Radiologic Appearances of Polyacrylamide Hydrogel Injection of the Facial Region

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ABSTRACT
PAAG injection is an established means of facial augmentation. However, its radiologic appearances have not been previously emphasized in literature, to our knowledge. We report 3 cases with PAAG injection of the face and their respective radiologic findings.

INTRODUCTION
PAAG has been successfully used as a soft-tissue filler for facial contouring and augmentation mammoplasty for more than a decade.1 It is a gelatinous, hydrophilic, and biocompatible material, claimed to be non-toxic and nonallergenic and to cause little fibrous capsule formation.2 However, the procedure is irreversible, and the gel cannot be completely removed once injected. Complications arising from injection for breast augmentation, such as induration, pain, migration, and infection, have been well-documented in literature.2-4

Its use in facial augmentation and related complications is less extensively reported, and the radiologic appearances have not been highlighted previously in literature, to our knowledge. We report 3 such cases, 1 uncomplicated and 2 with serious complications following PAAG injection to the facial region.

Case 1
A 40-year-old woman in good past health presented with a 3-months history of mild left temporal headache, aggravated by lying on the left side of her face. She revealed a history of PAAG injection in both temporal regions 8 years ago. On physical examination, there was subjective local tenderness, but the overlying skin appeared normal with no signs of inflammation. No neurologic deficit was found. MR imaging of the brain was unremarkable but revealed lobulated T2 hyperintense and T1 hypointense areas in both temporal regions, predominantly beneath the temporalis muscles. Small lobules were also found to have migrated posterior to the lateral orbital walls and zygomatic arches. The T2 hyperintensity was incompletely suppressed on the FLAIR sequence (Fig 1A–C). No surrounding edema or collection was identified.

Case 2
A 14-year-old girl was admitted with painful swelling over the nasal region. She had a history of multiple PAAG self-injections for nasal augmentation 6 months ago. On admission, she had a low-grade fever with diffuse cellulitis changes from the glabella to the nasal tip. Needle aspiration over the mid-dorsum of the nose yielded 1 mL of pus. CT was performed, which revealed 2 small collections on the nasal ridge and at the nasal tip as well as surrounding ill-defined soft-tissue infiltrates (Fig 2A, B). Incision and drainage was performed, and

ABBREVIATIONS KEY
FLAIR = fluid-attenuated inversion recovery
PAAG = polyacrylamide hydrogel imaging
intravenous antibiotics were administered. The swelling gradually resolved, and the patient was discharged. MR imaging was arranged to further delineate the distribution of PAAG in the face. T2 hyperintense and T1 isointense material, consistent with PAAG, was found within the superficial and deep subcutaneous tissues at the tip of the nose and along both sides of the nasal bridge extending up to the central forehead (Fig 2C). No residual abscess was identified. The patient underwent elective reduction rhinoplasty 2 months after the initial presentation. Intraoperatively, the
PAAG material had blended with subcutaneous tissue and was debrided as much as possible.

Case 3
A 39-year-old woman had a history of PAAG injection in the breast 15 years ago and into the nose and cheek 9 years ago. No immediate complications were encountered after these procedures. She then developed ulcers over both cheeks 3 years after the injection. Physical examination revealed multiple shallow ulcers over the cheeks and chin region. MR imaging showed multiple areas of increased T2 signal intensity corresponding to PAAG material along the nasal ridge, glabella region, both sides of the nasal ala, and predominantly in the subcutaneous layer of both cheeks (Fig 3A) and chin. The borders were ill-defined, suggestive of infiltration into the surrounding subcutaneous tissues and superficial muscular layer. In addition, a small collection was found over the right mandible, and an ulcer crater was noted over the left chin (Fig 3B). Debridement was subsequently performed. The underlying facial muscles were noted to be heavily scarred. Pathologic examination of the debrided tissue revealed necrotic debris and inflammatory cell infiltration deep to the dermis and subcutaneous fat.

DISCUSSION
Filler injection is a relatively simple and noninvasive means of facial augmentation and is one of the most commonly performed cosmetic procedures. A wide variety of filler materials are currently on the market, which all have their unique qualities, advantages, and disadvantages.5 The decision as to which filler to use is a complex one, beyond the scope of this discussion.

PAAG has been reported to be generally safe and effective in the correction of facial contours.6,7 Similar to many other facial fillers, PAAG is injected under sterile conditions with or without prior local anesthetic, depending on the site. Methods of injection may vary, though 1 mL of gel in prefilled sterile syringes is usually injected subcutaneously in a retrograde manner via a thin-gauge needle (eg, 27 ga). Light manipulation may be applied after injection, to obtain an even distribution.1 The gel is a permanent filler, and once injected, cannot be completely removed.

Although the results of facial augmentation by using PAAG have been promising, case reports and studies with a longer follow-up period have revealed that various complications can occur.8,9 Most noteworthy and serious of these is delayed infection, which, as in breast augmentation, is a recognized complication. The rate and severity of complications depend on the quantity of hydrogel used and the technical quality of the procedure. Complications following PAAG injection into the breast occur at an average of 3–36 months after surgery.2 It has been proposed that late-occurring infection may be related to additional repeat injections8 as well as a decreased immune response.2

The imaging features of PAAG injection into the facial region have not been highlighted in previous literature. Reports on other forms of facial fillers and their radiologic appearances are equally scarce. The signal-intensity characteristics of PAAG reflect its similarity to the biochemical characteristics of water. Uncomplicated PAAG injections appear as well-defined lobulated T1 hypointense and T2 hyperintense collections, with the high T2 signal intensity being incompletely suppressed on fluid-suppression sequences as shown in case 1. Of note, these signal-intensity characteristics are not specific to PAAG, and differentiation from other augmentation materials may not be possible. For example, hyaluronic acid is the most commonly used facial filler and consists of a polysaccharide preparation with hydrophilic properties and is therefore expected to have similar signal-intensity characteristics. There is, to our knowledge, scant literature on the MR imaging appearances of hyaluronic acid in facial augmentation, possibly due to its nonpermanent quality and infrequency of complications. Its use in urinary tract injections for vesicoureteral reflux has been more extensively reported and has shown T1 hypointensity and T2 hyperintensity, similar to that in PAAG.10
Silicone characteristically shows high signal intensity in fat- and fluid-suppression sequences;11,12 from our experience with case 1, this signal intensity differs from that of PAAG, which shows incomplete suppression (ie, intermediate signal intensity) on fluid-suppression sequences. Other less commonly used fillers, such as fat (hyperintensity on T1 and T2) and collagen (low-to-intermediate intensity on T1 and T2) display distinctly different MR imaging signals compared with PAAG.13 Again, literature describing the appearances these types of fillers pertain to injection of anatomic areas other than the facial region.

On CT, PAAG deposits appear as nonspecific soft-tissue densities, which may become ill-defined with superimposed inflammation. Eliciting a previous history of facial augmentation is key. An unusual location or distinctly symmetric distribution may raise the suspicion of an iatrogenic source. The main role of CT is to estimate the affected area and to identify any drainable abscess in the acute setting.

There are other differential diagnoses, other than facial augmentation, that may give rise to subcutaneous cystic lesions and/or subdermal infiltrates. In uncomplicated cases, these include epidermoid and dermoid cysts, cystic schwannomas, seromas, and certain parasitic infections. However, these tend to have a more focal appearance compared with deposits of filler material. In the setting of infection, any other causes of subcutaneous inflammation or cellulitis may be possible, though the relevant clinical history of previous facial augmentation will lead to the correct diagnosis.

As in breast augmentation, PAAG deposits in the craniofacial region may migrate beyond the confines of the original site of injection, and fat-suppression MR imaging sequences are recommended for optimizing detection. Secondary infection can result in more ill-defined lesions, which are difficult to distinguish from surrounding tissues. This is especially the case with CT, in which limited contrast resolution curbs demarcation between inflammatory soft-tissue and PAAG deposits. Delayed infection, ulceration of the overlying skin, and abscess formation may also occur. As mentioned previously, complete removal is not possible, and excision together with surrounding tissue is often required to control and prevent future local complications.9

For cases with suspected infection, a contrast-enhanced CT or MR imaging (according to availability) should be performed to detect any rim-enhancing abscesses. For planning of definite surgery, MR imaging is recommended because it is superior in delineating the true volume and distribution of PAAG depositions.

CONCLUSIONS
This is a report of 3 cases with PAAG injection into the face and their corresponding radiologic appearances. From the preliminary experience of imaging of such cases, it is apparent that PAAG has a fluidlike MR imaging signal-intensity characteristic, owing to its similar biochemical properties to water. This may mimic other filler materials with hydrophilic properties. Delayed complications such as migration, infection with abscess formation, and ulceration may occur following PAAG injection, similar to those encountered in PAAG breast augmentation. We recommend a fat-saturated T2-weighted MR imaging sequence to best depict PAAG material. In the setting of suspected infection, a contrast-enhanced CT or MR imaging may be used to detect abscesses. MR imaging is more sensitive in distinguishing the deposits from surrounding tissues and is the preferred technique in assessing the volume and distribution of PAAG for surgical planning.

REFERENCES