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# The impact of the COVID-19 pandemic on frozen shoulder incidence rates and severity



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**Background:** Although there is evidence that the COVID-19 pandemic had profound physiological and psychological effects, there is no research aimed at understanding if the pandemic has had an impact on the incidence or severity of frozen shoulder (FS). The aim of this study was to compare the incidence and severity of idiopathic FS before and during the pandemic.

**Methods:** A retrospective cohort study was performed to establish the incidence of FS during the pandemic, from March 2020 to January 2021 (pandemic study period), compared to the same time period 1 year earlier, before the pandemic (control group). All patients who were diagnosed with idiopathic FS were included. To assess the severity of the condition, visual analog scale (VAS) for pain score and Subjective Shoulder Value (SSV) on presentation were recorded and the patients were categorized into 5 different treatment groups (0 injections, 1 injection, 2 injections, 3 injections, or capsular release). As the pandemic and public health restrictions could have influenced the availability of appointments, the waiting time between referral and first appointment was calculated as a possible confounding factor. Statistical analysis was performed using the chi-square and Student *t* test for categorical and continuous variables, respectively.

**Results:** There were 847 new patient consultations during the pandemic study period; of these, 232 were for idiopathic FS. One year earlier, there were 898 initial consultations for a new shoulder problem; of these, 176 were for idiopathic FS. This represents a relative increase of 39.8% ( $P < .001$ ) in the incidence of patients with FS. The mean SSV in the control group was  $50\% \pm 20\%$  vs.  $45\% \pm 18\%$  in the pandemic group—statistically significant ( $P = .013$ ) but unlikely to be clinically significant. The VAS pain score was similar in both groups: mean  $6 \pm 2$  and  $7 \pm 2$ , respectively ( $P = .06$ ). There was no significant difference between the control and the pandemic group in the distribution of patients per treatment group ( $P = .94$ ). The mean waiting time from referral to appointment was not significantly different between the control and the pandemic group:  $58 \pm 30$  days vs.  $55 \pm 27$  days ( $P = .30$ ).

**Conclusion:** During the COVID-19 pandemic, there was a significant increase in the incidence of patients with FS. No significant difference in severity was observed. Further research is needed to evaluate a causal relationship between the COVID-19 pandemic and FS.

**Level of evidence:** Level IV; Case Series; Descriptive Epidemiology Study

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Frozen shoulder (FS) or adhesive capsulitis is a commonly encountered condition in orthopedic practice with a prevalence of 2%-5% in the general population. Patients often present with a varying degree of shoulder pain and stiffness owing to a pathologic process of inflammation and fibrosis involving the capsule and ligaments.<sup>6</sup>

FS typically occurs in women aged 40-60 years and has been associated with many systemic conditions. Diabetes mellitus (DM) has the strongest association with FS, but other conditions include thyroid dysfunction, ischemic heart disease, lower body mass index, Dupuytren's/Peyronie's disease, hyperlipidemia, hypoadrenalism, chronic obstructive pulmonary disease, osteopenia/reduced bone mineral density, ipsilateral distal limb injury, cardiac and head/neck surgery, hyperkyphosis, medications, immunizations, obesity, breast cancer treatment, and neurologic disorders.<sup>8,15,16,18</sup>

A recent review of the available evidence on the pathophysiology of FS concludes that a chronic state of low-grade inflammation is an important factor that predisposes to the development of FS, such as in patients with cardiovascular disease, metabolic syndrome, DM, and thyroid disorders. However, what triggers the onset of FS is still unclear, and further investigation in predisposing factors can give a better understanding of the etiology.<sup>11</sup>

The first case of COVID-19 on the island of Ireland was announced on February 27, 2021, and the Republic of Ireland went into full lockdown on March 27, 2021. During the pandemic we developed a subjective sense of an increased incidence of FS patients presenting to our practice. It is established that the pandemic has profound impact on mental health and that COVID-19 can affect several body systems, including the musculoskeletal system.<sup>10</sup> A recent case series of 12 patients who developed FS after having been infected with COVID-19 hypothesizes that both direct and indirect effects of the viral disease may contribute to the pathogenesis of FS.<sup>1</sup>

The aim of this retrospective cohort study was to investigate if the COVID-19 pandemic has influenced the incidence and severity of idiopathic FS. Our hypothesis was that since the beginning of the pandemic, an increased number of patients were presenting with FS to our single-surgeon practice compared with prior to the pandemic.

## Materials and methods

All consultations by the senior author from March 2020 to January 2021, the pandemic period, and from March 2019 to January 2020, the control period, before the pandemic hit Ireland, were manually reviewed in the electronic medical record. All patients aged 18 years or older with a first consultation for a new shoulder problem within the 2 specified time periods and who were diagnosed with idiopathic or primary FS were included. Diagnosis of FS was based on history and a clinical examination showing loss of active and passive range of motion of the shoulder with no radiologic evidence of glenohumeral arthritis. The definition of primary FS varies in the literature. For the purpose of this research, patients with risk factors for FS such as diabetes were considered as primary FSs and FSs with typical minor age-related degenerative changes such as nontraumatic partial-thickness rotator cuff tears, biceps degeneration, calcific tendonitis, and minor radiologic arthritis signs were also included. Exclusion criteria

were secondary FS due to significant underlying primary pathology or structural damage (full-thickness rotator cuff tears, fractures, dislocations) and patients with FS with a first consultation outside the predefined time periods. All the patients in this single-surgeon practice were seen, examined, and diagnosed with FS by the senior author.

Demographic data, risk factors, and clinical characteristics were also recorded to assess for homogeneity between both groups (age, gender, dominant side, manual work, diabetes, other risk factors).

The incidence of FS was calculated as the number of patients included in each group divided by the total number of first consultations for a new shoulder problem within the respective time periods. To assess the severity of the condition, the visual analog scale (VAS) for pain and the Subjective Shoulder Value (SSV) on presentation were recorded. The treatment protocol for idiopathic FS in our institution consists of a first-line conservative treatment with a gentle home exercise program and corticosteroid and local anesthetic injections into the glenohumeral and subacromial spaces, which can be repeated after a time period of 4-6 weeks, if pain is persisting. In very painful cases, this is supplemented with an oral course of nonsteroidal anti-inflammatory drug and/or a short, tapered course of an oral corticosteroid. In recalcitrant cases, an arthroscopic circumferential capsular release is offered to the patient, followed by intensive physiotherapy. As repeat injections and ultimately capsular release are reserved for cases with persisting pain and/or stiffness, these treatments were recorded as a reflection of the severity of the condition and of its responsiveness to treatment. The patients were categorized into 5 different treatment groups (0 injections, 1 injection, 2 injections, 3 injections, or capsular release) where every "injection" stands for a set of injections into the subacromial and glenohumeral spaces.

The pandemic and public health restrictions also may have influenced the incidence of other shoulder pathologies, for example, traumatic and sports injuries. It was possible that this could have led to a falsely elevated incidence of FS. To assess this, the waiting time between referral and first appointment was recorded as a possible confounding factor. Finally, to evaluate if because of the pandemic patients waited longer before seeking specialized care, the duration from onset of symptoms to presentation was also determined.

As this was a retrospective review, no immunologic data were available regarding COVID infection or vaccination status.

Statistical analysis to assess for differences and associations between the 2 groups was performed using the chi-square test for categorical variables and the Student *t* test for continuous variables. Continuous variables are represented as a mean  $\pm$  standard deviation. A *P* value  $<.05$  was considered significant.

## Results

During the pandemic period, there were 847 consultations for a new shoulder problem; of these, 232 were for idiopathic FS, with 9 patients having a bilateral FS, thus resulting in 242 FSs. During the same 11-month time period 1 year earlier, there were 898 initial consultations for a new shoulder problem; of these, 176 were for idiopathic FS, with 9 patients having a bilateral FS, resulting in 185 FSs. This represents a relative increase of 39.8% ( $P < .001$ )

**Table I** Baseline demographic and clinical characteristics of the 2 groups

	Control	Experiment	<i>P</i> value
Age, yr	54.34 ± 8.41	55.27 ± 8.88	.27*
Sex			.88†
Male	68 (38.6)	88 (37.9)	
Female	108 (61.4)	144 (62.1)	
Hand dominance			.91†
Dominant	88 (47.6)	116 (48.1)	
Nondominant	97 (52.4)	125 (51.9)	
Manual labour			.23†
Yes	18 (10.2)	16 (6.9)	
No	158 (89.8)	216 (93.1)	
Diabetes			.09†
Yes	13 (7.4)	29 (12.5)	
No	163 (92.6)	203 (87.5)	
Other risk factors present?			.03†
Yes	62 (38.0)	56 (27.6)	
No	101 (62.0)	147 (72.4)	

Values are presented as a mean ± standard deviation or n (%).

\* Student *t* test.

† Chi-square test.

in the incidence of patients with FS presenting to our practice during the COVID-19 pandemic.

There were no significant differences between the groups in age, gender, hand dominance, manual labor, and diabetes diagnosis; however, there were more patients in the control group with other, nondiabetes risk factors for FS (Table I).

The mean presenting SSV in the control group was 50% ± 20 vs. 45% ± 18% in the pandemic group, statistically significant ( $P = .013$ ) but unlikely to be clinically significant. The VAS pain score was similar in both groups, mean 6 ± 2 and 7 ± 2 ( $P = .06$ ). There was no significant difference between the control group and pandemic group in the distribution of patients per treatment group ( $P = .94$ ) (Table II).

The mean waiting time from referral to appointment was not significantly different between the control and the pandemic group, 58 ± 30 days vs. 55 ± 27 days ( $P = .30$ ). At the time of presentation to specialist care, there was no significant difference in the duration of the symptoms between the 2 groups: 258 ± 205 days vs. 251 ± 158 days ( $P = .69$ ).

## Discussion

The main finding of this retrospective cohort study is the significant increase in the incidence of FS in the pandemic group. As the exact etiology and pathophysiology of FS remains unclear, it is not possible to give a definitive explanation for this association; however, identifying this association can help to a better understanding of the disease.

A state of low-grade inflammation is probably an important factor predisposing to FS.<sup>11</sup> This is commonly encountered in patients with DM, cardiovascular disease, and thyroid disorders but is present in depression too.<sup>9</sup> It is a concern that the COVID-19 pandemic could have an important impact on mental health, and large studies are already showing an increase in mental distress in the general population during the pandemic period in the United States,<sup>12</sup> United Kingdom,<sup>13</sup> and Saudi Arabia.<sup>2</sup> It is possible that mental distress during the pandemic may be linked to the increased incidence of FS through low-grade inflammatory responses.

It is also known that infection with SARS-CoV-2 can have multiple extrapulmonary complications, such as cardiovascular disease, inflammatory, autoimmune and rheumatologic implications, musculoskeletal complications, chronic pain and fatigue, psychiatric consequences and many more.<sup>10</sup> A growing number of reports are emerging illustrating the musculoskeletal consequences of SARS-CoV-2 infections, mostly manifest as fatigue, myalgia, and transient arthralgia but also osteonecrosis, muscle denervation, and joint effusions.<sup>7,14</sup> Considering the wide spectrum of complications, including the appearance of de novo rheumatologic diseases,<sup>5</sup> FS could be triggered through inflammatory and immunologic pathways after SARS-CoV-2 infection. In their recent case series of 12 patients who developed FS after COVID-19, Ascani et al<sup>1</sup> hypothesize that both direct effects of the virus on the infected target cells and indirect effects due to the systemic inflammatory response of the host to infection, may contribute to the pathogenesis of FS. Additionally, viral infection may be related to the development of FS resulting from the more sedentary lifestyle induced by the pandemic and quarantine.

Previous studies could not demonstrate an association between HbA<sub>1c</sub>, a marker of glycemic control for a 3-month interval. However Chan et al<sup>3</sup> showed that worse long-term glycemic control may cause an increased incidence of FS using a new unvalidated variable, the cumulative HbA<sub>1c</sub>. Although there was no significant difference in the proportion of patients with DM between the pandemic and control group, it is still possible that DM was less well controlled during the pandemic and this consequently could have caused a slight increase in the incidence of FS. Data on the glycemic control of diabetic patients were not available for analysis.

To further evaluate the hypotheses of FS as a consequence of mental distress and FS secondary to SARS-CoV-2 infection, we suggest that future studies on FS should include psychiatric questionnaires, COVID-19 immunologic data, and glycemic control data.

There are rare reports of FS after vaccination in the literature,<sup>4,17</sup> and FS is often mentioned as a possible Shoulder Injury Related to Vaccine Administration (SIRVA). The first vaccine for COVID-19 in Ireland was administered on December 29, 2020, and by the end of

**Table II** Distribution of patients per treatment group

Treatment	Control	Experiment
0 injections	11 (5.9)	13 (5.4)
1 injection	85 (45.9)	117 (48.5)
2 injections	59 (31.9)	82 (34.0)
3 injections	11 (5.9)	12 (5.0)
Capsular release	19 (10.3)	17 (7.1)

Values are presented as n (%).

January 2021, 4% of the adult population of Ireland had received their first vaccination; however, there were no patients reporting an association of their shoulder symptoms with vaccination, and as the study inclusion period ended on January 31, 2021, SIRVA cannot explain the observed increase in incidence in FS.

There was no significant difference in severity of the disease between the 2 groups as reflected by the VAS and SSV at initial presentation. Similarly, there was no significant difference between the groups in the number of corticosteroid injections or incidence of capsular release; nevertheless, FS symptoms may persist after several years,<sup>6</sup> and at the time of data collection, the follow-up time since the last inclusion was only 5 months. The short follow-up time is a limitation to draw any definite conclusions regarding treatment modalities.

Secondary FSs were not included in this cohort study but a broad definition of primary FS was adopted, to include all idiopathic cases, where no trigger can explain the onset of the symptoms. Although the definition may influence the absolute incidence of FS, it does not affect the relative increase between the 2 groups.

Finally, there are many other hypothetical factors that may have influenced the relative increase in incidence of FS: total number of appointments available during each period, number of operations and follow-up appointments, decreased number of sports injuries and traumatic injuries presenting to clinic, fear of presenting to clinics due to COVID-19, temporary closures of public health services, travel restrictions, etc. Although these factors can affect the incidence of FS to some degree, it is very unlikely that a relative increase of 39.8% could be attributed to this. The waiting time for an appointment between both groups was similar, as well as the time since the onset of the symptoms; therefore, logistical issues do not explain the observed increased incidence of FS during the pandemic period.

## Conclusion

During the COVID-19 pandemic, there was an increase of 39.67% in the incidence of FS presenting to our

practice. No significant difference in severity or response to treatment was observed. Further research is needed to evaluate a causal relationship between the COVID-19 pandemic and FS.

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