Effect of the COVID-19 Pandemic on Treatment Strategies for Secondary Prevention of Hip Fragility Fractures

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ABSTRACT

Background: The coronavirus disease 2019 (COVID-19) pandemic has disrupted healthcare systems globally, affecting chronic disease management like osteoporosis and the prevention of fragility hip fractures. We hypothesized that it led to suboptimal prevention of secondary femoral neck fractures, reduced treatment frequency, and delayed treatment initiation.
Objectives: To evaluate the treatment initiation rate for secondary prevention of femoral neck fractures, comparing pre-COVID-19, COVID-19, and post-COVID periods, considering patient demographics.
Methods: This retrospective diagnostic cohort study used automated electronic medical records database from Clalit Health Services. Data regarding patients with hip fractures from January 2017 through September 2021 were extracted from the database. Treatment for osteoporosis included one of the following treatments: alendronate, risedronate, zoledronate, abaloparatide, denosumab, romosozumab, and teriparatide. The primary outcome variable in the study is the time taken to initiate appropriate therapy for the secondary prevention of femoral neck fractures.
Results: Treatment frequency decreased over time, with rates declining from 40.4% in 2019 to 33.5% in 2021 (*P*-value < 0.05). However, the percentage of prompt care management (within 3 months) increased between 2020 and 2021 (47.3%–62.5%) and between 2019 and 2021 (48.7%–62.5%), $P < 0.05$.
Conclusions: The COVID-19 pandemic reduced the rate of appropriate treatment initiation following hip fractures. However, adherence to timely treatment within 3 months of the fracture has improved. The findings highlight the effectiveness of the health system response in managing crises and ensuring the timely delivery of critical treatment.

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KEY WORDS: coronavirus disease 2019 (COVID-19), hip fracture, osteoporosis, rehabilitation

Hip fracture is the most serious complication of osteoporosis, with one in every five hip fractures resulting in death within the first year following the injury. Compared to the general population, the overall risk of mortality after a femoral neck fracture increases by a factor of five to eight within the first 3 months. Furthermore, patients presenting with an osteoporotic fracture are twice as likely to sustain subsequent fractures than peers with no prior fracture history, with a particularly high risk for a contralateral hip fracture. Accordingly, secondary prevention following hip fracture has become a key objective for health systems worldwide [1,2].

THE IMPACT OF THE COVID-19 PANDEMIC ON TREATMENT DELIVERY

The coronavirus disease 2019 (COVID-19) pandemic significantly disrupted osteoporosis care. In 2020, the strain on healthcare systems and shifting priorities led to delays in managing chronic conditions like osteoporosis [3]. Health services were rapidly adapted by revising care models, prioritizing treatments, and adopting telemedicine to minimize exposure to the virus. Remote consultations became common for routine care and chronic disease management, especially benefiting patients in remote areas or those unable to attend in-person visits [4]. Due to system pressures, patients with femoral neck fractures were discharged earlier, had fewer intensive care unit admissions, and received more home-based care [5]. In Israel, the National Quality Indicators Program reported a drop in femoral neck fracture cases and shorter hospital stays in 2020 compared to pre-pandemic levels [6].

The objective of this study was to evaluate the impact of the COVID-19 pandemic on the initiation rates of sec-

ondary prevention treatment for femoral neck fractures, as well as its effect on treatment management practices. According to established clinical guidelines, any patient who sustained a fracture resulting from low-energy trauma and belonged to the appropriate age group was considered eligible for immediate treatment initiation. International recommendations define a fracture caused by low-energy trauma in an individual within the relevant age group as a fragility fracture, which constitutes a clear indication for immediate pharmacologic treatment to prevent subsequent fractures.

For patients naïve to prior osteoporosis medication, the recommended approach is to initiate antiresorptive therapy, most commonly bisphosphonates or denosumab. In cases where the patient has previously received an anabolic agent (e.g., teriparatide or romosozumab), treatment should be followed by an antiresorptive agent to preserve the anabolic effect and support bone restoration [7].

Before initiating any treatment, it was essential to ensure adequate vitamin D and calcium levels, as well as to conduct an individual assessment of risk factors and contraindications, including the need for significant dental procedures before initiating bisphosphonates or denosumab due to the associated risk of osteonecrosis of the jaw [8].

The primary outcome evaluated was the initiation of treatment within 3 months following the first femoral neck fracture. Our first hypothesis was that the rate of anti-osteoporotic treatment initiation would decrease during the COVID-19 period and subsequently increase after lockdowns were lifted and population mobility resumed. We additionally hypothesized that there would be a delay in initiating appropriate treatment within the recommended timeframe during and following the pandemic. A third hypothesis posited that the average age of patients experiencing a first fracture and requiring treatment initiation would decrease, due to efforts to protect older populations, such as increased accessibility to healthcare and welfare services and restrictions on their mobility during the pandemic. Accordingly, we hypothesized that the average age of first-time fracture patients would rise again after a post-pandemic.

PATIENTS AND METHODS

STUDY DESIGN

This retrospective diagnostic cohort study was approved by the ethics committee at Loewenstein Rehabilitation Medical Center (approval no. LOE-0004-22). All methods followed the Declaration of Helsinki guidelines. Informed consent was not required.

DATA SOURCE

The data were extracted from Clalit's de-identified patient database via Clalit's research data-sharing platform, powered by MDClone (https://www.mdclone.com). The dataset includes clinical information from Clalit Health Services hospitalization and follow-up visits in community care. Extracted variables included demographic characteristics, clinical diagnoses, medical treatments, and co-morbidities.

STUDY SAMPLE

The cohort included adults aged 50–85 years who sustained a femoral neck fracture between January 2017 and September 2021. Osteoporotic femoral neck fractures were identified using ICD-9 codes consistent with low-energy trauma, such as a fall from standing height or lower. Patients with pathologic fractures secondary to malignancy were excluded. Similarly, patients with high-impact trauma (e.g., motor vehicle accidents as drivers, passengers, or pedestrians) were excluded to ensure accurate identification of fractures likely resulting from osteoporosis.

TIME WINDOWS FOR INTER-PERIOD COMPARISON

Data were collected from January 2017 to September 2021 for patients with femoral neck fractures. To reduce bias, three equal 7-month periods were selected: pre-COVID (March–September 2019), COVID (March–September 2020), and post-COVID (March–September 2021). Matching timeframes minimized statistical bias and controlled for seasonal effects on treatment adherence.

OUTCOME VARIABLE

The primary outcome variable was the time to treatment initiation, calculated as the number of days between the fracture date and the first recorded purchase of any medication approved for the secondary prevention of femoral neck fractures. Treatment data were based on guidelines from the American Association of Clinical Endocrinologists and the American College of Endocrinology (AACE/ACE), which recommend antiresorptive agents, such as alendronate, risedronate, and zoledronate (bisphosphonates), as first-line options. Alternative agents for patients with poor adherence or intolerance to oral therapy include abaloparatide, denosumab, romosozumab, and teriparatide (Grade A recommendations) [7].

For this study, we focused on whether pharmacologic treatment was initiated within 3 months of the fracture, which is the clinically recommended timeframe for treatment. Accordingly, the outcome variable was transformed into a binary variable: 1 = treatment initiated within 3 months (considered good treatment management) or 0 = treatment initiated after 3 months.

INDEPENDENT VARIABLES

The dataset included demographic variables such as age; socioeconomic status (SES) categorized as low, medium, or high; and sex. For age, the mean and standard deviation were calculated for each period and compared across periods. The distributions of SES and sex were similarly extracted and presented as percentages for each category across the three timeframes.

STATISTICAL ANALYSIS

Statistical analyses were performed using R Statistical Software, version 4.1.2 (R Foundation for Statistical Computing, Vienna, Austria). Categorical variables were analyzed using chi-square tests for independence via the chisq.test function. Pairwise comparisons across periods were performed using pairwise_chisq_gof_test from the rstatix package [9]. Normality of continuous variables was assessed using the Shapiro–Wilk test via the shapiro.test function. For non-normally distributed variables, group differences were tested using the Kruskal–Wallis test with the Kruskal test function from the dplyr package [10]. Statistical significance was defined as $P < 0.05$.

RESULTS

Table 1 presents the demographic data across the three defined periods. The mean and standard deviation (SD) for age, with the percentage of females and SES in each period are presented. The proportion of females was consistently and significantly higher than that of men across all three periods (p < 0.05). Female patients comprised 64.7% of the study population in the pre-COVID period, 65.9% during the COVID period, and 61.6% in the post-COVID period. Table 1 presents the statistical results for differences in sex distribution within and across periods. A chi-square test of independence did not reveal statistically significant differences in sex across the periods (chi-square [df 2] = 1.55, $P = 0.45$). Therefore, it can be concluded that no meaningful demographic shift in sex occurred over time. The overall average age across all periods was 72.5 ± 8.87 years. The mean and standard

Table 1. Summary of demographic variables: age, sex, and socioeconomic status across the three periods

Variable	Pre-COVID (2019)	COVID (2020)	Post-COVID (2021)
Age (mean ± SD)	72.5 ± 8.71	72.9 ± 8.77	73.2 ± 8.69
Sex (% female)	64.7% (n=356)	65.9% (n=317)	61.6% (n=324)
Socioeconomic status			
Low	11.5% (n=63)	11.3% (n=54)	11.4% (n=60)
Medium	65.1% (n=358)	65.1% (n=313)	61.6% (n=339)
High	20% (n=110)	19.7% (n=95)	20.5% (n=108)
Missing data	0.03% (n=19)	0.04% (n=19)	0.04% (n=19)

Table 2. Chi-square test for differences in sex and socioeconomic status within and between periods

	Comparison	*P*-value	Chi-square (df)
Sex	**Within each period**		
	Pre-COVID (2019)	0.007	21.4 (1)
	COVID (2020)	0.002	14.5 (1)
	Post-COVID (2021)	0.036	7.82 (1)
	Between periods		
	Pre-COVID vs. COVID	0.69	0.15 (1)
	Pre-COVID vs. Post-COVID	0.25	1.32 (1)
	COVID vs. Post-COVID	0.52	0.42 (1)
Socioeconomic status	High vs. Low	0.007	21.4 (1)
	High vs. Medium	0.002	14.5 (1)
	Low vs. Medium	0.036	7.82 (1)
	Between periods		
	Pre-COVID vs. COVID	0.69	0.15 (1)
	Pre-COVID vs. Post-COVID	0.25	1.32 (1)
	COVID vs. Post-COVID	0.52	0.42 (1)

deviation for each period are presented in Table 1. No statistically significant differences in age were found based on the Kruskal–Wallis test (chi-square [df 2] = 2.82, $P = 0.42$). A medium socioeconomic status was the most prevalent across all three time periods, with statistical significance. Table 1 displays the SES distribution by category (low, medium, and high). However, no significant differences were observed between periods (chi-square [df 4] = 6.9, $P = 0.64$). Table 2 presents the statistical test results for SES differences. Table 3 compare the frequency of anti-osteoporotic treatment initiation across the defined periods (2019–2020, 2020–2021, and 2019–2021). Chi-square test of independence found no statistically

Table 3. Distribution of patients receiving vs. not receiving anti-osteoporotic treatment across study periods

Period	Not received, n (%)	Received, n (%)	Total patients
Pre-COVID (2019)	328 (59.6%)	222 (40.4%)	550
COVID (2020)	297 (61.7%)	184 (38.3%)	481
Post-COVID (2021)	350 (66.5%)	176 (33.5%)	526

significant association between treatment status (initiated vs. not initiated) when comparing: 2019 (pre-COVID) vs. 2020 (COVID): chi-square (df 1) = 0.25, $P = 0.62$, 2020 (COVID) vs. 2021 (post-COVID): chi-square (df 1) = 2.7, $P = 0.09$. However, a statistically significant difference was found between 2019 (pre-COVID) vs. 2021 (post-COVID): chi-square (df 1) = 7.05, $P = 0.008$. Regarding the good practice parameter, defined as the initiation of anti-osteoporotic treatment within 3 months of fracture, it showed notably higher adherence in the post-COVID period (62.5%) compared to both the pre-COVID period (48.7%) and the COVID period (47.3%) [Table 4]. Statistical tests revealed a significant difference between the COVID and post-COVID periods: chi-square (df 1) = 7.05, $P = 0.005$, a significant difference between pre-COVID and post-COVID periods: chi-square (df 1) = 7.05, $P = 0.008$. No significant difference between pre-COVID and COVID periods: chi-square (df 1) = 0.03, $P = 0.86$.

Table 4. Timing of treatment initiation among patients who received therapy across study periods

Period	Treated within 3 months*, n (%)	Treated within 3–12 months, n (%)	Total treated patients
Pre-COVID (2019)	108 (48.7%)	114 (51.3%)	222
COVID (2020)	87 (47.3%)	97 (52.7%)	184
Post-COVID (2021)	110 (62.5%)	66 (37.5%)	176

*considered good practice

DISCUSSION

In this study, we assessed whether initiation rates of secondary prevention for femoral neck fractures changed across three periods: pre-COVID, COVID, and post-COVID, while considering patient demographics. In addition, the frequency of treatment initiation within 3 months of fracture, considered a good practice, was compared among the three periods. Results showed no significant changes in demographic or socioeconomic profiles across the time periods. The age distribution was consistent, with a mean age of 72.5 ± 8.87 years. The proportion of female patients remained higher than that of male patients across all three periods, and most of the study population came from areas classified as having medium socioeconomic status. Thus, the hypothesis that elderly individuals may have delayed or avoided care due to heightened concern about infection risk was not supported by demographic shifts.

Findings from the analysis of treatment data among hip fracture patients across the three periods offer important insights into how health systems functioned during the crisis and the implications for treatment delivery. The proportion of patients receiving treatment gradually decreased from 40.4% in 2019 to 33.5% in 2021. However, this reduction in treatment frequency was not statistically significant between consecutive periods (2019–2020 and 2020–2021). A significant decline in treatment initiation was observed only between the pre-COVID (2019) and post-COVID (2021) periods, not during the pandemic itself, as initially expected. This drop may reflect a lower incidence of fractures due to increased remote care and reduced mobility, as people avoided exposure to COVID-19. During the early pandemic phase, ongoing treatments and limited clinical operations supported by increasing telemedicine use likely maintained care continuity [4]. Variability across regions, providers, and healthcare systems may also have contributed to the lack of significance observed in 2020. In contrast, the post-COVID period was marked by ongoing disruptions in clinical services, including staff shortages, systemic overload, and provider burnout, which contributed to the sustained decline in treatment initiation rates [3].

These findings align with recent literature, which reports that the long-term decline in anti-osteoporotic treatment delivery and post-fracture follow-up was most pronounced after lockdowns were lifted, as treatment was postponed and patient adherence decreased [11]. A slight decrease was observed in the rate of anti-osteoporotic treatment initiation within 3 months of fracture between the pre-COVID period (48.7%) and the COVID period (47.3%). This situation was followed by a significant increase in initiation rates during the post-COVID period (62.5%).

It is essential to note that this change achieved statistical significance only when comparing the COVID and post-COVID periods, as well as the pre-COVID and post-COVID periods. The slight decline between pre-COVID and COVID was not significant, aligning with other studies that found minimal change during the pandemic

itself [12]. The increase in initiation rates during the post-COVID period may stem from a treatment prioritization process that developed at the time; patients who managed to receive follow-up care after their fracture were more likely to receive focused, efficient, and guideline-based treatment. It is possible that, following the pandemic, limited resources led to a situation where fewer patients were treated overall; however, those who did receive care were managed with greater quality and adherence to clinical guidelines and established timelines [3,13,14].

While, to the best of our knowledge, no study reports a post-COVID rise as sharp as ours, several highlight the role of structured systems like fracture liaison services (FLS) in maintaining consistent, focused care even under strain [13]. This finding highlights the importance of implementing FLS and similar protocols to maintain care quality during disruptions.

This study did not specifically address which anti-osteoporotic treatment (bisphosphonates or alternative agents such as abaloparatide, denosumab, romosozumab, or teriparatide) achieves better outcomes on initiation. However, our previous work demonstrated that the prevalence of bisphosphonate use in centers without an FLS program is higher. In contrast, centers implementing an FLS initiative showed higher use of denosumab, along with improved treatment initiation rates and better adherence [15]. These findings suggest that the presence of an FLS influences treatment patterns and optimizes post-fracture care for osteoporosis. Nevertheless, further research is needed to evaluate whether treatment protocols should be adjusted in the post COVID era, particularly regarding the balance between bisphosphonate use and potent alternatives like denosumab. Therefore, there is a need to determine the most effective strategies for osteoporosis management in the long term after the pandemic.

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The world is more malleable than you think and it's waiting for you to hammer it into shape.
Bono (born Paul David Hewso) (Born 1960), Irish singer-songwriter and activist