Relationship of Imaging-guided Corticosteroid Injections to COVID-19 Incidence in the Pandemic Recovery Period

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Conflicts of interest are listed at the end of this article.

Background: Corticosteroids injected for the treatment of musculoskeletal pain are systemically absorbed and can affect the immune response to viral infections.

Purpose: To determine the incidence of symptomatic COVID-19 disease in individuals receiving image-guided corticosteroid injections for musculoskeletal pain compared with the general population during the pandemic recovery period.

Materials and Methods: In this prospective cohort multicenter study, adults with a history of musculoskeletal pain who underwent imaging-guided intra-articular and spine corticosteroid injections from April 2020 to February 2021 were consecutively enrolled. Participants were followed for a minimum of 28 days through their electronic medical record (EMR) or by direct phone communication to screen for COVID-19 test results or symptoms. Clinical data, including body mass index (BMI), were also obtained from the EMR. The incidence of COVID-19 in the state was obtained using the Massachusetts COVID-19 Response Reporting website. The Student t test was used for continuous variable comparisons. Univariable analyses were performed using the Fisher exact test.

Results: A total of 2714 corticosteroid injections were performed in 2190 adult participants (mean age, 59 years ± 15 [SD]; 1031 women). Follow-up was available for 1960 participants (89%) who received 2484 injections. Follow-up occurred a mean of 97 days and 4 months). Participants diagnosed with COVID-19 within 28 days from the injection had a higher BMI than the entire cohort (n = 1960) (mean, 32 kg/m² ± 6; vs 28 kg/m² ± 6; P = .04).

Conclusion: Adults who received image-guided corticosteroid injections for pain management during the pandemic recovery period had a lower incidence of symptomatic COVID-19 compared with the general population.

Online supplemental material is available for this article.

Corticosteroid injections are a first-line treatment for musculoskeletal pain (1–3). During the beginning of the COVID-19 pandemic, concerns about the safety of intra-articular and spine corticosteroid injections were raised due to known systemic absorption and effects on the immune system (4,5). Corticosteroids have direct effects on immune cells, including a reduction in the ability of neutrophils to migrate to sites of infection, impairment of macrophage and monocyte function, and suppression of the hypothalamic-pituitary-adrenal (HPA) axis (5–7). When the HPA axis is suppressed by exogenous steroids through negative feedback, the organism becomes more vulnerable to the effects of the inflammatory cascade that happens in response to a pathogen such as SARS-CoV-2 (7,8). After an intra-articular or spine corticosteroid injection, HPA axis suppression usually peaks at 24–48 hours and may take up to 4 weeks for normalization (4,9–13). In a meta-analysis by Broersen et al (14), adrenal insufficiency was seen in up to 52.2% of individuals after intra-articular corticosteroid injection.

Corticosteroid hesitancy also derives from epidemics of other viruses, including influenza, Middle East respiratory syndrome (MERS), and severe acute respiratory syndrome (SARS), in which critically ill individuals receiving systemic corticosteroids showed worse outcomes than the general population (15–17). Due to the initial uncertainty, professional societies issued statements advising against elective corticosteroid injections, leading to disruptions of musculoskeletal pain treatment services throughout the world (18–21). In February 2021, the American Academy of Orthopaedic Surgeons recommended that alternative options to corticosteroids should be considered for treatment of musculoskeletal pain and that patients should be counseled regarding the potential immunosuppression risk associated with corticosteroids (22).

The results of studies evaluating individuals who received injections during the lockdown period have been reassuring, but the changes in public health policies, including decreased physical distancing and the reopening of businesses, and potentially higher exposure when vaccines were not yet available, warrant additional investigation.

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In this prospective study of 1960 adults who underwent image-guided corticosteroid injections for pain management during the COVID-19 pandemic, the rate of symptomatic COVID-19 within 28 days was lower than that of the state population (0.5% vs 7.5%, \( P < .001 \)).

Up to 4 months after corticosteroid injection, the rate of symptomatic infection (2.2%) was also lower than that of the general population (\( P < .001 \)).

The purpose of our study was to determine the incidence of symptomatic COVID-19 disease in individuals who received fluoroscopy- and US-guided corticosteroid injections for musculoskeletal pain compared with the general population during the COVID-19 pandemic recovery period.

Materials and Methods

The sample analyzed in this study partially overlaps with that used in a previous study (23). However, the analysis in the current study includes additional data from an extended follow-up period and offers a more robust evaluation of the relationship between corticosteroid injections and incidence of COVID-19. This prospective study was compliant with the Health Insurance Portability and Accountability Act and approved by the institutional review board, with verbal consent of the participants.

Participant Selection

Inclusion criteria were adults older than 18 years with a history of musculoskeletal pain who were scheduled for image-guided corticosteroid injection at our primary large academic center or affiliated community hospital. A convenience sample of participants who received injections from April 15, 2020, through February 26, 2021, was used. Exclusion criteria were age 18 years or younger, pregnancy, having undergone procedures in which corticosteroids were not administered or aborted procedures, and loss to follow-up. The follow-up period included the last few weeks of the lockdown period in the state of Massachusetts (April 15, 2020 to May 18, 2020) and the different recovery phases that were part of an official government plan for reopening businesses and industries in the state: phase 1 (May 19, 2020 to June 7, 2020), phase 2 (June 8, 2020 to July 12, 2020), phase 3 step 1 (July 13, 2020 to October 4, 2020), phase 3 step 2 (October 5, 2020 to December 13, 2020), and rollback to phase 3 step 1 (December 14, 2020 to February 26, 2021). The COVID-19 vaccine roll-out in the state started on December 15, 2020, initially targeting health care workers and first responders only. General public vaccination began on February 1, 2021, for people 75 years and older and on April 19, 2021, for those 16 years and younger. The state government of Massachusetts provides publicly available information on COVID-19 cases in the state through their COVID-19 Response Reporting website (27).

Image-guided Corticosteroid Injections

Injections were performed by a fellowship-trained musculoskeletal radiologist, musculoskeletal radiology fellows, or a radiology assistant with 8 years of procedure experience and supervised by musculoskeletal radiologists with less than 5 years (J.R.T.V., M.J., R.R.B.), 5–10 years (A.B.K., J.S.H., F.J.S.C., C.Y.C.), and more than 10 years (M.A.B., A.J.H., W.E.P) of experience. Extra measures in scheduling and preprocedural practices to physically distance participants and to minimize waiting room time were in place during the entire study period according to hospital policy, with minimal changes throughout the year. All participants were called the day before the examination to screen for sick contacts or symptoms of COVID-19. From April to June 2020, participants were instructed to physically distance for 1–2 weeks after the corticosteroid injection. This formal recommendation was later discontinued, although general safety measures were still endorsed for the remainder of the study period.

Injections were performed with a sterile technique, which included the use of povidone-iodine or chlorhexidine for puncture site cleaning. Radiologists and technologists wore personal protective equipment per hospital policy, including surgical masks and eye protection or face shields. Fluoroscopic or US guidance was used. Iodinated contrast medium (Omnipaque, 300 mg I/mL; GE Healthcare) was used for the confirmation of needle location for injections performed with fluoroscopy.

The following corticosteroids and doses were used: betamethasone sodium phosphate and acetate injectable suspension (6 mg/mL; American Regent [6–21 mg]), triamcinolone acetonide injectable suspension (Kenalog, 40 mg/mL; Bristol-Myers Squibb Company [40–160 mg]), methylprednisolone acetate (Depo-Medrol, 40 mg/mL; Pfizer [60–80 mg]), or dexamethasone (4 mg/mL; Fresenius Kabi [10 mg]). Injections were performed with and without anesthetic, which included lidocaine 1% (AuroMedics Pharma [1–4 mL]), ropivacaine 0.2% (AuroMedics Pharma [1–5 mL]), or bupivacaine 0.5% (Hospira [2–4 mL]).

Postprocedure Data Collection

At least 1 month (28 days) following corticosteroid injection, electronic medical records (EMRs) were reviewed for hospitalizations, emergency room or clinic visits for COVID-19 symptoms, and SARS-CoV-2 reverse transcriptase–polymerase chain reaction (RT-PCR) tests. If no records were available, participants were contacted by a direct phone call. The investigators were responsible for reviewing EMR data (J.R.T.V., CYC, and S.H.) and performing the follow-up phone calls (J.R.T.V., A.B.K., F.J.S.C., and C.Y.C.). Participants were considered lost to follow-up if there was no clinical information available in the EMR at least 1 month (28 days) after the procedure and they could not be reached by phone after two attempts on different dates.

Abbreviations

BMI = body mass index, EMR = electronic medical record, HPA = hypothalamus-pituitary-adrenal, RT-PCR = reverse transcriptase–polymerase chain reaction

Summary

Participants who received imaging-guided corticosteroid injections for pain management during the COVID-19 pandemic recovery period did not have an increased incidence of symptomatic infection compared with the general population.

Key Results

- In this prospective study of 1960 adults who underwent image-guided corticosteroid injections for pain management during the COVID-19 pandemic, the rate of symptomatic COVID-19 within 28 days was lower than that of the state population (0.5% vs 7.5%, \( P < .001 \)).
- Up to 4 months after corticosteroid injection, the rate of symptomatic infection (2.2%) was also lower than that of the general population (\( P < .001 \)).

The following corticosteroids and doses were used: betamethasone sodium phosphate and acetate injectable suspension (6 mg/mL; American Regent [6–21 mg]), triamcinolone acetonide injectable suspension (Kenalog, 40 mg/mL; Bristol-Myers Squibb Company [40–160 mg]), methylprednisolone acetate (Depo-Medrol, 40 mg/mL; Pfizer [60–80 mg]), or dexamethasone (4 mg/mL; Fresenius Kabi [10 mg]). Injections were performed with and without anesthetic, which included lidocaine 1% (AuroMedics Pharma [1–4 mL]), ropivacaine 0.2% (AuroMedics Pharma [1–5 mL]), or bupivacaine 0.5% (Hospira [2–4 mL]).
The criteria for a positive COVID-19 case following corticosteroid injection were (a) EMR documentation of new symptoms concerning COVID-19 in conjunction with a positive RT-PCR test within 28 days of the injection, (b) EMR documentation of a positive RT-PCR test within 28 days from the injection, or (c) confirmation by phone communication of the development of symptoms with a subsequent clinical diagnosis of COVID-19 and/or positive RT-PCR test within 28 days from the injection. The cutoff of 28 days was chosen due to data from studies showing that corticosteroid effects on the HPA axis and immune system can persist for up to 4 weeks (28). Additional positive cases up to 4 months were documented and analyzed separately.

Criteria for a negative COVID-19 case were (a) no symptoms concerning COVID-19 at least 1 month (28 days) and up to 4 months from the injection, with or without a negative RT-PCR test, or (b) no documentation of in-person visits to the hospital at least 1 month (28 days) and up to 4 months after the injection. All participants with in-person appointments at both participating hospitals were screened for symptoms, a history of COVID-19, and sick contacts by using a standardized questionnaire throughout the entire study period (Fig E1 [online]). The clinical notes were also used to confirm the absence of symptoms or COVID-19 diagnosis since the date of the injection.

Additional information obtained from the EMRs included the laterality and type of injections, body mass index (BMI, kg/m²) and presence of comorbidities, including hypertension, diabetes mellitus, and immunocompromised status. Criteria for immunosuppression were (a) chronic use of immunosuppressant medications for any indication, including inflammatory arthropathy and prior transplant, (b) diagnosis of primary or metastatic malignancy within the past year, and/or (c) chronic kidney disease.

Statistical Analysis
Categorical data are presented as frequencies and percentages and continuous data are presented using means and SDs. For the participants who had two or more visits, the demographic data were based on the clinical information at the time of the last visit. The clinical characteristics of the participants with positive COVID-19 cases were compared with those of the entire study cohort. Student t tests were used for continuous variable comparisons. Univariable analyses were performed using the Fisher exact test (Stata version 16.0; StataCorp). A two-tailed Bonferroni-adjusted P value less than .017 (.05 divided by 3) was considered indicative of a statistically significant difference to account for multiple comparisons and reduce the risk of false-positive results due to multiplicity.

Results

Participant Characteristics
A total of 3241 fluoroscopy- and US-guided corticosteroid injections for musculoskeletal pain were performed between April 15, 2020, and February 26, 2021, with 527 exclusions due to age less than or equal to 18 years, injections without corticosteroids (including arthrograms), and aborted procedures. The study cohort included 2714 corticosteroid injections performed in 2190 participants. Follow-up was available for 1960 participants (1960 of 2190 [89%]) with 2484 injections, including 1450 participants (1450 of 1960 [74%]) by EMRs only and 510 participants (510 of 1960 [26%]) by EMRs and phone communication, occurring a mean of 97 days ± 33 (SD) (range, 28–141 days) after the injection (Fig 1). There were 1031 (1031 of 1960 [53%]) women and 929 (929 of 1960 [47%]) men, with a mean age of 59 years ± 15 for all participants. A total of 277 participants had two or more visits for injections. The mean time interval between injections was 100 days ± 65 (range, 1–294 days).

During the entire study period, 10 of 1960 participants (0.5% [95% CI: 0.24, 0.94]) were diagnosed with COVID-19 within 28 days of an injection. The RT-PCR tests were performed a mean of 12 days ± 8 (range, 1–22 days) after their appointment. These 10 participants had a higher BMI than the entire study cohort (mean, 32 kg/m² ± 10 vs 28 kg/m² ± 6; \( P = .04 \)). No differences in other clinical features were seen in this group when compared with the entire study cohort, including the presence of immunosuppression (two of 10 [20%] vs 141 of 1960 [7%], \( P = .14 \)). When considering the period up to 4 months after injection, 43 of 1960 participants (2.2% [95% CI: 1.6, 2.9]) were diagnosed with COVID-19. BMI values were also higher for this group (mean, 31 kg/m² ± 7 vs 28 kg/m² ± 6; \( P = .005 \)). Demographics for the entire study cohort and for the participants with positive diagnoses are listed in Table 1. Details of injections and corticosteroid doses are listed in Table 2. The most common symptoms are listed in Table E1 (online).

The only participant with a positive COVID-19 diagnosis requiring hospitalization was a 72-year-old man with a BMI of 37 kg/m² who was admitted due to worsening shortness of breath and found to have COVID-19 and bilateral pulmonary embolism. The participant was treated with anticoagulation and noninvasive ventilatory support and discharged.
after 12 days without major complications. No COVID-19–related deaths were registered among the participants during the follow-up period. The death of an 87-year-old man with diabetes who was diagnosed with a urinary tract infection 9 days after a hip injection was the only registered death in the study cohort.

**COVID-19 Incidence Rates in Adults after Corticosteroid Injection versus the General Population**

The standardized questionnaire used for the follow-up phone calls is depicted in Figure 2. From April 15, 2020, to February 26, 2021, 519,195 new diagnoses of COVID-19 were registered on the Massachusetts COVID-19 Response Reporting website, with an incidence rate of 7.5% (519,195 of 6,892,503). Thus, the incidence rate of COVID-19 in the study sample within 28 days from corticosteroid injection (10 of 1960 participants [0.5%], P < .001) and at 4 months after injection (43 of 1960 participants [2.2%], P < .001) was lower than that in the general population. When comparisons were performed for each phase of recovery in the state of Massachusetts, no evidence of a difference was seen between the number of infections diagnosed up to 28 days from the injections and the new diagnoses in the general population. The only exception was during the rollback to the phase 3 step 1 period (December 14, 2020 to February 26, 2021), in which the rate of infection in the study group (five of 576 [0.9%]) was lower than that in the general population (267,784 of 6,892,503 [3.9%], P < .001).

**Participants with Two or More Corticosteroid Injections**

Of the 277 participants who had two or more corticosteroid injections, three (1.1%) tested positive for COVID-19 within 28 days and eight (2.9%) tested positive within 4 months, which were lower rates of infection than that of the general population during the same period (P < .001 for the 28-day cutoff and P = .002 for up to 4 months). These participants were older than the entire cohort (mean age, 63 years ± 14 vs 59 years ± 15; P < .001). Comparisons for each pandemic

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**Table 1: Participant Demographics**

| Characteristic                      | Study Cohort (n = 1960) | Two or More Visits for Injections (n = 277) | P Value | COVID-19 Diagnosis within 28 Days of Injection (n = 10) | P Value | COVID-19 Diagnosis within 4 Months of Injection (n = 43) | P Value |
|-------------------------------------|-------------------------|---------------------------------------------|---------|--------------------------------------------------------|---------|----------------------------------------------------------|---------|
| Age (y)†                            | 59 ± 15 (19–97)         | 63 ± 14 (20–97)                             | <.001   | 65 ± 19 (25–90)                                        | .22     | 59 ± 15 (21–90)                                          | .93     |
| Sex                                 |                         |                                             |         |                                                        |         |                                                          |         |
| Female                              | 1031 (53)               | 140 (51)                                    | .39     | 5 (50)                                                | .87     | 24 (56)                                                  | .67     |
| Male                                | 929 (47)                | 137 (49)                                    | .01     | 5 (50)                                                |         | 19 (44)                                                  |         |
| Body mass index (kg/m²)†            | 28 ± 6 (15–61)          | 29 ± 6 (18–61)                              | .34     | 32 ± 10 (22–49)                                       | .04     | 31 ± 7 (18–61)                                           | .005    |
| Hypertension                        | 858 (44)                | 137 (49)                                    | .08     | 4 (40)                                                | .69     | 17 (40)                                                  | .44     |
| Diabetes mellitus                   | 239 (12)                | 41 (15)                                     | .24     | 1 (10)                                                | .78     | 9 (21)                                                   | .10     |
| Immunocompromised                   | 141 (7)                 | 29 (10)                                     | .07     | 2 (20)††††                                          | .14     | 3 (7)‡‡‡‡                                            | .91     |
| Type of injection                   |                         |                                             |         |                                                        |         |                                                          |         |
| Spine (epidural, nerve root)        | 550 (28)                | 149 (54)                                    |         | 4 (40)                                                |         | 17 (40)                                                  |         |
| Nonspine (joint, bursa, tendon sheath) | 1410 (72)              | 128 (46)                                    |         | 6 (60)                                                |         | 26 (60)                                                  |         |
| Interval between injection and symptoms and/or positive COVID-19 test (d)* | …                       | …                                           |         | 12 ± 8 (1–22)                                         |         | 59 ± 33 (1–118)                                          |         |

Note.—Except where indicated, data are numbers of participants, with percentages in parentheses.

* Data are medians ± SDs, with ranges in parentheses.
† Chronic kidney disease and non–small cell lung cancer on methotrexate.
‡ Chronic kidney disease, non–small cell lung cancer on methotrexate, and systemic lupus erythematosus.
§ Median per participant, 2 (range, 2–6).
|| One participant with five visits and two participants with two visits each.
# One participant with five visits, one participant with three visits, and eight participants with two visits each.

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recovery phase and for all infections within 4 months from corticosteroid injection are listed in Table 3.

**Evaluation according to Injection Site**

A total of 1410 participants (1410 of 1960 [72%]) had nonspine (joint, bursa, or tendon sheath) injections (1708 injections). The remaining 550 participants (550 of 1960 [28%]) underwent spine injections, including epidural injections and nerve root blocks (776 injections). No evidence of a difference in the COVID-19 incidence rate was seen between the nonspine and spine injection groups when considering infections diagnosed within 28 days (six of 1408 [0.4%] vs four of 552 [0.7%]; respectively; \(P = .481\)) and up to 4 months (26 of 1408 [1.9%] vs 17 of 552 [3.1%]; respectively; \(P = .121\)) after injection (Table 4).

**Discussion**

The purpose of this prospective cohort multicenter study was to determine the incidence of symptomatic COVID-19 in participants who received fluoroscopy- or US-guided corticosteroid injections for musculoskeletal pain compared with the general population in the state of Massachusetts during the pandemic recovery period, given ongoing concern for corticosteroid-induced immunosuppression. We found that participants who received image-guided corticosteroid injections for pain management performed during the recovery period of the COVID-19 pandemic did not have associated increased rates of symptomatic COVID-19 compared with the general population (10 of 1960 [0.5%] vs 519,195 of 6,892,503 [7.5%]; \(P < .001\)). In addition, participants who had two or more visits for injections did not show a significantly higher infection rate than the general population (three of 277 [1.1%] vs 519,195 of 6,892,503 [7.5%]; \(P < .001\)). Finally, those diagnosed with COVID-19 after receiving corticosteroid injections had a higher body mass index than the general population (mean, 32 kg/m² ± 10 vs 28 kg/m² ± 6; \(P = .04\)).

The association between intra-articular corticosteroids and susceptibility to infection was previously questioned by Sytsma et al (29), who found an increased relative risk (1.52) of developing influenza among individuals who had received corticosteroid injections. Other studies have shown mixed results, including a review by Youssef et al (30) on the risk of infection among individuals with rheumatologic diseases receiving corticosteroid treatment, with suggestion of increased risk in observational studies but not in randomized controlled trials.

A prior prospective study by our group showed no evidence of an increased risk of COVID-19 during the lockdown period of the current pandemic (23). Additional retrospective studies with cohorts ranging from 30 to 734 patients have shown similar results since then (19,24–26). The findings during the pandemic recovery period in our state further support the safety of intra-articular and spine corticosteroid injections during the COVID-19 pandemic. No difference in the 28-day infection rate was seen between our cohort and the general population, even when the analysis was performed separately for each phase of recovery. Most studies indicate that systemic or intra-articular corticosteroid effects on the immune system are unlikely to be significant after more than a month, but effects on the adrenal glands may persist for more than 4 weeks (4,12,13,31). Our findings were similar even when accounting for infections occurring up to 4 months after corticosteroid injection.

It is interesting that the COVID-19 incidence rate in our cohort was lower than that in the general population. A few different factors could explain this finding. First, all participants

| Table 2: Types of Corticosteroid Injections |
|-------------------------------------------|
| Type of Injection | Value |
|-------------------|-------|
| Total no. of injections | 2484 |
| Spine (epidural, nerve root) | 776 (31) |
| Corticosteroid dose (mg)* | 12 ± 3 (6–24) |
| Laterality | |
| Right | 366 (47) |
| Left | 316 (41) |
| Midline (epidural steroid injection) | 44 (5) |
| Bilateral | 50 (7) |
| Nonspine (joint, bursa, tendon sheath, trigger point, peripheral nerve) | 1708 (69) |
| Corticosteroid dose (mg)* | 40 ± 20 (6–160) |
| Laterality | |
| Right | 796 (47) |
| Left | 636 (37) |
| Bilateral | 276 (16) |

Note.—Except where indicated, data are numbers of injections, with percentages in parentheses.

* Data are medians ± SDs, with ranges in parentheses.

**Figure 2:** Template shows the postprocedure survey used for follow-up phone calls.
were screened for symptoms and sick contacts before their injection, which would decrease the chances of an injection being performed during the initial phases of the disease. Second, with a mean age of 59 years ± 15, we would expect most of our participants to have been employing safety measures due to a perceived higher risk of developing complications from COVID-19. Third, because we used EMRs and phone calls to screen for laboratory test results and COVID-19 symptoms, asymptomatic infections could have been missed, although a similar phenomenon would be expected among the general population.

Another feature to be considered was the duration of corticosteroid effects based on the type of medication used. Normalization of HPA axis suppression may take up to 1–2 weeks for betamethasone and methylprednisolone acetate and up to 4 weeks for triamcinolone acetonide (4,9,11–13,31). The main medications used for spine injections in our group are betamethasone and dexamethasone, while triamcinolone and methylprednisolone are used for joint and soft-tissue injections. No differences in COVID-19 incidence rates were seen between spine (epidural injections and nerve root blocks) and nonspine (joints, bursae, and tendon sheaths) injections (P = .481), suggesting that longer-acting corticosteroids (triamcinolone and methylprednisolone) are similar to shorter-acting corticosteroids (betamethasone and dexamethasone) in terms of their risk for COVID-19.

In unadjusted analyses, participants diagnosed with COVID-19 had a higher BMI than the entire study cohort. Excess adipose tissue can affect the immune system by creating a proinflammatory environment that alters the phenotype of lymphocytes, resulting in a delayed adaptive immune response (32,33,34). Although at least one study has shown increased odds of hospitalization for COVID-19 among patients with rheumatologic disease who were treated with systemic corticosteroids at doses greater than or equal to 10 mg per day, this trend has not been seen in studies with intra-articular and spine injections, which is further supported by our findings (24–26,35).

Our study had limitations. First, that positive diagnoses of COVID-19 disease were identified based on symptoms and available test results could have led to asymptomatic infections being missed. Second, some participants followed by EMR data alone could have undergone COVID-19 testing in other facilities. Multivariable adjustment for risk factors was not performed.

In conclusion, participants who received fluoroscopy- or US-guided corticosteroid injections for pain management performed during the pandemic recovery period had a lower incidence of COVID-19 compared to the general population.
symptomatic COVID-19 compared with the general population in the state of Massachusetts. These findings provide reassurance to providers and individuals who rely on corticosteroid injections for the management of musculoskeletal pain during potential new COVID-19 surges, even in locales with low vaccination rates.

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