


# The tolerance of physiotherapy treatment in patients with COVID-19 and undergoing surgery for fragility hip fracture

## An observational study

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### Abstract

The aim of the present work was to evaluate the tolerance of physiotherapy treatment implemented for patients with coronavirus disease (COVID-19) and undergoing hip surgery

Case-control study. During the period between March and May 2020, 9 patients were enrolled in the study with diagnosis of COVID-19 and hip fracture. In order to evaluate the tolerability of physiotherapy treatment a comparison group, involving 27 patients with a hip fracture but in the absence of suspicion of COVID-19 positivity, were put together. Blood saturation and heart rate, number of physiotherapy sessions, start of physiotherapy from surgery, number of healthcare providers, recovery of ambulation, execution of walking training and dyspnea measured by Borg scale were collected before and after each single physiotherapy session to describe the exercise tolerance of the patients.

There are no significant differences between the two groups regarding basic characteristics. Average of Borg scale post treatment for COVID patients was 1.3 (DS = 1.3) compared to 0.6 (DS = 0.7) of non-COVID patients ( $P < .0005$ ) but the breathing difficulty was light during the treatment, only 9% of COVID patients had a worsening superior of two points with Borg scale compared to 3% of non-COVID patients ( $P = .138$ ). The incidence of walking recovery was 63% in the non-COVID patients group compared to 44.4% in the COVID group ( $P = .329$ ).

Physiotherapy treatment of patients with COVID-19 infection and undergoing surgery for hip fracture is well tolerated and should be encouraged and well monitored.

**Abbreviations:** COVID-19 = coronavirus disease, SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2, WHO = World Health Organization.

**Keywords:** coronavirus disease, hip fracture, rehabilitation

## 1. Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a new coronavirus disease that emerged in December 2019 in China (COVID-19).<sup>[1]</sup> The global outbreak of COVID-19 has

spread around the world with dramatic effects in terms of deaths and impact on countries' health systems. On March 11 2020, the (WHO) declared the international outbreak of the new coronavirus SARS-CoV-2 infection a pandemic.<sup>[2]</sup> As of August 17, the Istituto Superiore di Sanità (ISS), the leading scientific body of the Italian National Health System, reported 253,619 cases of infection, of which 35,833 died and 191,204 recovered.<sup>[3]</sup> Individuals with COVID-19 may have a flu-like illness with a respiratory tract infection whose signs and symptoms include fever (89%), cough (68%), fatigue (38%), sputum production (34%) and/or shortness of breath (19%). The severity spectrum of the disease varies from asymptomatic or mild to severe forms with pneumonia, respiratory failure and/or death. Older people with multiple comorbidities are more likely to experience more severe outcomes.<sup>[4]</sup> In addition to direct damage to the respiratory system and lungs, the data increasingly show possible multi-organ involvement. Neurological, cardiac, cognitive, psychological and muscular sequelae are described. Patients report severe fatigue, joint stiffness and pain, and loss of muscle mass.<sup>[5–7]</sup>

All these aspects must be considered in the treatment of the patient affected by COVID-19 and rehabilitation professionals can play a central role in this area starting from the hospitalization phase.<sup>[8,9]</sup> Liu K et al<sup>[10]</sup> show how a 6-week respiratory treatment in elderly people with COVID-19 results in an improvement in the quality of life and a reduction in the state

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of anxiety. Multiple indications have been published to guide the rehabilitation treatment, and step by step, the discovery of the natural history of the disease is being understood in greater depth and the guidelines are modified and updated as more knowledge is being accumulated.<sup>[9,11,12]</sup> At the same time, however, there is a lack of data relating to the tolerance of the rehabilitation treatment itself in the various stages of the disease, the ways in which the patient must be managed and the effects. The correct amount of effort, from the initial phase, emerges as a key element in the management of the patient suffering from COVID-19 to avoid that the training itself is counterproductive.

During the pandemic, in the orthopedic hospital, scheduled elective surgeries were suspended and only emergency orthopedic surgeries were maintained as fragility hip fracture.<sup>[13,14]</sup> As a consequence of the city hospital reorganization, the number of patients admitted to the hospital for surgery after fragility hip fracture increased and included also some patients with a COVID-19 infection.<sup>[15]</sup> The hip fracture in the elderly is a particularly burdensome event for the subject and can determine a significant disability. Indeed, 50% of subjects fail to recover the pre-fracture daily living skill level.<sup>[16]</sup> In such a delicate context, the possibility of having COVID-19 can add an even more devastating impact on patients.

The aim of the present work was to describe the tolerance of physiotherapy treatment implemented for patients undergoing surgery for fragility hip fracture and with a concurrent COVID-19 infection.

## 2. Materials and methods

### 2.1. Study design

Observational study, case-control.

### 2.2. Setting and participants

The study was conducted through the collection of data on patients hospitalized during the period between March and May 2020, within a highly specialized orthopedic hospital, located in one of the regions of northern Italy most affected by the pandemic. The study was approved by the hospital Institution and, given the retrospective type of study, written consent was not collected.

Following the reorganization of the regional hospital network services during the period of maximum spread of the epidemic and the consequent lock-down period, the hospital's activity was radically changed: scheduled elective surgeries were suspended while emergency orthopedic surgeries were maintained. All procedures aimed at reducing the risk of spreading the virus were implemented, such as the use of the appropriate Personal Protective Equipment, appropriate distancing measures between healthcare providers and patients, the isolation of people with suspicion and diagnosis of COVID19, the tracing of contacts and dedicated paths for access to the emergency room according to national and international guidelines.<sup>[17,18]</sup> Within this reorganization, it was also necessary to open a dedicated department for the hospitalization of suspected, probable and confirmed cases of COVID19, according to the definition of the "Istituto Superiore di Sanità" COVID 19/2020 report.

Through the computerized register of hospital admissions, patients who had accessed the COVID-19 ward and for whom physiotherapy treatment had been requested following hip fracture surgery, were considered eligible for this study. Patients

were enrolled only for those cases in which the diagnostic suspicion was confirmed by a positive molecular test for SARS-CoV-2 or following a diagnosis of COVID infection in the presence of clinical positivity and at the same time of radiological signs of interstitial pneumonia with Ground Glass injury.

In order to evaluate the actual potential and tolerance of physiotherapy treatment of patients suffering from COVID-19 in the presence of a hip fracture, it was decided to put together a comparison group involving patients diagnosed with a hip fracture but in the absence of suspicion of COVID-19 positivity. The patients taken into consideration were consecutively enrolled in two different departments of the same hospital in the month of April, operated on for a fracture of the femur and for which rehabilitation treatment had been requested. To compare the two groups of patients, the same basic characteristics of the study group were collected in the comparison group.

### 2.3. Physiotherapy treatment for COVID patients

The objectives of the rehabilitation treatment were individually defined for each patient on the basis of the type of intervention and the patient's clinical condition with a multidisciplinary team work that involved the physiotherapist, the orthopaedic surgeon, the internist and the physiatrist. The physiotherapy treatment began the day after the surgery for two daily physiotherapy sessions lasting 30 minutes each.

The physiotherapy session included two steps:

- The first step included bed exercises performed independently by the person with supervision or manual assistance of physiotherapist. No specific instruments were used and strength exercises against a manual resistance were avoided. Description of the exercises and details such as number of sets, repetitions, rest times and progression are summarized in Table 1
- The second step of treatment included transfer training with the repetition of transfers such as sitting to standing and bed to chair and ambulation training, walking with aids according to patient skills and post-operative weight-bearing medical indication. The progression was not based on a fixed protocol, but it was closely linked to patient's medical conditions. It was necessary to pay attention to recognize initial symptoms of fainting as nausea and sweating and to avoid dyspnoea increasing, providing adequate resting periods. In those cases where the physiotherapist deemed it appropriate, the verticalization activities could require the intervention of two healthcare providers in order to carry out the activity safely.

In accordance with the guidelines for the rehabilitation treatment of COVID-19 patients in the post-acute phase of illness, the physiotherapy sessions did not include specific respiratory rehabilitation exercises in order to not aggravate respiratory stress and to avoid dispersing the viral load where not necessary.<sup>[9]</sup> The organization of physiotherapy treatment was affected by the prevention rules adopted for the containment of COVID-19 such as the execution of rehabilitation treatment within the perimeter delineated by the room and the use of disposable or dedicated devices for each patient.

### 2.4. Physiotherapy treatment for non-COVID patients

The physiotherapy treatment of the non-COVID-19 patients affected by hip fracture was similar to one delivered to COVID-19 patients. Exercises performed in bed were the same for COVID

**Table 1****Description and details of exercises.**

Exercise description				
Ankle Dorsiflexion and Plantar Flexion		Slowly point foot up towards knee. Slowly point toe downward and away from knee		
Isometric quadriceps contraction		Push back of knee into bed and tighten the muscles on top of the thigh. Hold for 5 s and relax		
Hip/Knee Flexion and Extension		Slowly slide foot of back towards buttock, bending the knee and hip		
Hip abduction/adduction		Slowly spread leg apart and come back		
Short Arc Quadriceps Raise		With a pillow under the knee, slowly raise the foot until the knee is straight. Hold for 5 s and slowly return to starting position		
Hip bridge		Raise your hips from the bed. Hold from 2 s and slowly return to starting position.		
Exercise detail				
	Assistance	Set and Repetitions	Rest period	Progression
COVID patients	The exercises were performed independently by patients or with manual assistance of physiotherapist. Strength exercises against a manual resistance were avoided	Each exercise included 1 set, from 0 to 10 repetitions.	From 1 to 5 min of rest was provided between each exercise	Assistance, number of repetitions and rest period was decided by physiotherapist according to the patient clinical conditions avoiding dyspnoea and pain
non-COVID patients	The exercises were performed independently by patients and also manual resistance could be provided.	Each exercise included from 1 to 3 sets of 10 repetitions.	1 min of rest was provided between each set and 3 min of rest between each exercise.	Assistance and number of sets was decided by physiotherapist according the clinical conditions avoiding pain.

and non-COVID patients, the two treatments were different for training intensity as described in Table 1. The protocol for transfer training included to reach a standing position in the first two post-operative days and to walk in the first five days.

### 2.5. Main outcome: evaluation of individual physiotherapy treatments

In order to evaluate the tolerance of physiotherapy treatment and the results possible to achieve during the individual sessions, through the patient's computerized medical record and the specific application dedicated to recording the rehabilitation activity, a series of data relating to the clinical condition of the patient for each single physiotherapy session was carried out. In clinical practice blood saturation and heart rate, measured by portable pulse oximeter (Nellcor, OxyMax n-65) were recorded 2 minutes before rehabilitation session starting and within 2 minutes from the end of it. Pulse oximetry is usual evaluation for people with COVID-19.<sup>[19]</sup> The number of treatment sessions delivered, the time elapsed between the surgery and the start of physiotherapy, the number of healthcare providers involved and the execution of walking training within the treatment provided, were collected. Dyspnea was measured by administering the Modified Borg scale<sup>[20,21]</sup> which provided a score that ranged from 0 (no breathing difficulties), to 10, (maximum respiratory difficulty).

The incidence of number of patients able to perform at least once a more than 4 meters long walk was calculated to evaluate the postoperative recovery of function of the patients.

The data relating to the pre- and post-treatment evaluation of the patient were recorded only starting from the week following the start of physiotherapy treatment in the COVID ward, following the change in procedures that occurred suddenly with the start of the spread of the virus.

### 2.6. Variables: basic characteristics

Regarding the basic characteristics of the enrolled patients, the following variables were collected through the computerized

medical records: age, sex, presence of comorbidities (such as hypertension, diabetes, cardio-circulatory, respiratory, hepatic diseases, renal, gastrointestinal, tumors and disorders of the central and peripheral nervous system), admission diagnosis (fracture of the femoral neck vs pertrochanteric), type of intervention (osteosynthesis vs endoprosthesis), oxygen therapy delivery, length of stay at hospital and number of patients died.

### 2.7. Sample size

It was not possible to carry out *a priori* sample calculation. It was decided to consecutively enroll all patients who met the inclusion and exclusion criteria in the study period for both the cohort of patients diagnosed with COVID-19 and for patients in the comparison cohort.

### 2.8. Statistical analysis

The statistical analysis was conducted with the aid of the IMB SPSS Statistics v. 20. Continuous variables were described by means and standard deviation where the distribution was normal and by median and interquartile distance where the distribution was not normal. For the ordinal variables the frequency and the percentage were reported. The comparison between the two groups of patients was conducted for ordinal variables using Pearson's chi square test or Fisher's exact test where appropriate and for continuous variables using ANOVA test and Wilcoxon-Mann-Whitney test where appropriate. The tests performed were considered significant for  $P$ -value  $< .05$ . The main outcomes were assessed by non-blinded assessors.

## 3. Results

The patients eligible for the study admitted to the hospital's COVID department were 22, of which 8 patients who did not have a confirmed diagnosis of COVID-19. Of the 14 patients with COVID-19, 9 were diagnosed with a hip fracture and were therefore enrolled in the present study. Of this study group, 7 patients (77.8%) had symptoms referable to the COVID-19

**Table 2****Basic characteristics of the enrolled patients.**

	Patients (total) N=36	COVID N=9	No COVID N=27	P-value
Age, median (IQR)	83.5 (10.8)	80 (15.2)	85 (10.0)	.432
Female, n (%)	28 (77.8)	6 (66.7)	22 (81.5)	.384
N of patients with 3 or more comorbidities, (%)	20 (55.6)	7 (77.8)	13 (48.1)	.245
Femoral neck fracture (vs Trochanteric), n (%)	18 (50.0)	4 (44.4)	14 (51.9)	1.000
Osteosynthesis, (vs endoprosthesis), n (%)	17 (47.2)	5 (55.6)	12 (44.4)	.706
Patients with oxygen therapy, n (%)	14 (38.9)	7 (77.8)	7 (25.9)	.014
Litres of oxygen therapy, mean (DS)	2.1 (0.5)	2.3 (1.3)	1.5 (0.8)	.014
Length of stay, median (IQR)	8 (5.75)	17 (16)	8 (3)	.008
Discharge at home (vs health facility), n (%)	17 (51.5)	3 (50.0)	14 (51.9)	1.000
Died, n (%)	3 (8.3)	3 (33.3)	0 (0.0)	.012
Recovery of ambulation, n (%)	21 (58.3)	4 (44.4)	17 (63.0)	.329

DS = standard deviation, IQR = interquartile range.

infection and a related pneumonia confirmed by CT scan. Three patients (33.3%) had a positive swab and all patients received at least two swabs. The comparison group, diagnosed with a hip fracture, but not with COVID-19 infection, included 27 patients. There are no significant differences between the two groups regarding basic characteristics such as age, sex, comorbidity, type of fracture and intervention. An important difference is highlighted in the use of oxygen therapy which was required in 77.8% of patients with COVID-19 compared to 25.9% of non-COVID-19 patients ( $P=.014$ ) and with an average of more liters per minute required. In the group of COVID patients, there were 3 deaths (33.3%), while in the comparison group there were none ( $P=.012$ ). The incidence of walking recovery did not show a significant difference ( $P=.329$ ) between the two groups of patients, in the non-COVID group the recovery rate was 63.0% compared to 44.4% in the COVID group. The characteristics of the two groups are summarized in Table 2.

### 3.1. Tolerance of physiotherapy treatment

The evaluation of the daily parameters relating to the individual physiotherapy treatments provided showed some differences

between the two groups. The perception of respiratory distress measured with the Borg scale showed a higher pre and posttreatment score in the group of COVID-19 patients. Average of Borg scale post treatment for COVID-19 patients was 1.3 (DS=1.3) compared to 0.6 (DS=0.7) of non-COVID patients ( $P<.0005$ ). Conversely, the saturation and heart rate parameters did not show this difference. Compared to the rehabilitation activity carried out, in 40% of the treatments of non-COVID-19 patients it was possible to perform walking training, compared to 22% for COVID-19 patients ( $P=.002$ ). The main results are summarized in Table 3.

## 4. Discussion

In patients undergoing surgery for hip fracture and with concurrent COVID-19 infection, physiotherapy treatment proved to be well tolerated. The need for surgery combined with COVID-19 infection certainly had significant impact on patient health outcomes. In the present study, the mortality of the population undergoing surgery for fracture and affected by COVID-19 was equal to 33.3% against a mortality rate of 0% for patients with fracture but not affected by COVID-19 and with

**Table 3****Evaluation of individual physiotherapy treatments.**

	Physiotherapy treatments (total) N=248	Physiotherapy for COVID patients N=132	Physiotherapy for NO COVID patients N=116	P-value
Evaluation pre and post physiotherapy treatment				
Percentage of blood saturation pre physio, mean (DS)*	96.6 (2.0)	97.0 (1.9)	96.1 (2.1)	.002
Percentage of blood saturation post physio, mean (DS)*	96.6 (2.8)	96.8 (3.2)	96.4 (2.2)	.312
Patients with difference of percentage of blood saturation pre-post physio >3, n (%)	13 (6.7)	7 (6.3)	6 (7.1)	1.000
Heart rate pre physio, mean (DS)	81.7 (15.4)	81.4 (15.0)	82.0 (16.0)	.806
Heart rate post physio, mean (DS)	83.1 (15.4)	84.3 (15.2)	81.5 (15.7)	.213
Patients with difference of heart rate pre-post physio >10, n (%)	28 (14.5)	17 (15.6)	11 (13.1)	.684
Dyspnoea score pre physio (Borg scale), mean (DS)	0.6 (0.9)	0.8 (1.0)	0.4 (0.5)	.001
Dyspnoea score post physio (Borg scale), mean (DS)	1.0 (1.1)	1.3 (1.3)	0.6 (0.7)	<.001
Patients with difference of dyspnoea score pre-post physio >2, n (%)	13 (5.2)	11 (8.7)	2 (2.7)	.138
Evaluation of the physiotherapy provided				
Number of days from surgery to the start of physiotherapy, median (IQR)	1 (0.75)	1 (1)	1 (0)	.137
Number of treatments where 2 healthcare were involved, n (%)	181 (79.4)	92 (80.0)	89 (78.8)	.871
Number of treatments where the training of ambulation was provided, n (%)	76 (30.6)	29 (22.0)	47 (40.5)	.002

Missing: 47 percentage of blood saturation pre, 53 percentage of blood saturation post, 50 heart rate pre, 55 heart rate post, 70 dyspnoea score pre, 78 dyspnoea score post.

DS = standard deviation.

\* The evaluation was performed in presence of oxygen therapy where prescribed.



similar basic characteristics. Iaccarino et al<sup>[22]</sup> reported a mortality of 11.8% recorded among patients suffering from COVID-19 and hospitalized.

The clinical conditions of COVID-19 patients therefore require careful monitoring, particularly in relation to respiratory capacity. Patients in this study, in 77.8% of cases, had oxygen-assisted therapy with an average of liters administered equal to 2.3 l/min. Both parameters showed a significant difference compared to the comparison group where the percentage of patients with oxygen therapy was 25.9% with a mean administration of 1.5 l/min. In populations hospitalized for COVID-19 infection and with an average age of less than 50 years, Kim et al<sup>[23]</sup> and Zhao et al<sup>[24]</sup> report much lower rates of oxygen therapy use; 21% and 32%, respectively.

The values relating to saturation and heart rate measured before and after physiotherapy treatment did not show significant differences compared to the control group, highlighting how the rehabilitation treatment did not cause a significant worsening of these parameters. By relating these data to the different frequency of use of oxygen therapy in the two groups of patients, with hip fracture with or without COVID-19 infection, it can be assumed that adequate supportive therapy allows the patient to face rehabilitation without significant critical issues emerging.

Moreover, dyspnea measured with the Borg scale was different value between the two groups. In this case, both pre- and post-treatment measurements showed greater breathing difficulties in the study group with an average value of 0.8 (SD 1.0) in the pre-treatment and 1.3 (SD 1.3) in the post-treatment. The mean difference of dyspnea between COVID-19 patients and the control group was 0.4 points in the pre-treatment phase and 0.7 in the post-treatment phase. Thus, the difference is statistically significant revealing a worse dyspnea perception in the COVID-19 group, the difference does not reach one point of score, identified as the minimally clinical importance difference for the Borg Scale.<sup>[25]</sup> In describing the methods of applying physiotherapy treatment in clinical practice, some authors<sup>[26]</sup> identified that, when modified, Borg scores are greater than 3 it is recommended that the physiotherapy treatment be discontinued. In this study, the average values of the Borg scale recorded are below this threshold and only in 9% of cases there was a worsening of more than 2 points of the score after treatment. Therefore, breathing difficulty does not seem to prevent the execution of the rehabilitation treatment for COVID patients.

The importance of physiotherapy treatment has been highlighted by various authors<sup>[8,9]</sup> in order to counteract and prevent all the symptoms of fatigue and bed rest that have been seen to be present in cases of COVID-19 infection.<sup>[7]</sup> The incidence of walking recovery in the two groups did not show significant differences and was in line with the values found in the literature.<sup>[16]</sup> A difference between groups was found considering the use of ambulation as a training within the single physiotherapy session. In fractured patients with COVID-19 only 22% were able to perform ambulatory training during individual rehabilitation sessions compared to 40% in non-COVID-19 fractured patients. This difference can be explained primarily in the patient's clinical condition. A greater difficulty in breathing reported by the patient and more unstable clinical conditions may have resulted in greater difficulty for the patient in performing a more physically demanding activity such as walking during every physiotherapy session. Another aspect to take into consideration was the different setting in which the professionals found themselves working, the isolation procedures

put in place for COVID-19 patients, could somehow have made the rehabilitation approach and stimulation to the recovery of the patients more difficult for patient motor skills, especially walking. The aspect of the intensity of the treatment for patients with COVID-19 infection is an element of discussion to avoid, on the one hand, overloading the respiratory structures and on the other hand, to offer a treatment that is not very effective. The Modified Borg scale could be a useful tool in this context. Further studies are needed to better define which parameters to use as a reference and to deepen the definition of optimal physiotherapy treatment intensity in a more comprehensive way.

The care burden within such a particular context, in order to allow the activities to be carried out safely, required the presence of two healthcare providers in 80% of cases, a percentage in line with the care burden of the comparison group. This aspect would need to be investigated in further studies in order to understand the real benefit between the risk of exposure to contagion for healthcare providers and the outcome of the physiotherapy intervention. According to the present authors, in the current state of knowledge and according to the proposed data, physiotherapy treatment in a post-acute phase of the infection and after surgery can play a central role in the patient's healing process and for this reason it must be taken into consideration by the multidisciplinary team in charge of the patient with a case-by-case evaluation.

#### 4.1. Limits

The study showed several limitations: the sample size was very low. The uniqueness of the situation and of the patients recruited did not allow for larger samples. Moreover, the comparison group also presented a small number. The sudden change in care procedures linked to the COVID-19 pandemic has led to an equally rapid evolution of clinical practice. This context did not facilitate the collection of data which in some cases were found to be fragmented. The use of computerized medical and physiotherapy records was able to contain this difficulty.

#### 5. Conclusion

Physiotherapy treatment of patients with COVID-19 infection and undergoing surgery for hip fracture should be encouraged, as in the postoperative phase, it has proven to be well tolerated by patients. The fragility of this type of patient requires careful evaluation prior to, during and after the rehabilitation treatment, and in this context, the Borg scale has proven to be a useful tool. Finally, the intensity of physiotherapy treatment must be better defined in order to be sure of offering an optimal intervention for patients.

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