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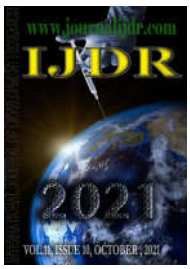

RESEARCH ARTICLE OPEN ACCESS

PHYSIOTHERAPEUTIC REHABILITATION OF ADULT PATIENTS WITH COVID-19 DISEASE IN HOSPITAL ENVIRONMENT: A SYSTEMATIC REVIEW

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ABSTRACT

Since the start of the Covid-19 disease pandemic until August 20, 2021, approximately 210 million infected individuals worldwide have been reported to the World Health Organization (WHO), including more than 4.4 million deaths. In Brazil, more than 21 million confirmed cases of COVID-19 were recorded, with approximately 580 thousand deaths reported to the WHO. In general, the elderly and people with comorbidities are at higher risk of developing severe disease. The role of the physiotherapist is necessary at all stages of hospital care. Objective: To present and evaluate the effectiveness of physical therapy procedures used in the treatment of hospitalized patients with COVID-19. Methods: Literature review, registered in the OSF Registry, with DOI registration 10.17605/OSF.IO/UE5YX, available at https://osf.io/ue5yx. The application of physical therapy procedures in the treatment of patients with COVID-19 in a hospital environment was reviewed. Data were collected by two independent reviewers, from March 1st to July 31st, 2021, through databases such as: Pubmed, VHL Regional Portal and Scielo according to the PRISMA recommendation (Main Items for Reporting Systematic Reviews and Meta - analyses). The search terms included the descriptors in English: (patients with COVID-19) OR (Infections à SARS-CoV-2 ARDS) OR (confirmed diagnosis of COVID-19) OR (severe acute respiratory syndrome coronavirus 2) OR (patients with SARS-CoV-2 ARDS) OR (Betacoronavirus) AND (physiotherapy) OR (physical therapy resources) OR (Physical Therapy Modalities). In the end, 6 scientific productions were selected. Results: Several authors recommend that, with clinical feasibility and human and technical resources available, prone positioning, mobilization and/or early therapeutic exercises be applied to patients with COVID-19 to reduce the deleterious effects of the disease on neuro-muscle function. skeletal, cardiopulmonary and functionality. Conclusion: We can conclude that there is still no specific guidance in the physical therapy treatment of COVID-19. However, the use of the prone position, exercises for rehabilitation of the motor and respiratory function in critically ill patients on mechanical ventilation, are being considered promising in the management of complicationsand prevention of the disease's sequelae.

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INTRODUCTION

Covid-19 is a contagious disease caused by the action of a new coronavirus and has been considered a Public Health Emergency of International Importance (ESPII). This decision by the World Health Organization (WHO) aims to improve coordination, cooperation, and global solidarity to stop the spread of the virus, as declared by the WHO on January 30, 2020. Since the start of the Covid-19 disease pandemic, as of July 8, 2021, more than 185 million infected individuals have been registered worldwide, including more than 4 million deaths. In Brazil, approximately 19 million confirmed cases of COVID-19 were recorded, with more than 530 thousand deaths reported to the WHO (Abodonya, 2021). The role of the physiotherapist is necessary at all stages of care for patients infected with Covid-19, in order to limit the functional consequences of the disease in the acute phase in the hospital environment and also in the long-term follow-up of these patients in the chronic phase (Assobrafir, 2021). Although 80% of infected patients are classified as at low risk, as they remain asymptomatic or have few symptoms, about 20% of detected cases are classified as medium risk, with clinical manifestations associated with infection and requiring hospital care because they have breathing difficulty approximately 5% of which may need ventilatory support, which are considered high risk (Bastoni, 2020). Evidence from studies conducted around the world show that COVID patients who presented severe conditions and required hospitalization are at high risk of developing respiratory muscle and limb weakness (Borges, 2020; Brasil, 2021; Burns, 2020).

In general, the elderly has a higher risk of developing severe conditions of COVID-19, and this increased risk happens more in people with comorbidities, for example; hypertension, chronic respiratory diseases, diabetes and cancer (Brasil, 2021; Carvalho, 2021; Castro, 2021). In most cases, the symptoms start off mild, four to five days after exposure to the virus, among the main initial clinical symptoms of COVID-19 stand out fever, cough, body aches, fatigue, nasal congestion, pain head and shortness of breath. However, some patients may present with conjunctivitis, sore throat, loss of taste or smell, skin rash, or discoloration of the fingers or toes (Bastoni, 2020; Brasil, 2021; Clarke, 2021). Monitoring through laboratory tests help to control complications and patient treatment. Chest radiographs should be taken for the diagnosis of lung infections, the dosage of gases and electrolytes is important in cases of respiratory insufficiency. If the patient has a respiratory deficit, he or she must be admitted to an appropriate unit under an emergency regime and, if necessary, the use of mechanical ventilation must be offered to maintain normal oxygen levels until the patient recovers, which may take a few days. Hospitalization usually takes place in the severe phase of the disease and is indicated for intensive care, where there is necessary support for the management of complications and consequent reduction of sequelae and lethality (Bastoni, 2020; Comoli, 2021; Coppo, 2020; Dantas, 2021). The WHO classification and definition of severity of COVID-19 for adults reads: Mild disease: Symptomatic patients diagnosed with COVID-19 with no evidence of severity. Moderate disease (pneumonia): Patients with clinical signs of pneumonia but no signs of severity, including SpO2 $\geq$ 90% (room air). Severe illness (severe pneumonia): patient with clinical signs of pneumonia, such as fever, cough, dyspnea, tachypnea, with signs of seriousness: respiratory rate greater than 30 cycles/min; severe breathing difficulty; or SpO2<90% (room air). Critical Illness: Worsening of symptoms after approximately one week of onset of pneumonia. Acute respiratory distress syndrome (ARDS), Chest image showing bilateral opacities not fully explained by volume overload, lobar or pulmonary collapse, or nodules (Despres, 2020). The evolution of the disease from the symptoms begins in the first week of contagion of the disease, where the patient can generally be classified as a mild disease and the symptoms observed are only flu, routine laboratory tests, arterial blood gases and oxygen saturation (SaO2) in the blood will be normal and most will have Computed Tomography (CT) of the chest without alterations (Guimarães, 2020).

The second stage of the disease, already considered moderate with pneumonia, starts around the second week with the appearance of dry cough, arthralgia, myalgia and low-grade fever. This phase ranges from mild to moderate symptoms. Laboratory tests performed in this phase will indicate inflammation, SaO2 will be lower than in the previous phase, however still above 93%, and the D-dimer will begin to change. A pleural thickening may be observed on chest X-ray and USG, and on chest CT, ground glass will be observed, showing the onset of pneumonia. Until this stage, the patient can evolve with the resolution of the disease, corresponding to 80% of cases or with worsening (Guimarães, 2020). The third stage already considered a severe disease (severe pneumonia) affects 20% of all patients with worsening respiratory symptoms between the 8th and 10th day, with severe cough and dyspnea and SpO2 lower than 93%, with an increase of ferritin, PCR, lactic dehydrogenase (LDH) and D-dimer. And even greater delineation of the ground-glass appearance and bilateral infiltrate in imaging exams (Guimarães, 2020). The change from the third to the fourth phase, which is considered a critical illness, can happen quickly, affecting mainly the respiratory part, progressing through the respiratory tract to the pulmonary alveoli. In the alveoli, leukocyte migration occurs through the action of cytokines, resulting in gas exchange dysfunction, with pneumonia, characterized by productive cough, fever and respiratory insufficiency. In this phase, the patient is in a more critical condition than in the previous phase and some patients may still present; acute cardiac injury, arrhythmias, acute kidney injury, electrolyte alterations, hypoproteinemia, coagulation alterations and neurological manifestations (Bastoni, 2020; Despres, 2020; Hallifax, 2020). The several studies developed in relation to the sequelae of patients infected with coronavirus, still need to be discussed for a better understanding, as well as the available physiotherapeutic approaches, in which there are still few precise results. Therefore, the aim of this systematic review is to present relevant evidence regarding the effectiveness of physical therapy procedures used in patients treated with COVID-19.

METHODS

A systematic review of the application of physical therapy procedures in the treatment of patients with COVID-19 in a hospital environment was carried out. The descriptive variables extracted were country of origin of the sample, year, number of participants, mean age, stage of the disease, number of sessions, treatment time, mentioned physiotherapeutic approaches, evaluation measures and conclusion of the obtained results. This research was registered in the OSF Registry, with DOI registration 10.17605/OSF.IO/UE5YX , available at https://osf.io/ue5yx. The data were collected by two independent reviewers, in the months of March, April and May of 2021, with the final date of the database search until June 1st, 2021, through databases such as: Pubmed, BVS Regional Portal and Scielo according to the PRISMA recommendation (Main Items to Report Systematic Reviews and Meta-analyses) for articles that could answer the following question: What are the physiotherapeutic resources used in the treatment of patients with COVID-19 in a hospital environment? The included studies aim to point out the physical therapy procedures used in the frontline of the COVID-19 pandemic in Brazil and worldwide in the period 2020 and 2021. Exclusion criteria: Studies without accessible full text, studies that did not report quantitatively specific results, abstracts, comments, reviews, posters and editorial reviews. Initially, an online search was performed in the different databases, using the PICO strategy (population, intervention, comparison/control, and result), as follows: Population: patients with COVID-19 and intervention: any type of physical therapy. In Pubmed, the following filters were applied: Free full text; Clinical study; Clinical trial; Comparative study; Controlled clinical trial; Randomized clinical trial; articles published from 01/01/2020, by studies whose titles or abstracts had the following descriptors: (patients with COVID-19) OR (confirmed diagnosis of COVID-19) OR (Severe acute respiratory syndrome coronavirus 2) OR (patients with SARS-CoV-2 ARDS) OR (Betacoronavirus) OR (Coronavirus Infections) OR (SARS-CoV-2 ARDS Infections) with 4,256 results.

Using the following descriptors: (physiotherapy) OR (physical therapy resources) OR (Physical Therapy Modalities) 1,792 with results. With the crossing of the data, 59 results were obtained. In Scielo, the following filters were applied: (Year of publication: 2020); (Year of publication: 2021) ;(SciELO Subject Areas: Health Sciences); (Quotable); (Literature type: Article). The following descriptors were used: (patients with COVID-19) OR (SARS-CoV-2 ARDS Infections) OR (confirmed diagnosis of COVID-19) OR (severe acute respiratory syndrome coronavirus 2) OR (patients with SARS-CoV- 2 ARDS) OR (Betacoronavirus) with 512 results. When using the descriptors: (physiotherapy) OR (physical therapy resources) OR (Physical Therapy Modalities) with 98 results. By crossing the data, 90 results were found for the search. Articles published from 2020 onwards with the following filters were selected on the BVS Regional Portal: Controlled clinical trial, with full text available. Using the descriptors: (patients with COVID-19) OR (SARS-CoV-2 ARDS Infections) OR (confirmed diagnosis of COVID-19) OR (severe acute respiratory syndrome coronavirus 2) OR (patients with SARS-CoV- 2 ARDS) OR (Betacoronavirus) with 5,202 results. When the descriptors were used: (physiotherapy) OR (physical therapy resources) OR (Physical Therapy Modalities) 6,246 results were found. By crossing the data, 21 results were found. All publications identified in the databases were exported to the End-Not Reference Manager for storage and later use in the manuscript and to Rayyan (Rayyan QCRI/web app) a web application to aid in systematic review and meta-analysis research (Ibarra-Estrada *et al*., 2021). In Rayyan a duplicate removal filter was used. After removing the duplicates, potentially eligible studies were selected and their texts were independently analyzed by two evaluators, in case of disagreement between the two, a third was consulted. From the titles or reading the abstracts of the texts, duplicate studies, unrelated to the topic or with a PEDro scale score < 5 were excluded, and the reference list of the selected articles was analyzed. During the reading and manual search of the references, new studies were found and selected for the selection process of those eligible through full reading. The description of the study was carried out by the PRISMA recommendation.

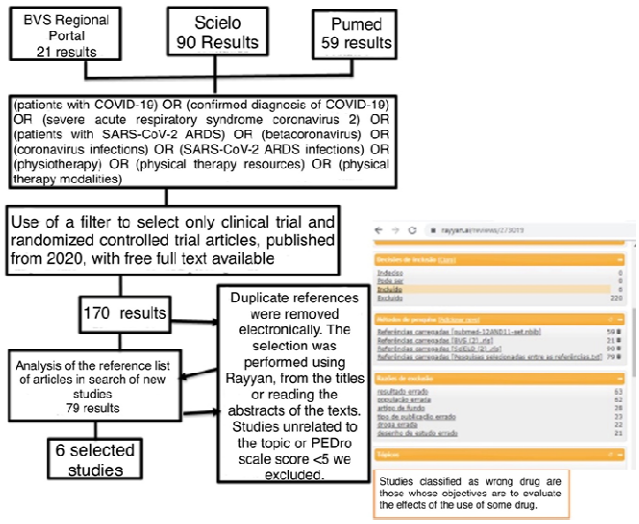

Figure 1. Shows the study review flowchart (adapted from PRISMA)

RESULTS AND DISCUSSION

Six articles were included in the study (Chart 1), selected with a comprehensive sampling strategy that allowed us to identify the various physiotherapeutic strategies used in the hospital environment during the disease, so that some relevant criteria can be provided on the physiotherapy options, considering the stages of rehabilitation and patient tolerance. The focus of the present study was to present the physical therapy resources used in the hospital environment and to evaluate the effects in adult patients with covid-19, during and after mechanical ventilation.

The types of physical therapy resources most used in the eligible articles for this study were the use of the prone position and exercises for the rehabilitation of respiratory function. As demonstrated in several results of our current study, these features indicate safe and efficient effects on the rehabilitation of respiratory function during and after consecutive weaning from mechanical ventilation in patients with COVID-19 (Medrinal, 2021; OPAS, 2021). The Brazilian Association of Cardiorespiratory Physiotherapy and Intensive Care Physiotherapy (ASSOBRAFIR) and several authors also recommend that, with clinical feasibility, human and technical resources available, breathing exercises and/or early mobilization be applied to the patient to avoid deleterious effects and sequelae of the disease serious and critical about neurological, musculoskeletal, cardiopulmonary function and functionality (Coppo, 2020; Orsini, 2021; Paul, 2020). The ventilatory repercussions of COVID-19 infection imply higher morbidity and the health-related quality of life after discharge is poor. Patients suffer from severe physical and psychological impairment, although the pathophysiology of the disease is not yet fully understood, the most likely hypothesis is that it is associated with a severe ventilation/perfusion incompatibility and we should consider a prolonged duration of rehabilitation time, especially for patients who were discharged after being severely ill and long hospitalized (Paul, 2020; QCRI, 2021).

According to Abodonya, *et al*. (2021), valuable and significant improvements in inspiratory muscle functions were observed with a 2-week inspiratory muscle training (IMT) program in patients with COVID-19 in the intensive care unit (ICU) after consecutive weaning from mechanical ventilation (Medrinal, 2021). In a study by Hallifax, *et al*. (2020), reports in an observational cohort study that the mortality of patients with COVID-19 who require respiratory support is considerable. However, patients treated by a respiratory physiotherapy team with the successful use of CPAP plus prone position had better survival outcomes[19]. Survival data in a COVID-19 cohort, mean 81 years, severely hypoxic, in which referral to intensive care for invasive ventilation was not considered appropriate, suggest a 50% survival in patients who received NIPS treatment (CPAP or BiPAP) as part of a respiratory escalation strategy in hospitals administering COVID-19 (Righetti, 2019). Coppo, A *et al*. (2020) demonstrated in a retrospective study that the effect of prone positioning on improving blood oxygenation was maintained after resupination in half of patients requiring oxygen supplementation by COVID-19 (Sancho, 2020). Changing from supine to prone position can be a facilitator to mobilize and eliminate secretions, facilitating ventilation of the alveoli, preventing obstruction of the bronchioles by mucus plugs and improving PAO 2 / FIO 2, thus reducing the possibility of pulmonary atelectasis (27). However, Gattinoni *et al*. (2020), recommend the use of the prone position only after evaluation of pulmonary involvement by tomographic analysis of patients with SARS-COV-2.

The authors suggested the division into 2 groups: “L” or “H”, or type “1” and type “2”. Patients with type 2 alterations have higher potential to recruit alveoli, for which the use of the prone position is indicated, as well as ventilation strategies for ARDS. In type 1 patients, the prone position is considered a rescue strategy, facilitating the redistribution of blood flow and the opening of collapsed areas, however, in patients with normal or high pulmonary compliance, it is not as beneficial (Vieira, 2020). According to the guidelines of the Brazilian Association of Cardiorespiratory Physiotherapy and Intensive Care Physiotherapy, the prone position should be used early, preferably within the first 24 hours, in patients with PaO2 and lower inspired oxygen fraction - FiO2 (PaO2/FiO2) at 150 mmHg, with sat < 92%. It is also recommended in clinical practice that the patient be kept in pronation for at least 16 hours (up to 20 hours), before returning to the supine position (Vieira, 2020). Several studies have recently been published reporting the use of the prone position as an alternative treatment in intubated patients and in non-intubated patients with COVID-19-related Acute Respiratory Distress Syndrome (ARDS) (Paul, 2020; Polastri, 2021; Sancho, 2020; Silva, 2020; World).

Table 1. Physical therapy intervention procedures

N	Title	Author	Country of origin/ Year/ ISSN/ Qualis	Sample number Age Disease stages	Cited approaches Session number Time	Assessment measures	Conclusion of the results obtained
1	Feasibility and physiological effects of prone positioning in non-intubated patients with acute respiratory failure due to COVID-19 (PRON-COVID): a prospective cohort study	Coppo, Anna, et al.,	Italy 2020 2213-2600 A1	Nº 47 57 years of age on average. 3rd and 4th stages of the disease.	Use of the prone position. Prone position, maintained for a minimum period of 3 hours.	Variation in oxygenation.	Improvement in oxygenation maintained in the supine position in 50% of patients.
2	Prone positioning improves oxygenation and lung recruitment in patients with SARS-CoV-2 acute respiratory distress syndrome; a single centre cohort study of 20 consecutive patients	Clarke Jet al.,	Ireland 2020 1756-0500 B1	Nº 20 54 years of age on average. 4th stage of the disease.	Use of the prone position 16,2h in the prone position.	Variables of arterial blood gases and electrial impedance tomography.	Average improvement in ratio PaO_2 / FiO_2 * in the prone position compared to the supine position.
3	Inspiratory muscle training for recovered COVID-19 patients after weaning from mechanical ventilation: A pilot control clinical study	Abodonya AM, et al.,	Saudi Arabia 2021 0025-7974 A2	Nº 42 48 years of age on average 4th stage of the disease.	TMI* Program using na inspiratory threshold muscle trainer (Respironics, Cedar Grove, NJ). 2 daily sessions of 6 inspiratory cycles of 5 min of resisted inspiration and 60 seconds of rest. 5 days a week for 2 consecutive weeks.	FVC%, FEV1%, DSI, QL/ EQ-5D-3L and TW6m*.	Improvement in lung functions, dyspnea, functional performance and QL*.
4	Successful awake proning is associated with improved clinical outcomes in patients with COVID-19: single-centre high-dependency unit experience	Hallifax et al.,	United Kingdom 2020 2044-6055 A1	Nº 48 69 years of age on average. 4th stage of the disease.	Awake pronation with CPAP or HFNO respiratory support. Initial 6-8cm H20 CPAP with supplemental oxygen incorporated, targeting 92%-96% SaO2. 2h in the prone position, 2 times a day for 2 consecutive days.	Association between total pronation and reduced mortality.	Successful pronation with CPAP was associated with better survival chances.
5	"Improved survival following ward-based non-invasive pressure support for severe hypoxia in a cohort of frail patients with COVID-19: retrospective analysis from a UK teaching hospital."	Burns, Graham P et al.	United Kingdom 2020 2044-6055 A1	Nº 28 81 years of age on average. 4Th stage of the disease.	Positive airway pressure (10-14 cmH 2O) with oxygen flow rates dragged to a maximum of 15 L/min. Pressure and flow rates were titrated to reach an oxygen saturation of ≥94%.	Retrospective analysis of survival in severely hypoxic patients where referral to intensive care for invasive ventilation was not considered appropriate.	The ward-based NIPS for severe hypoxia was associated with 50% survival in this cohort. *
6	"Prone positioning in patients treated with non-invasive ventilation for COVID-19 pneumonia in an Italian emergency department."	Bastoni D, et al	Italy 2020 0959-8138 A1	Nº 10 73 years of age on average. 4th stage. Of the disease.	Prone position associated with non-invasive helmet ventilation (NIV) with continuous positive airway pressure (CPAP). *	PaO_2 value and in thePaO_2 / FiO_2 ratio before and after 1hour of prone ventilation. *	After 1 hour of pronation there was na improvement in thePaO_2 / FiO_2 ratio for all patients (from severe hypoxemia with. A median PaO_2 / FiO_2 ratio of 68 ± 5 mm Hg. To median 97 ± 8 mm Hg).*

Source: prepared by the authors.

* PP = Prone Position; [PaO 2] / [FiO 2]) = (oxygen partial pressure [PaO 2] / fractional oxygen concentration in inspired air [FiO 2]); TMI = inspiratory muscle training; FVC% = forced vital capacity; FEV1% = forced expiratory volume in 1 second; DSI = dyspnea severity index; QL/ EQ-5D-3L = Quality of life / EuroQuality-5Dimensions-3Levels; TW6m = 6 minute walking distance test; QL = Quality of life; QF/ SF-36 = Quality of life / quality of life assessments scores SF-36; mMRC = modified dyspnea rating scale of the British Medical Research Council; HAMD = Hamilton Depression Scale Rating Scale; HAMA = Hamilton Anxiety Rating Scale; SAS = anxiety scores; SDS = depression scores; CPAP = Continuous Positive Airway Pressure; HFNO = High Flow nasal oxygen. SpO2 = peripheral oxygen saturation; NIPS = non-invasive pressure support.

As shown in the studies (Table 1), the use of the prone position improves SpO2, increases PaO2 in most patients while they remain in this decubitus position, and in some patients, this therapy was effective for sustained improvement in PaO2 even after returning to the supine position (Clarke, 2021; Pereira, 2020; Polastri, 2021; Sancho, 2020; Vieira, 2020; World; World, 2021; Yan, 2020; Zhang, 2020; Zhang, 2020). However, some authors warn about the cardiovascular physiological changes after prone positioning, which include reduced venous return due to increased intra-abdominal pressure resulting in reduced systolic volume, increased sympathetic response, increased heart rate, increased vascular resistance systemic and pulmonary and reduced left ventricular compliance due to intrathoracic pressure increase.

All of these changes can result in reduced cardiac output and systemic hypotension (Vieira, 2020). In Silva, *et al*. (2020), it is recommended the early practical action of the care and involvement of the physiotherapy team with patients with severe respiratory failure associated with COVID-19 in ICU care, to release the airways, especially in those patients with cough deficiency or helping in the removal of pulmonary secretions from mechanically ventilated patients (Zha, 2020). COVID-19 can present several cardiovascular sequelae, in many cases cardiovascular alterations happen even when the lung is better preserved, requiring continuous and multidisciplinary follow-up to these patients in order to reduce complications and adverse events. According to a study on the distribution of physiotherapeutic assistance to patients infected with COVID-19, it was found that 96.7% of the interviewed professionals reported that during their shift they work in the management of IMV and NIV (Pereira, 2020).

Respiratory repercussions imply oxygenation limitations. In this context, as seen in several articles, respiratory physiotherapy is necessary with the main objective of promoting respiratory rehabilitation of patients with pulmonary overload and preventing damage. However, it is important to emphasize that early mobilization is also cited as extremely necessary for the patient's recovery. According to Righetti *et al*. (2020), patients hospitalized because of the disease, have a significant decrease in their activity levels, being subject to loss of muscle strength and cardiorespiratory capacity, therefore, early mobilization should be started as soon as possible, as long as the patient presents adequate clinical conditions. The analysis of the studies showed that some physical therapy procedures are being considered promising in the management of complications, prevention, and reduction of sequelae. In this context, the care provided by physiotherapy, medical and nursing teams experienced in treating this type of illness is of fundamental importance (Assobrafir, 2021; Pereira, 2020; Polastri, 2021; Zhang, 2020). The limitations of the study are that the evidence found is based on a limited number of articles, as we are researching treatment interventions for an entirely new disease. However, we can consider as strengths that they were selected with a comprehensive sampling strategy that allowed us to provide the various physiotherapeutic strategies used in the course of the disease.

CONCLUSION

It can be concluded that the main evidences of physical therapy treatment, considering the stages of rehabilitation and patient tolerance are the use of the prone position, rehabilitation exercises of the motor and respiratory function in critically ill patients on mechanical ventilation, are being considered promising in the management of complications and prevention of disease sequelae. It is noteworthy that there is still no specific guidance on the physical therapy treatment of COVID-19, however, in this systematic review, physical therapy intervention was shown to promote significant improvements in impaired pulmonary and muscle functions in patients with COVID. As this is a recent disease, many studies on safety, effects and physiological mechanisms are needed to establish validated protocols that allow professionals to act based on strong evidence.

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