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Binocular Horizontal Diplopia Following mRNA-1273 Vaccine

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Isolated cranial nerve (CN) VI palsy has been associated with SARS-CoV-2 infection in 6 reported cases (1,2). Research suggests that SARS-CoV-2 causes virally mediated injury along the cranial nerves, most commonly affecting the olfactory nerve leading to anosmia (2). In this report, we describe a patient who received the Moderna COVID-19 vaccine and subsequently presented with a bilateral CN VI paresis. Our case is the first report demonstrating MRI confirmation of abducens nerve enhancement consistent with a postvaccination inflammatory cranial neuritis.

A 45-year-old healthy woman presented with a 3-week history of painless binocular horizontal diplopia worse on right gaze, the onset of which was 4 days after receiving her initial dose of the mRNA-1273 vaccine. Diplopia was initially intermittent and subsequently became constant. Within this 3-week period, the etiology of her diplopia remained unclear, and neuro-ophthalmology consultation was requested. As part of her outside evaluation, the patient underwent serial SARS-CoV-2 polymerase chain reaction tests, all of which were negative.

At presentation, corrected visual acuity was 20/25 in the right eye and 20/20 in the left eye. Cross-cover testing revealed a 2-prism diopter esophoria in primary position, 18-diopter esotropia on right gaze, and 8-diopter esotropia on left gaze. There was limited abduction of both eyes, worse in the right eye (Fig. 1). Dilated fundus examination was unremarkable. Automated visual fields were within normal limits in both eyes. A contrast enhanced MRI brain and orbits showed right greater than left enhancement of CN VI at the proximal cisternal segment and root entry zone (Fig. 2).

On follow-up 2 months later, the patient stated her diplopia significantly improved. Cross-cover testing revealed orthophoria in primary position and left gaze and a remaining 18-diopter esotropia in right gaze. A repeat MRI brain and orbits showed complete resolution of previously seen enhancement along the right abducens nerve and near-complete resolution of previously seen enhancement of the left abducens nerve. The patient received her second dose of the mRNA-1273 vaccine 5 weeks after her initial vaccine without adverse effect.

Although there have been numerous cases reported of abducens palsies related to SARS-CoV-2 infection and one case of unilateral abducens palsy associated with COVID-19 vaccination (3) without MRI confirmation of CN VI enhancement, we believe this to be the first reported case of a bilateral CN VI paresis associated with COVID-19 vaccination. Cranial nerve palsies have been reported as a rare complication following routine immunization for other diseases. In a study excluding CN VII, the most commonly reported deficits involved cranial nerves III, IV, and VI. Onset of isolated nerve palsies following immunization ranges from days to weeks (3).

The pathophysiology of vaccine-associated cranial neuropathies remains unknown and has been hypothesized as immune-mediated damage resulting in demyelination or reduction in blood flow to the nerve (3). Until the recently reported case of a unilateral CN VI palsy reported by Reyes-Capo et al (3), the only cranial neuropathy associated with the administration of any COVID-19 vaccines has been CN VII palsy (4). Whether these reported neurological

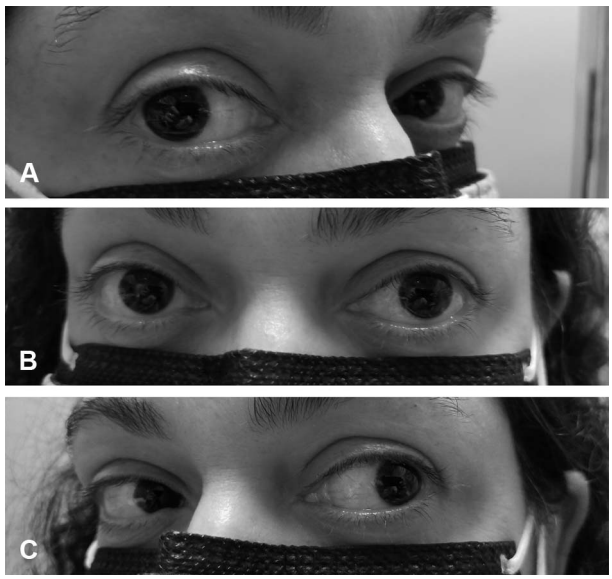

FIG. 1. Patient presentation in right gaze (**A**), primary gaze (**B**), and left gaze (**C**), demonstrating bilateral abduction deficit in the right eye greater than that in the left eye.

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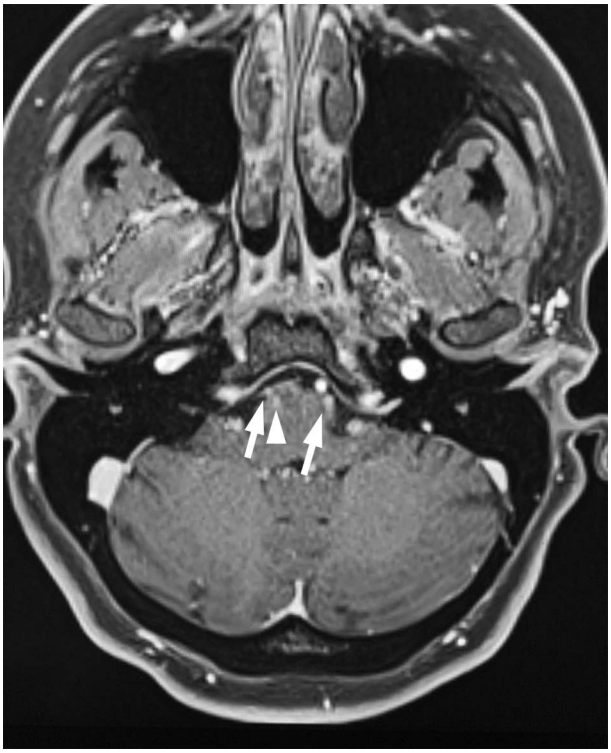

FIG. 2. MRI demonstrating bilateral inflammatory abducens neuritis. High-resolution postcontrast T1 axial VIBE image of the skull base shows bilateral enhancement of the proximal abducens nerve (*arrows*). There is an additional focus of brainstem enhancement involving the right abducens nerve root entry zone at the pontomedullary junction (*arrow head*).

complications are associated with the vaccine components or with the SARS-CoV-2 mRNA itself has yet to be elucidated. Other than cranial neuropathies, neurological involvement of COVID-19 has been associated with occurrences of Guillain–Barre syndrome, Miller Fisher syndrome, and large vessel stroke (2). More specifically, there have been numerous neuro-ophthalmologic complications attributed to COVID-19, including optic neuritis, intracranial hypertension, and nystagmus (5).

Public perception of risk associated with vaccinations, particularly COVID-19 vaccines in light of their accelerated production, can limit the success of eradicating a disease. Although isolated cranial nerve palsies can cause significant symptoms during their course, the majority of patients with these neurologic complications recover within 6 months. There have been cases reported in children of recurrent CN VI palsies following different live-attenuated vaccines with recovery (3). Because our patient presented with symptoms of CN VI after the first vaccine dose, it came into question whether the second dose should be administered. After weighing the risk of a recurrent benign cranial nerve paresis to the benefit of a potentially life-saving vaccine, it was recommended to our patient to proceed with the second dose of the mRNA-1273 vaccine.

The differential diagnosis for an isolated bilateral CN VI palsy in a young adult would include an infiltrative process, demyelinating disease, and elevated intracranial pressure. However, we feel the patient's young age and absence of vasculopathic risk factors coupled with bilateral enhancement of the abducens nerve and absence of other demyelinating plaques on MRI supports a vaccine-induced immune-mediated neuritis as the most plausible explanation for our patient's presentation.

STATEMENT OF AUTHORSHIP
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REFERENCES

1. **Greer CE**, Bhatt JM, Oliveira CA, Dinkin MJ. Isolated cranial nerve 6 palsy in 2 patients with COVID-19 infection. J Neuroophthalmol. 2020;40:520–522.
2. **Francis JE**. Abducens palsy and anosmia associated with COVID-19: a case report. Br Irish Orthoptic J. 2021;17:8–12.
3. **Reyes-Capo DP**, Stevens SM, Cavuoto KM. Acute abducens nerve palsy following COVID-19 vaccination. J AAPOS. 2021;25:302–303.
4. **Colella G**, Orlandi M, Cirillo N. Bell's palsy following COVID-19 vaccination. J Neurol. 2021;268:3589–3591.
5. **Gold DM**, Galetta SL. Neuro-ophthalmologic complications of coronavirus disease 2019 (COVID-19). Neurosci Lett. 2021;742:135531.