1% (1/112) each developed rare adverse events, including recurrent herpes zoster, edema in treated areas after a flu-like illness, and erythema lasting over 7 days, respectively. In the population receiving CaHA, 7% (3/41) were reported to develop subcutaneous nodules within 12-month follow-up, while 5% (2/41) developed episodes of inflammation requiring antibiotic treatment. Finally, within the group receiving PLLA injections, 17% (197/1187) of patients developed subcutaneous nodules, while less than 1% developed inflammation (3/1187), infection (2/1187), induration (1/1187), anaphylaxis (1/1187), and ophthalmic herpes zoster (1/1187) within a range of 3 month to 3 years of follow-up.

A summary of all reported complications in immunocompromised patients treated with filler can be viewed in [Supplemental Table 3](#), located online at www.aesthetic-surgeryjournal.com.

The overall complication rate in the HIV-positive patient population consisting of 1682 patients was 28% (475/1682); the rate of development of subcutaneous nodules was of 13% (225/1682). The overall complication rate in patients who were immunocompromised, either in the context of immunosuppressants or of HIV infection, was 28% (481/1690);

the rate of development of subcutaneous nodules in this entire population was 14% (231/1690). When studies reporting on 842 patients injected with PLLA at reconstitutions less than 5 mL were excluded, the rate of subcutaneous nodule formation in the immunosuppressed population was lower, at 6% (107/1690), with an adjusted total complication rate of 21% (357/1690). A detailed breakdown of reported complication rates is found in [Supplemental Table 4](#), located online at www.aestheticsurgeryjournal.com. Before and after photographs of a patient treated by author S.D. with a combination of neurotoxin, hyaluronic acid filler, and biostimulators in the context of immunosuppression are presented in [Figure 2](#). The patient is a 69-year-old female who was diagnosed with triple negative breast cancer, stage 2A, in May 2023. She was treated with a lumpectomy and adjuvant chemotherapy of doxorubicin and paclitaxel for 12 weeks. The patient was treated with neurotoxin and filler between August and October 2023 during her ongoing chemotherapy treatment.

DISCUSSION

Although minimally invasive aesthetic procedures recently have been gaining popularity and are considered generally safe, with low rates of mild and transient adverse events, there is a paucity of studies on aesthetic outcomes and complications associated with these procedures in the immunosuppressed population from which definitive guidelines for optimal management can be drawn.^{1,2,22} In the present study, the reported overall complication rate for filler in immunosuppressed patients was 28%. Subcutaneous nodules in the context of filler injection were the most frequently reported complication in this population at 14%. In a multicenter cohort study by Alam et al in 2015 evaluating complications in 20,399 cosmetic dermatology procedures, a total of 48 adverse events were reported, a rate of 0.24%.²² The rates for filler were the highest (0.74%), followed by energy devices (13%), and neurotoxin (0.03%).²²

Foreign body granulomas are rare complications of filler injection and rates tend to vary by substance; in HA it has been reported to be up to ~0.4%, while CaHA displays the lowest rate at 0.001%.²³ This rate is reported to be slightly higher for semipermanent and permanent fillers such as PLLA, at up to ~0.25%, PMMA at up to ~1.51%, and silicone at ~0.22%.²⁴⁻²⁶ As reported in a 2014 consensus study concerning clinical use of PLLA, reconstitution with over 5 mL of sterile water was found to lead to significantly decreased rates of nodule formation, and volumes of 6 to 9 mL are now frequently utilized.²⁷⁻²⁹ Of note, when studies reporting on patients who had been injected with PLLA reconstitutions of less than 5 mL were excluded, the rate of subcutaneous nodule formation in the present study dropped to 6%, with an overall complication rate of 21%. Overall, these results suggest that

immunosuppressed patients may have a slightly increased risk of complications from minimally invasive aesthetic procedures, however given the lack of large high-quality studies in patients with drug-induced immunosuppression, this remains to be confirmed. The authors aimed to provide a comprehensive synthesis on the available evidence and description of molecular pathways and cellular responses at play, to supply guidance on optimal management of aesthetic treatments in this patient population. The study summary and authors' recommendations are summarized in [Figure 3](#).

Immunosuppressants and Immunomodulators

A wide range of immunosuppressive and immunomodulatory agents exist to treat a vast breadth of medical conditions including, but not limited to, organ transplant recipients, autoimmune diseases, psoriasis, atopic dermatitis, and malignancy.¹⁰⁻¹³ Immunosuppressants such as corticosteroids, calcineurin inhibitors, azathioprine, and mycophenolate mofetil, through a variety of mechanisms, broadly inhibit the transcription and synthesis of many proinflammatory cytokines, widely suppressing the proliferation of T- and B-lymphocyte lineages.³⁰⁻³⁹ Conversely, immunomodulators such as immune checkpoint inhibitors (ICI), interleukin inhibitors, and monoclonal antibodies suppress specific targets to selectively modulate the immune response.⁴⁰⁻⁴³ Finally, interferons (IFN) α or β may exert immunosuppressive effects, while IFN γ may stimulate both innate immunity and the T-helper type 1 (Th1) response.^{44,45}

Foreign Body Granuloma

Delayed complications of fillers are generally attributed to the formation of foreign body granulomas, due to either the tissue reaction to the unfamiliar filler material, or the presence of an infection and formation of biofilms.⁴⁶ Foreign body granulomas present between 6 months to 2 years after filler injection, although they have been reported over 10 years postadministration.²⁵ The acute inflammatory process, occurring within the first 24 to 72 hours, begins with the recruitment of neutrophils to the injection site, as well as local mast cell degranulation.^{47,48} Subsequently, the chronic inflammatory phase ensues through the recruitment of monocytes and lymphocytes, and stimulation of the Th2 pathway, leading to the development of multinucleated giant cells from which granulomas are formed.^{25,49} Late granuloma formation occurs months to years after injection, in which stimuli, such as infection, and possibly certain immunomodulatory medications, may precipitate the migration of memory macrophages to the filler site and cause late granuloma formation.^{25,50} Another hypothesis is that the filler serves as an antigenic trigger



Figure 2. Before and after frontal (A, B), quarter-right (C, D), right (E, F), quarter-left (G, H), and left (I, J) views of a patient treated with neurotoxin and filler in the context of immunosuppression. The patient was a 69-year-old female diagnosed with triple negative breast cancer, stage 2A, in May 2023. She was treated with a lumpectomy and adjuvant chemotherapy of doxorubicin (continued)

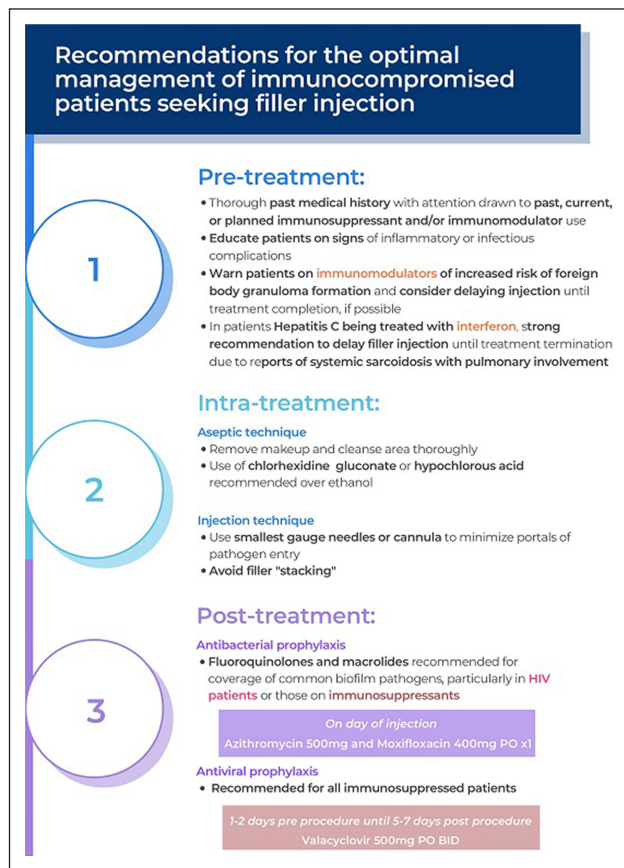


Figure 3. Flowchart of rudimentary guidelines and recommendations for the optimal management of immunosuppressed patients seeking filler injection. Review of strategies for pretreatment evaluation and decision making, intratreatment aseptic technique and injection technique, and finally posttreatment antibacterial and antiviral prophylaxis choices.

for a delayed hypersensitivity reaction (DHR), mediated by a variety of T-lymphocyte subtypes, as described.^{25,51}

Given the broad inhibition of lymphocytes and their mediators, it is likely that immunosuppressants would reduce the risk of a DHR to filler material, or reactivation of inflammatory pathways and memory macrophages in the context of foreign body granuloma formation.^{24,30-39,47-55} This is supported by the fact that immunosuppressant medications, such as prednisone and cyclosporine, are widely chosen to treat other conditions caused by DHR, such as

drug rash with eosinophilia and systemic symptoms (DRESS) and toxic epidermal necrolysis (TEN), as well as filler granulomas themselves.^{47,56} Conversely, patients on immunomodulating medications may be at increased risk of filler-related granuloma formation through their stimulation of T-lymphocyte responses.^{24,40-42,44,45,47-51,53-55} This is supported by the fact that ICIs and targeted anticancer therapies have been implicated in drug-related DHR, such as in cases of DRESS, TEN, and acute generalized exanthematous pustulosis (AGEP), as well as by the results of the present literature search in which all medically immunosuppressed patients presenting with filler granuloma had started immunomodulators such as interferon, omalizumab, ipilumab, and cetuximab.^{15-20,57-60}

Infection

In the present study, the rate of infection related to filler injection (including viral infection with herpes zoster) was 0.2% (4/1690), with all 4 cases being from the HIV patient cohort. Filler agents have been shown by a wide variety of authors to be safe and well tolerated by HIV patients in the correction of lip-oatrophy.^{61,62} However, some studies such as that of Kadouch et al have reported complication rates of up to 28%, with HIV patients being significantly more susceptible to abscess formation, particularly with permanent fillers.⁶³ The immunosuppression seen in these patients, particularly of CD4+ T cells and their pathways, is hypothesized to decrease the risk of development of foreign body granuloma in this patient population, but increase the risk of associated biofilm formation, and susceptibility to filler contamination with other infectious agents, complications which may also clinically present as subcutaneous nodules.⁶¹ Therefore, there are 6 hypothesized mechanisms by which the delayed onset of nodules, low-grade inflammation, and abscesses affecting the region of filler injection can occur.⁶³ In summary, it may be due to an invasive procedure (eg, dental work) triggering either the local innate immune system to stimulate an inflammatory response, the reactivation of dormant bacteria in biofilms, or the introduction of new pathogens that spread to the previously sterile filler.⁶³ Additionally, if no causal invasive procedure is identified, it may be due to contamination from bacteria present in hair follicles or cutaneous glands.⁶³ In this context, a rigorous infection prophylaxis protocol has been suggested by Rauso et al in their study of PMMA injection for HIV patients, in which the areas are double-cleansed with chlorhexidine 2%, and

Figure 2. (Continued)

and paclitaxel for 12 weeks. The patient was treated with neurotoxin and filler between August and October 2023 during her ongoing chemotherapy treatment. Photographs were obtained 8 weeks after her last treatment. Treatments performed included 60 units of botulinum toxin A (Botox, Allergan, Dublin, Ireland) to the upper face, periorbital region, upper lip, depression anguli oris, and platysma on August 31, 2023; 1 ml of collagen biostimulator to the midface (Sculptra, Galderma Laboratories, Lausanne, Switzerland), 1 ml of hyaluronic acid filler to the temples (Juvederm Ultra XC, Allergan, Dublin, Ireland), and 4 ml of hyaluronic acid filler to the marionettes and lower face (Restylane Defyne, Galderma Laboratories, Lausanne, Switzerland) on September 29, 2023; and finally 1 ml of hyaluronic acid filler to the lips (Belotero, Merz Pharmaceuticals, Frankfurt, Germany) on October 26, 2023.

patients are treated with 3 g of intravenous ceftriaxone before treatment, followed by 2 g per day of oral amoxicillin and clavulanic acid for 2 days.⁶⁴ Patients were also instructed not to shave or apply cologne, perfume, or cosmetics on the treated areas for the following week.⁶⁴

Recommendations

Pretreatment Considerations

A thorough medical history from all patients consulting for dermal filler is necessary, with particular attention drawn to immunosuppressants and immunomodulators, and medical histories of returning patients reevaluated longitudinally. The authors recommend that patients on immunomodulators in consultation with their prescribing physician be warned of the potential risks of filler granuloma formation and asked to consider delaying injection until completion of treatment. Should patients opt to pursue filler augmentation in acknowledgment of these risks, they should be aware of presenting signs and symptoms of filler granuloma and monitored for rapid intervention and management. Given rare retrospective reports of systemic sarcoidosis with pulmonary involvement in the context of treatment with interferon for hepatitis C infection, the authors recommend, based on findings in the literature, that consideration be given to excluding these patients from filler treatments, silicone filler in particular, until termination of their treatment.¹⁵⁻¹⁷ In addition, we urge physicians prescribing immunomodulators to inquire about any previous history of filler injection before initiating treatment, because these patients may necessitate consultation and management by an aesthetic physician.

Treatment and Posttreatment Considerations

Injectors are encouraged to adhere to aseptic technique during the procedure; any makeup should be removed and the area should be thoroughly cleansed with chlorhexidine gluconate, rather than ethanol, due to its prolonged residual effect.^{65,66} Hypochlorous acid can also be considered in patients with hypersensitivity to chlorhexidine, because it has been found to be as efficacious as chlorhexidine, iodine, and ethanol against common skin pathogens that can frequently be found in biofilms.⁶⁷ The smallest possible gauge needles, or a cannula, are encouraged to reduce trauma, minimize the risk of pathogen introduction, and decrease the need for multiple punctures and entries.^{65,66} Filler “stacking,” the practice of injecting additional filler into previously treated areas, should be avoided to prevent contamination of previous filler sites.⁶⁷

Given that immunosuppressed patients have higher susceptibility to infections, there is evidence supporting antibiotic prophylaxis for these patients, particularly when injecting semipermanent and permanent fillers.⁶⁸ Additionally, given that the presence of a biofilm may exacerbate the host's immune response and contribute to

chronic inflammation and persistent nodules at the filler site, prophylactic antibiotics can be considered for patients on immunomodulating medications.⁶³ Fluoroquinolones or macrolides have been suggested as appropriate choices for the prevention and treatment of infection in this context, with a single dose of 500 mg of azithromycin and 400 mg of moxifloxacin on the day of treatment having been effective at reducing inflammatory and infectious complications after PMMA injection from 7% to 2% in a cohort of 657 healthy patients.⁶⁸ Finally, in immunocompromised patients, HSV prophylaxis with valacyclovir 500 mg twice daily can be initiated 1 to 2 days preprocedure and continued for 5 to 7 days postprocedure.^{69,70}

A Note on Botulinum Toxin

Of note, only 1 study, by Scali et al, was retrieved by the literature search that reported on the use of neurotoxin in the immunosuppressed population; the authors had injected botulinum toxin A to correct posterior cheek enlargement in HIV patients. By 1 year, only transient side effects (lasting <4 weeks) were noted, including decreased bite force, changed facial expression, dysgeusia, and sunken cheeks. The complexing proteins that are added to certain formulations of botulinum toxin, rarely, can be immunostimulatory, leading to reported increases in IL-6 and TGF-beta 1, and occasionally, the development of neutralizing antibodies.⁷¹ A large meta-analysis evaluating the frequency of development of neutralizing antibodies in onabotulinumtoxin A revealed a rate of 0.49% across all cosmetic and medical indications.⁷² Therefore, despite the need for more studies in which this patient population is thoroughly investigated, it can be hypothesized, based on the principles described here, that immunosuppressed patients may be at an even lower risk of developing such adverse effects, and that botulinum toxin represents a safe option for uplifting patients suffering from a variety of neoplastic, autoimmune, and chronic infectious diseases.

Study Limitations

From this review of the literature, it is evident that there is a paucity of data objectively reporting on outcomes and complications associated with aesthetic procedures in the immunosuppressed population from which conclusions may be drawn. Likely in clinical practice many thousands of patients are on immunomodulators or immunosuppressants, or start them soon after undergoing aesthetic treatments, yet the anecdotal reports of adverse events in these aesthetic patients are few. There exist inherent biases when comparing clinical outcomes across various studies, because clinical experiences and protocols vary across different institutions. Patients on immunosuppressive therapy almost always harbor underlying inflammatory or

malignant conditions that may confound aesthetic outcomes or complications observed following aesthetic treatments, as investigated in this study. Recommendations have been hypothesized in light of basic science evidence given the paucity of quality clinical data available, and remain to be clinically validated in future studies.

CONCLUSIONS

The present article evaluates the limited available clinical and basic science evidence to propose guidelines for optimal practices in the delivery of aesthetic medical care to patients on immunosuppressant and immunomodulatory medications. Ongoing advancements in aesthetic physicians' understanding of the molecular mechanisms underlying nonsurgical aesthetic procedures and their effects on inflammatory processes and tissue remodeling will undoubtedly serve to optimize management in all patient populations, particularly those more vulnerable and on immunosuppressant medications.

Supplemental Material

This article contains [supplemental material](https://www.aestheticsurgeryjournal.com) located online at www.aestheticsurgeryjournal.com.

Disclosures

Dr Dayan is a consultant/speaker for Abbvie (North Chicago, IL), Galderma (Lausanne, Switzerland), Merz (Frankfurt, Germany), and has received research support from Abbvie, Galderma, Merz, and Revance (Nashville, TN). Dr Fabi is a consultant/speaker for Abbvie, Galderma, Merz Aesthetics, and Revance and has received research support from Abbvie, Galderma, Merz, and Revance. Dr Cattelan has nothing to disclose.

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