Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

Main Imaging Modalities Predicting Face Induced Post-Filler Injection Complications: A Prospective Pilot Diagnostic-Accuracy Study"

Reham E. A. AbdElKareem[1]*, Salah E. AboElenin[1], Sherif A. Shama[1], Moataz M. Montasser[1], Moustafa M. A. Abdelnaby[2]

[1] Department of Radio Diagnosis, Faculty of Medicine, Alexandria University, Egypt

[2] Department of Otorhinolaryngology, Faculty of Medicine, Alexandria University, Egypt

*Correspondence: Reham E. A. AbdElKareem, Department of Radio Diagnosis, Faculty of Medicine, Alexandria University, Egypt, Tel. 01069582654 - Email: se.dream@hotmail.com.

Abstract: *Background:* The increasing use of dermal fillers in aesthetic procedures has led to a rising number of associated complications. Accurate imaging is essential for diagnosing and managing these complications, especially when symptoms are non-specific or mimic other pathologies. *Objective:* To assess the diagnostic performance of magnetic resonance imaging (MRI) and ultrasound (US) in the evaluation of post-aesthetic filler-related complications, and to correlate imaging findings with clinical and pathological outcomes. *Methods:* Twenty female patients with clinically suspected filler complications were retrospectively analyzed. All patients underwent both US and MRI evaluations. Imaging features were assessed regarding filler location relative to the SMAS, and complication characteristics. Data were correlated with clinical follow-up and, when available, histopathology. *Results:* The most common complications were nodules (55%), migration (45%), and overfilling (35%). MRI showed superior sensitivity in detecting deep complications, achieving 100% detection in abscess, lymphoma, and fat necrosis. US was effective for superficial findings, with 100% detection of overfilling and abscess. US was used for therapeutic measures in some cases. *Conclusion:* MRI and US are complementary in evaluating filler complications. MRI is superior in deep or complex lesions, while US remains a reliable first-line tool for superficial findings and follow-up.

Keywords: MRI; Ultrasound; Aesthetic complications; Filler migration.

1. Introduction

With the increased number of injectable fillers and the increasing reputation; as for offering the best means of everlasting youthful face. In the past ten years, millions of people undergone filler injection, many have had their beauty promise and others risked it all suffering from filler-induced complications. (1-4)

Based on MRI tissue characteristics and its ability to interpret different lesion composition and relying on the US/Doppler for identification of superficial lesions; the complementary use of these imaging modalities can offer accurate identification and characterization of filler induced complications: nodular reactions: Foreign body granuloma (FBG) and NIN (non-inflammatory nodules), particle migration, overfilling; abscess formation; inflammatory changes, facial scars, fat necrosis and face lymphoma. This opens the door for early diagnosis and better management. (3, 5-7)

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

Therefore, this study aimed to evaluate the imaging characteristics of various filler materials and their associated complications using multiple imaging modalities.

2. Materials and methods

2.1. Patients

This retrospective study included 20 female patients who presented with suspected complications following dermal filler injections. All patients underwent ultrasound (US) and magnetic resonance imaging (MRI) for evaluation. Written informed consent was obtained from all participants, including consent for publication of anonymized images.

This study was approved by the institutional ethics committee of Alexandria Faculty of Medicine in year 2023, approval reference unavailable as the committee doesn't assign numerical codes.

Sample size justification: This study is considered a pilot because aesthetic practitioners have limited awareness of the added value that radiologic imaging can provide in evaluating face post–filler complications, and consequently, patients are not routinely referred to radiology for assessment. As a result, there is a scarcity of prior data, making preliminary exploratory research necessary to define the role of imaging in this context.

2.2. Inclusion Criteria

Patients were included if they presented with one or more of the following: Persistent or progressive facial swelling following filler injection, clinically suspected filler-related nodules, migration, or other soft tissue abnormalities and need for imaging-based differentiation between inflammatory, granulomatous, or neoplastic lesions.

2.3. Exclusion Criteria

Patients were excluded if they had: Primary osseous or intraoral lesions not related to filler injection, Poor-quality MRI or US images, incomplete clinical data or lack of follow-up confirmation and contraindications to MRI (e.g., non-compatible pacemakers, cochlear implants).

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

2.4. Ultrasound Examination

US was performed using high-frequency linear probes (12–15 MHz) on Philips IU22, Philips EPIQ 5, or GE LOGIQ E9 systems. Dynamic assessment in at least two orthogonal planes was conducted. Doppler imaging was used to evaluate vascularity. All examinations were reviewed independently by two radiologists with >8 years of experience; discrepancies were resolved by a third senior radiologist.

2.5. Magnetic Resonance Imaging (MRI)

MRI was performed on a 1.5T scanner (Avanto, Siemens) using T1-weighted, T2-weighted, fat-suppressed, STIR, post-contrast, and diffusion-weighted sequences. PETRA sequences were obtained in selected cases on a 3.0T system (Skyra, Siemens) to assess bone involvement. Two experienced radiologists (12 years each) interpreted the images in consensus, blinded to US findings.

2.6. Statistical Analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Qualitative data were described using numbers and percent. Quantitative data were described using range (minimum and maximum).

3. Results

Out of 20 patients with post-aesthetic filler complications, a clear female predominance was observed, with a female-to-male ratio of 5:1. The patients' ages ranged from 18 to 60 years, with a mean age of 39 years. Assessment of the filler position relative to the superficial musculoaponeurotic system (SMAS) was found to be of considerable clinical importance, as it directly influences the management approach and potential surgical intervention. In this study, 50% of the cases showed complications confined to the superficial plane above the SMAS, while the remaining 50% demonstrated deeper extension below the SMAS, indicating more severe and potentially invasive outcomes.

The most frequently encountered filler-related complications were nodule formation (55%), filler migration (45%), and overfilling (35%). Less frequent findings included low-grade inflammation (30%), facial scarring (30%), and isolated cases of abscess, lymphoma, and fat necrosis. Ultrasound (US) demonstrated excellent sensitivity in detecting overfilling and abscess formation, both of which were identified in 100% of the relevant cases.

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

US also performed well in detecting nodules (72.7%) and low-grade inflammation (71.4%). However, its sensitivity decreased in evaluating filler migration (66.7%) and facial scarring (66.7%). Notably, US failed to identify the only case of lymphoma, resulting in 0% detection for this complication. In contrast, it successfully detected fat necrosis in its single occurrence (**Table 1**).

MRI demonstrated high detection sensitivity across most complication types, successfully identifying 100% of abscesses, lymphomas, and fat necrosis, and detecting more than 70% of nodules, migrations, and overfilling cases. MRI was also effective in evaluating low-grade inflammation (85.7%) and facial scarring (83.3%) (**Table 1**).

Mild inflammatory changes showed T2 hyperintense signals (83.3%), while foreign body granulomas (FBG) and fibrotic bands or scars were mainly associated with T2 intermediate signal intensity (75% each). Non-inflammatory nodules (NIN) showed mixed T2 signals, with half presenting intermediate intensity and the remainder split between hypo- and hyperintense patterns. Abscesses demonstrated T2 hyperintensity in 67% of cases, whereas the only case of lymphoma exhibited a distinct hypointense signal on T2-weighted images.

Post-contrast MRI showed avid or moderate homogeneous enhancement in cases with mild inflammatory changes and foreign body granulomas (FBG) representing 83.3% and 75% of cases, respectively. In contrast, non-inflammatory nodules (NIN) exhibited mainly minimal homogeneous enhancement (75%), while chronic inflammation or fibrotic scars showed enhancement in only 25% of cases. Abscesses and fat necrosis were both associated with peripheral rim enhancement (100%), while the only case of lymphoma demonstrated a heterogeneous enhancement pattern.

Diffusion-weighted MRI (DWI) findings revealed characteristic patterns among the different types of filler-induced complications. Abscesses and lymphoma consistently demonstrated restricted diffusion in 100% of cases. In the contrary, non-inflammatory nodules (NIN) exhibited no diffusion restriction across all cases. Mild inflammation and foreign body granulomas (FBG) showed restricted diffusion in 40% and 25% of cases, respectively. No measurable diffusion signals were recorded in cases of chronic inflammation or fibrotic scarring

On US FBG appeared as ill-defined hypoechoic lesion, in three cases 75% and well-defined hypoechoic nodule in 25%, NIN was interpreted as ill-defined hypoechoic nodule or well-defined hypoechoic nodule in 50% each. Lymphoma was seen as an abscess formation. Turbid cysts for abscess formation were seen in 75%. Identifying with edematous hypoechoic pattern in 85% of cases with low grade inflammation, and identifying all cases with face scars as architectural distortion and fat thinning out.

FBG showed peri-nodular increased Doppler vascularity in 75%. NIN revealed increased peri-nodular vascularity in 50%, whereas all cases with lymphoma shows increased peripheral vascularity. Diffuse areas of increased vascularity was identified in 90% of the cases with mild inflammations, however areas of scarring shows no

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

vascularity in 80%.

US allowed for aspiration of areas with overfilling in 10% and areas of migrating nodules in 20%, abscess in 50%. Also; it allowed for guided injection for hyaluronidase in 20% of cases with FBG, that enhanced therapeutic outcome.

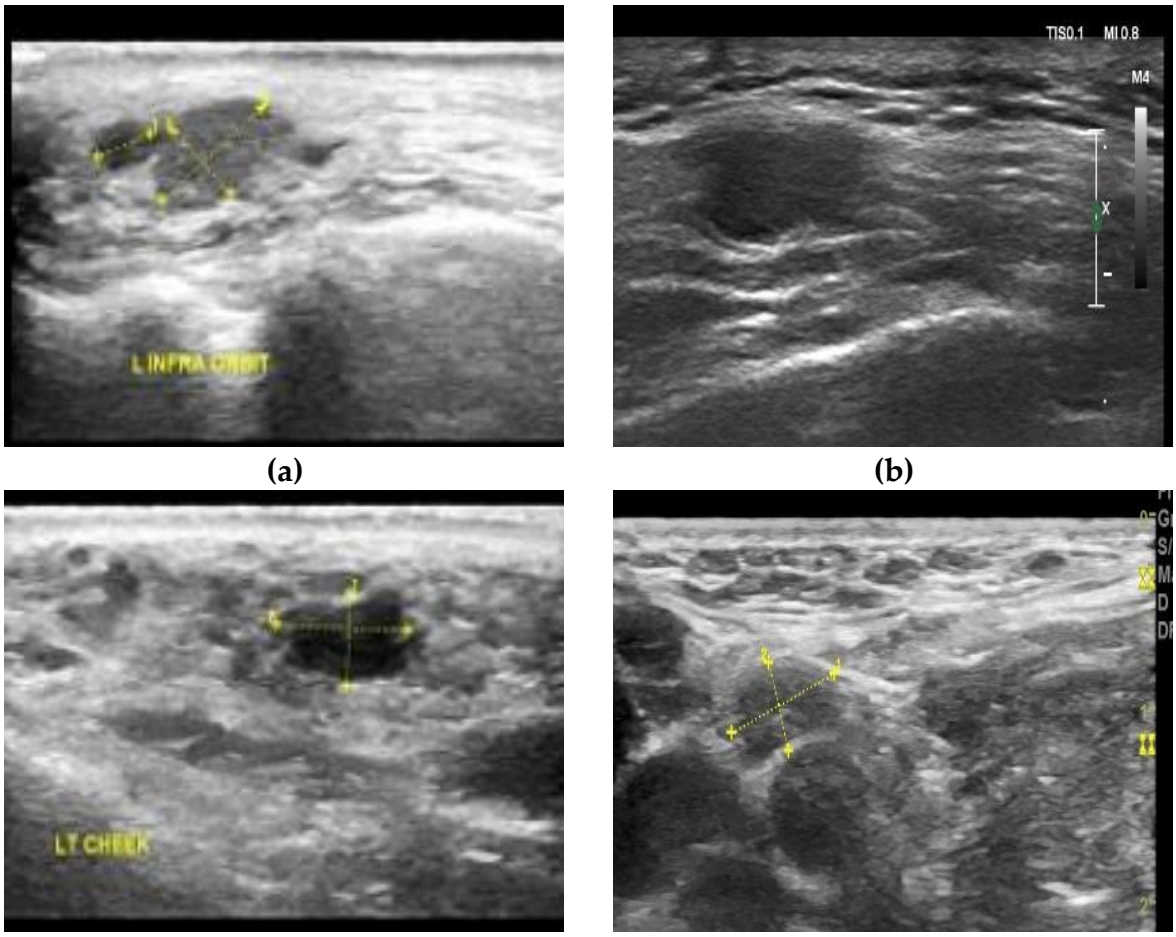
Table 1. Distribution of the studied cases according to incidence of complications and detection on US and MRI (n =20)

Findings	Total		US finding		MRI	
	N	%	8	72.7	N	%
Nodules	11	30	7	77.8	8	72.7
Migration	9	45	5	71.4	7	77.8
Overfilling	7	35	6	85.7	5	71.4
Low-grade inflammation	7	30	5	83.3	6	85.7
Facial scarring	6	10	3	100	5	83.3
Abscess	3	15	1	100	3	100
Lymphoma	1	5	1	100	1	100
Fat necrosis,	1	5	N	%	1	100

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

4. Cases

Case (1)



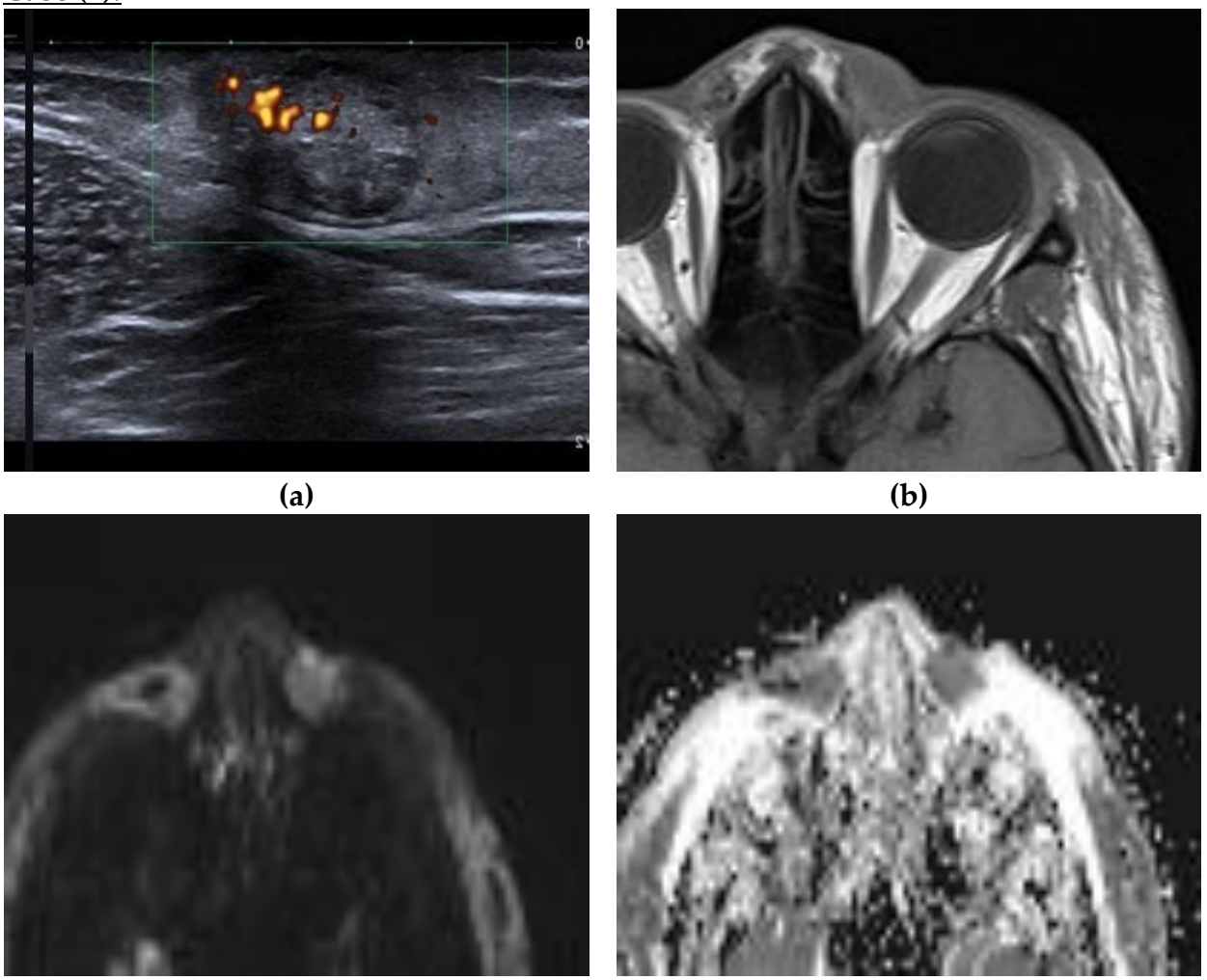
(a) **(b)**

(c) **(d)**

Figure (1): Different cases with migration and face nodules **(a)** 45 -year-old female patient, after lip filler injection complained of nodular painful swelling at the nasolabial fold, no fever, **US reveals particle migration with FBG** formation; it appears a rather well-defined, lobulated, hypoechoic nodule with no significant posterior enhancement, it is associated with related echogenic fat planes. **(b)** 29 -year-old female patient, after filler injection to the nasolabial region complaining of non-painful nodular swelling at the mandible; **US showing migrating particles, one formed a NIN** that appears as a rather well-defined heterogeneous nodule with no posterior enhancement, related echogenic fat planes, on the left is a migrating particle with no granulomatous changes, that is still seen well-defined, showing thin wall, posterior enhancement. **(c)** 55 -year-old male patient, after filler injection to the nasolabial region complaining of non-painful nodular swelling at the inferior eye lid; **US showing a migrating nodule** preserving its well-defined outline and anechoic pattern, having the normal appearance of posterior acoustic shadowing. **(d)** 29-year-old female patient with painful nodular skin**; US showing a FBG** with multiple nodules all are rather well-defined with hypoechoic content and no posterior acoustic enhancement.

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

Case (2):



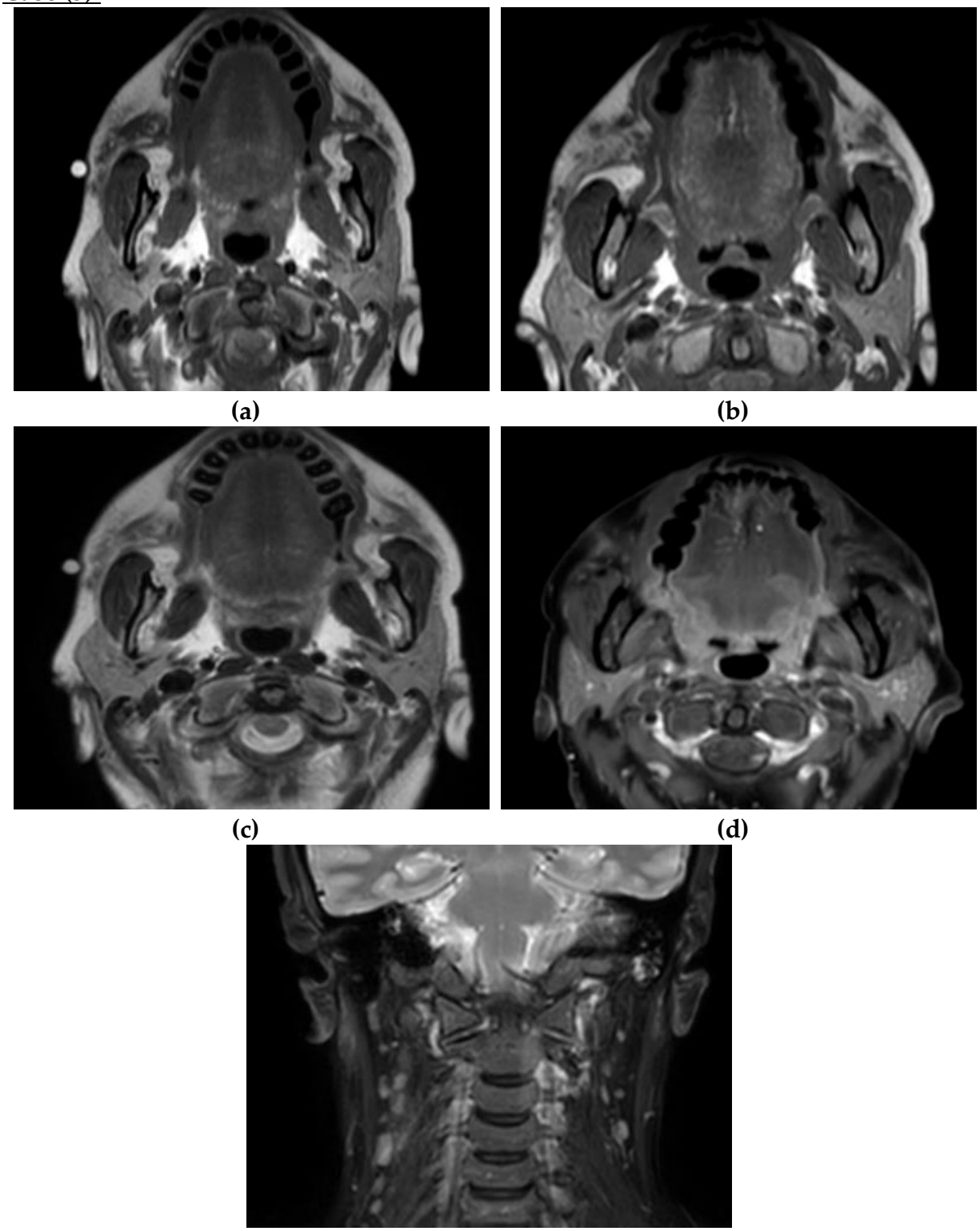
(a) **(b)**

(c) **(d)**

Figure (2): Case with post filler face lymphoma; 32-year-old female patient after filler injection, she complained of asymmetrical non-painful swelling on the left side **(a) US shows lateral cheek skin lymphoma;** it reveals a well-defined heterogeneous iso-echoic mass lesion with internal vascularity, though not typical pattern of vascularity in cases with complicated filler nodules; it was though for a granuloma nodule and after surgical excision the histopathology confirmed skin lymphoma. (b)axial cuts T1W sequences reveals intermediate signal nodule. (c, d) axial cuts DWI and ADC map that shows high restriction values on ADC-DWI

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

Case (3)

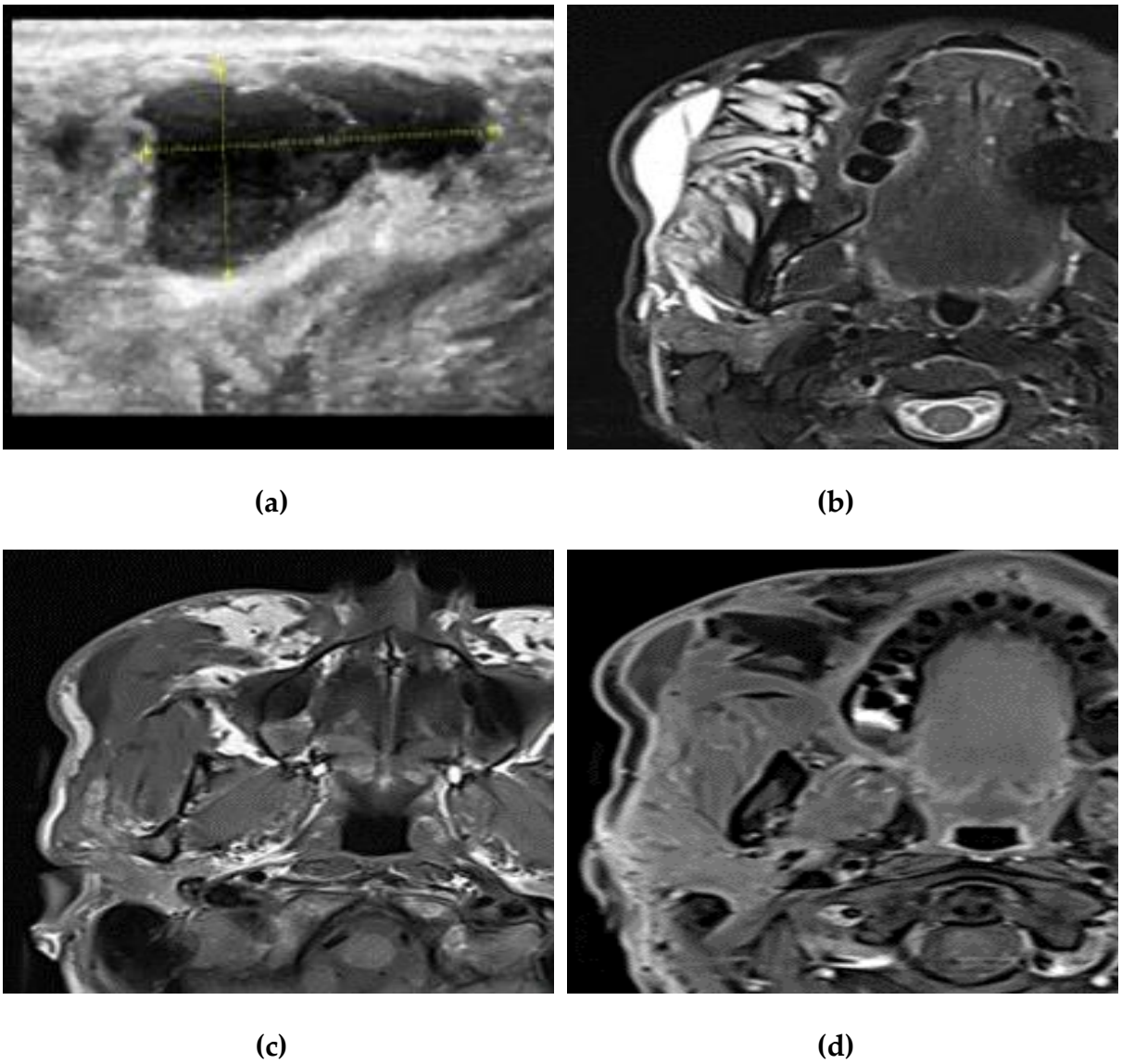


(a) (b) (c) (d) (e)

Figure 3): Case with FNG; 33 -year-old lady complained of painful swelling, MRI-showing the signal pattern of the FBG; fibro-nodular granuloma (a, b) axial cuts T1W sequences, reveals intermediate signal of nodular fibrotic streaks, (c) axial cuts of T2W sequence showing the nodules as intermediate signal, (d) axial cuts T1 FATSAT post contrast shows mild enhancement of the nodules.

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

Case (4)



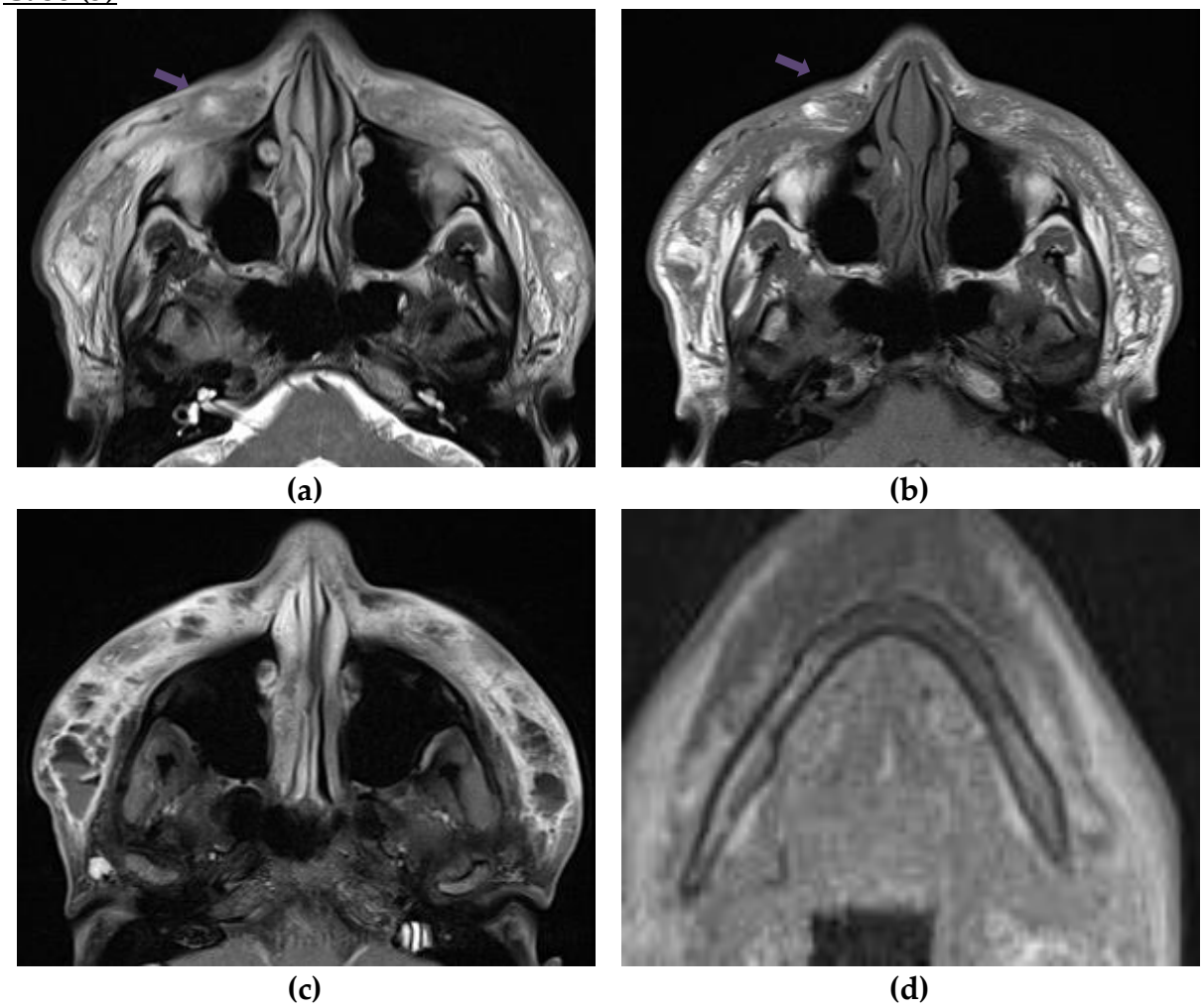
(a) **(b)**

(c) **(d)**

Figure (4): **This lady complained of throbbing pain with moderate elevation of temperature, localized redness and irregular skin texture, images show fibrotic changes with partial loculated inflammatory changes and abscess formation** (a) US reveals subcutaneous abscess formation with internal echoes and posterior acoustic enhancement , (b) MRI-axial cuts STIR sequence confirming the cystic appearance of the pseudo-loculations and the appreciable wall for the loculated collection, also seen the thick fibrotic plates expressing intermediate to hypointense signals. (c) MRI- axial cuts T1W and T1FAT SAT sequences, reveals intermediate to hypointense linear bands with pseudo-loculations that expresses hypointense T1 signal and a larger loculus that shows complete wall, (d) MRI- axial cuts T1 FATSAT post contrast images; revealed a superficial rim enhancing abscess formation and subtle enhancing fibrotic bands with no other abscess formation.

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

Case (5)



(a) **(b)**

(c) **(d)**

Figure (5): Case with face necrosis post filler injection; 45-year-old **lady complained of painful face swelling and redness,** show a migrating nodule to the facial vessels with consequent vascular occlusion, face edema and fat necrosis nodules; that shows fat/fluid leveling; (a) axial T2W sequences showing the migrating filler particle medial with lost void signal of the facial vessels (yellow arrow), diffuse edematous changes (blue arrow), and fat necrosis pocket seen as different signal intensities where the dependent component is seen more hyperintense. (b)axial cuts T1W sequences reveals the migrating particle as an intermediate signal with the related vessel still losing the void signal; diffuse edema reflects intermediate signal and fat necrosis pocket with the hypointense fluid at the dependent aspect and fat floating above; (c) axial cuts T1 FATSAT post contrast show enhancement of the nodule and the diffuse avid enhancement of the edema; non-opacification of the vessels with the fat seen suppression of the peripheral hyperintense signal and enhancement of the central core, (d) PETRA sequence showing possibility for associated osseous necrosis notable at the anterior margins of the mandibular bone with interrupted periosteal reactions and thickening and altered marrow signal.

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

5. Discussion

This study highlights the diagnostic performance of MRI and ultrasound (US) in detecting and characterizing post-aesthetic filler complications. Complications included nodules, particle migration, overfilling, low-grade inflammation, abscess, lymphoma, fat necrosis, and scarring. MRI demonstrated higher sensitivity in identifying deep or complex lesions, while US was more accessible and informative for superficial pathologies.

MRI was able to detect 100% of abscesses, lymphoma, and fat necrosis cases, and demonstrated high detection rates for low-grade inflammation and scarring. On the other hand, US reached 100% detection for overfilling and abscess, with slightly lower sensitivity in nodules and particle migration.

T2 hyperintense signals were predominant in mild inflammation and abscesses, while intermediate and hypointense signals were observed in FBG and NIN nodules. On contrast assessment FBG have showed moderate homogeneous enhancement whereas lymphoma shows heterogeneous enhancement, peripheral enhancement was common finding in abscess with milder peripheral enhancement on areas of fat necrosis. Avid enhancement predominates in areas with inflammatory changes and delayed enhancement was typical for tissue scarring

This is in concordance to the findings mentioned by **Pravin Mundada, et al., (7)** who stated that intermediate signal nodules are seen more commonly in cases with FBG rather than NIN.

In **Di Girolamo et, al. (8)** study, it was interpreted that after the injection of Gd-DOTA; areas of moderate enhancement were typical for inflammatory granuloma on histo-pathological evaluation and areas with delayed enhancement showed fibrotic changes and no post-therapeutic improvement.

In our study, Diffusion restriction was a typical feature characterizing lymphoma and abscess lesions. While FBG nodules show restricted diffusion restriction in 25% of the cases, NIN typically show no appreciable diffusion restriction.

In **Di Girolamo et al. [9],** study, it was highlighted that facilitated diffusion was a feature for NIN, whereas restricted diffusion was found more commonly in active inflammatory changes.

In this study, US fulfilled the frequent need to monitor the degree of augmentation induced at the superficial layers of the face soft tissue, using the Doppler for detection of the neovascularization for the dermis, which was of great impact in monitoring therapeutic response.

This was resonant to the sequential studies carried out by **Privalova E.G. (9-11)** In which they assessed the therapeutic value of filler injection versus the filler induced complications. In their studies they used US guidance for sub-dermal filler injection and adopted US regular check for interpreting the effective duration for different filler material.

Ill-defined hypoechoic nodules on US were typical for FBG that wasn't a feature for NIN. Smaller well-defined nodules are suggested for NIN. In this study; one of the nodules had a management under US guidance for hyaluronidase injection with successful regressed symptoms and improved outcomes.

In Doppler identified cases with migratory nodules occluding branches for the facial artery. One of the cases was adequately localized under US and was managed by injection of hyaluronidase under US guidance. Doppler aided in predicting the prognosis after injection, showing that inflammatory areas with increased vascularity would give better prognosis over scarred areas with regressed vascularity or no detectable vascularity.

In concordance to the sequential studies on filler complications carried by **Privalova E.G. (9-11)** that described the value of using doppler in filler assessment can't be disregarded when aiming for accurate diagnosis and therapeutic values. In their studies they reflected that Doppler values on consequent time durations can allow for better management interpretation and early shifting for alternative treatment plans that markedly reduces the consequent morbidities associated with filler injection.

6. Limitations

This study had several limitations. First, the relatively small sample size (n = 20) may affect the statistical power and limit the generalizability of the findings to broader populations. Second, histopathological confirmation was not available for all imaging findings, particularly in cases managed conservatively without surgical intervention, which may influence the accuracy of lesion classification. Third, ultrasound assessment was operator-dependent, which could introduce variability in image interpretation and diagnostic performance. Lastly, the lack of long-term follow-up data hindered evaluation of the progression or resolution of some filler-related complications.

7. Recommendations

Larger, multicenter studies are recommended to validate imaging accuracy across diverse filler types and complications. Standardizing MRI and Doppler US protocols and improving radiologist training may enhance diagnostic consistency. Clinically, a combined MRI and US approach is advised for suspected filler complications to improve diagnostic confidence and guide appropriate management.

8. Conclusion

MRI and ultrasound offer complementary roles in assessing post-aesthetic filler complications. MRI excels in detecting deep or complex lesions, while US remains valuable for superficial findings. Characteristic MRI signal patterns and enhancement help differentiate between inflammatory, granulomatous, and neoplastic changes. Dual-modality imaging optimizes diagnosis and clinical decision-making.

Senses Sci (Educ Sci Tech) 2024: 11 (4): 276-288
doi: 10.14616/sands-2024-4-276288

Funding
No funding will be received to perform the study.

Conflict of interest
None

References

1. Funt D, Pavicic T. Dermal fillers in aesthetics: an overview of adverse events and treatment approaches. Plast Surg Nurs. 2015;35(1):13-32.

2. Hamrah D, Aleman B. Injectable Soft Tissue Fillers and Their Use in Facial Rejuvenation. In: Amin D, Marwan H, (eds). Pearls and Pitfalls in Oral and Maxillofacial Surgery. Cham: Springer International Publishing; 2024. 301-13.

3. Hong GW, Hu H, Chang K, et al. Adverse Effects Associated with Dermal Filler Treatments: Part II Vascular Complication. Diagnostics (Basel). 2024;14(14):1555.

4. Desai S, Given K, Lee M, Sadeghpour M, Alam M. Complications of Temporary Fillers. In: Carruthers J, Carruthers A, Dover JS, Alam M, Ibrahim O, (eds). Procedures in Cosmetic Dermatology: Soft Tissue Augmentation-E-Book. 5th ed. London: Elsevier Health Sciences; 2023. 291-313.

5. Grippaudo FR, Di Girolamo M, Mattei M, Pucci E, Grippaudo C. Diagnosis and management of dermal filler complications in the perioral region. J Cosmet Laser Ther. 2014;16(5):246-52.

6. Ginat DT, Schatz CJ. Imaging features of midface injectable fillers and associated complications. AJNR Am J Neuroradiol. 2013;34(8):1488-95.

7. Mundada P, Kohler R, Boudabbous S, Toutous Trellu L, Platon A, Becker M. Injectable facial fillers: imaging features, complications, and diagnostic pitfalls at MRI and PET CT. Insights Imaging. 2017;8(6):557-72.

8. Di Girolamo M, Mattei M, Signore A, Grippaudo FR. MRI in the evaluation of facial dermal fillers in normal and complicated cases. Eur Radiol. 2015;25(5):1431-42.

9. Privalova EG. The possibilities of ultrasound in injection cosmetology. Radiat Diagn Ther. 2019;1:25-34.

10. Privalova E. High-Resolution Ultrasonography in Differential Diagnosis of Complications after Face Contouring. Diagn Radiol Radiother. 2020;1:52-3.

11. Privalova EG. The role of high-resolution ultrasound in the diagnosis of complications of facial contouring Metamorphoses. 2017;18:28–33.