

# Physiotherapy in severe polytrauma patients: a therapeutic care model

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## ABSTRACT

**Objective:** In view of the high degree of complexity that the polytrauma patient represents to the multiprofessional team in the elaboration and execution of their care plan in the intensive care unit (ICU), combined with the lack of evidence on the subject, this study suggests a model of early physiotherapeutic assistance to critical polytrauma patients based on the clinical experience of recent years. **Method:** The model was elaborated based on the practices verified in the records of 6,388 physiotherapy sessions performed in 198 patients hospitalized between December 2009 and September 2011 in polytraumas-specialized ICU. The activities/care were inserted in the model after approved in discussion with the multiprofessional team. All patients enrolled were aged 18 years or older and were victims of severe trauma according to the Injury Severity Score (ISS). **Results:** The proposed model was structured in such a way that the physical therapy activities/care were organized according to the injured body region (traumatic brain injury, face fractures, spine fractures, thoracic trauma, abdominal trauma, pelvic fracture and extremities fractures). The routine of the ICU encouraged daily discussions with the medical team to know the particularities of each clinical case, to establish therapeutic goal and to design the rehabilitation program. **Conclusion:** The proposed model became routine and consolidated the physiotherapeutic action in the respective care unit. The physiotherapy team started working 24 hours a day. The model made possible the standardization of physical therapy assistance and greater safety for the severe polytrauma patient.

**Keywords:** Trauma Centers, Intensive Care Units, Wounds and Injuries, Physical Therapy Modalities, Exercise Therapy, Rehabilitation

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## INTRODUCTION

Polytrauma is characterized by a complex lesion model involving different anatomical regions. It is one of the most important causes of mortality and morbidity in the world's young adult population.<sup>1</sup> In Brazil, according to data from the Ministry of Health referring to the Unified Health System (SUS), 86,563 hospitalizations for trauma were recorded in December 2016, and that approximately 43% (37,218) of these hospitalizations occurred in the southeastern region of the country.<sup>2</sup> Depending on the hospital, hospitalization due to traumas may reach values above 40%.<sup>3</sup>

The morbidity resulting from injuries resulting from trauma causes a high demand for emergency and intensive care services, as well as stopping any work activities and decreasing socioeconomic production, which further exacerbates the need of assistance given to polytraumatized patients. It is a constant challenge to find alternatives for support, assistance and reinsertion of this individual into society. Physiotherapy, a science dedicated to promoting the recovery and preservation of functionality through human movement and its variables, fits in this new assistance and management perspective of a multiprofessional team that works in the intensive care unit (ICU).<sup>4-6</sup>

In this context, physiotherapy works in several treatment conditions, such as: critical patient in spontaneous breathing; assistance during the pre- and postoperative period; prevention of respiratory, circulatory and motor complications; and assistance to critically ill patients who require invasive or non-invasive ventilatory support.<sup>6-9</sup> Early physiotherapy also includes therapeutic activities in various functional conditions of the patient, such as bedside exercises, bedside sedation, orthostatism, Transfer to the armchair and ambulation.<sup>6,10,11</sup>

However, the fact that polytrauma involves complex lesions in different anatomical regions causes a number of challenges to be encountered when considering mobilization and early physiotherapy for these patients. The presence of lesions and/or specific features used for the treatment of lesions secondary to trauma, such as paralysis, compartment syndrome, presence of grafting areas, unstable fracture not surgically treated, pain of difficult control, splints, external fixations, skeletal traction, and immobilizing devices may temporarily restrict or preclude the ability to mobilize patients early.<sup>12</sup> Additionally, decision-making about early motor physical

therapy in patients with complex injuries is also hampered by the absence of guidelines or good practice in this subject.

Although severe trauma is one of the main causes of hospitalization and the use of intensive physiotherapeutic care, little has been written about physical therapy in the care of patients who are victims of trauma.

## OBJECTIVE

This study aims to suggest a model of physical therapy care for severe polytrauma patients admitted to the ICU based on the clinical experience of the last years.

## METHOD

The present study is an exploratory-descriptive, qualitative approach that was developed at the ICU of Surgical Emergencies and Trauma of the Central Institute of Hospital das Clínicas of the Medical School of the University of São Paulo (ICHC-FMUSP).

It is a specific unit with 17 beds, in a large public hospital and tertiary referral center for the care of trauma victims throughout the city of São Paulo. It has teams of emergency surgery, neurology, neurosurgery and orthopedics available on-site 24 hours a day, in addition to other professionals, such as physiotherapists and psychologists, who work in conjunction with the medical and nursing teams. During the data collection period, the unit had 12 hours of physical therapy per day. The inpatient received on average 2 physiotherapeutic appointments per day, with a duration of 25 to 40 minutes each.

The assistance model was elaborated from the practices verified in the 6388 records of the physiotherapy sessions performed in 198 patients hospitalized between December 2009 and September 2011 in the intensive care unit in polytrauma. All patients attended were aged 18 years or older and were victims of severe trauma according to the Injury Severity Score (ISS). Severe trauma is defined when the ISS  $\geq$  16 points. The ISS is a widely used anatomical score that assesses the severity of patients with multiple traumatic lesions. The system takes into account the three most severely injured body regions and provides an overall severity score.<sup>13,14</sup>

The activities/care recorded in medical records in the 6388 physiotherapy sessions served as a substrate for the elaboration of

the physiotherapeutic assistance model for the severe polytraumatized patients in the ICU. The following steps were carried out: a) consultation of patient records (physiotherapy evolution sheets), b) organization of activities/care schedules according to the patient's injured bodily region, c) selection of the most frequently performed physiotherapeutic activities, d) search in the scientific literature for the activities/care, e) discussion of the activities/care in a meeting with multiprofessional team (physiotherapists, doctors and nurses), f) insertion into the model of activities/care approved by the multiprofessional team.

The ethical and legal aspects of the study were preserved through the approval of the study by the HC-FMUSP Ethics Committee (No. 1159/07).

## RESULTS

The characteristics of the studied population, trauma mechanisms and injured body region are described in Tables 1, 2 and 3, respectively.

The proposed assistance model organizes the physiotherapeutic activities/care according to the patient's injured body region (traumatic brain injury, face fractures, spine fractures, chest trauma, abdominal trauma, pelvic fracture and extremity fractures):

### Severe cranioencephalic trauma

- Attention to measures of neuroprotection. In the ICU, the main objective of neurological patient care is to optimize cerebral perfusion and avoid secondary injury, maintaining hemodynamic, metabolic and respiratory stability, in order to establish an adequate supply of oxygen and nutrients to the brain tissue. Among the fundamental measures during the recovery of the neurological lesion are mechanical ventilation (MV) and deep sedation.

- Blood pressure control of carbon dioxide (PaCO<sub>2</sub>). Initially maintain values around 35 mmHg in arterial blood gas. Installation of capnography for continuous monitoring of exhaled carbon dioxide. According to a study by Warner et al.<sup>15</sup>, which evaluated 851 patients with TBI, the mortality rate was lower for patients maintained with PaCO<sub>2</sub> between 30 and 39 mmHg. Optimized hyperventilation (PaCO<sub>2</sub> between 30 and 35 mmHg) can be performed when high intracranial pressure (ICP) persists (above 20 mmHg) with risk of brain tissue herniation.

**Table 1.** Characteristics of the population studied (n = 198)

Variables	Values
Male	162 (81.8)
Age (years)	39.9 ± 15.9
Initial Glasgow	8 ± 3.7
APACHE II	13.8 ± 5.7
ISS	31 ± 14.4
Number of lesions	4 ± 2.7
Time in ICU (days)	19 ± 12.7
Length of hospital stay (days)	30.6 ± 22
Length with MV (days)	10.5 ± 8

APACHE II – Acute Physiology and Chronic Health Disease Classification System II; ISS – Injury Severity Score; ICU – intensive care unit; MV – mechanical ventilation. Data presented as n (%) or mean ± SD (standard deviation).

**Table 2.** Trauma mechanisms (n=198)

Trauma mechanisms	Frecuence	Percentage (%)
Traffic accidents	125	63.1
Trampling	46	23.2
Motorcycle accident	40	20.2
Car accident	39	19.7
Falls	50	25.2
Fall from own height	27	13.6
Other falls	23	11.6
Violence	23	11.6
Physical aggression	14	7.1
GSW	6	3
SW	3	1.5

GSW – Gunshot wound; SW – Stab wound.

**Table 3.** Injured body region (n=198)

Injured body region	Frecuence	Percentage (%)
Head	157	79.3
Face	57	28.8
Chest	69	34.8
Abdomen	35	17.7
Upper limbs	32	16.2
Lower limbs	40	20.2
Pelvis	21	10.6
Spine	34	17.2

- Patients should also be maintained with good oxygenation, ie, peripheral oxygen saturation (SpO<sub>2</sub>) ≥ 95% and arterial oxygen pressure (PaO<sub>2</sub>) between 80 and 120 mmHg, to ensure adequate supply of oxygen to the brain tissue.

- Preferably low BPP values, between 5 and 8 cmH<sub>2</sub>O, should be used according to pulmonary complacency. The physiotherapist should be aware of the possible repercussions

of PEEP on the value of intracranial pressure (ICP). According to Georgiadis et al.<sup>16</sup>, the increase in PEEP up to 12 cm H<sub>2</sub>O does not lead to an alteration in ICP and can be safely applied to neurological patients.

- Techniques of respiratory physiotherapy: maneuvers of bronchial hygiene and pulmonary reexpansion can be performed safely. Endotracheal aspiration is the technique that will promote the greatest transient increase in

ICP, so the real need for its application must be evaluated and it must be performed with caution in the shortest possible time.<sup>17-21</sup>

- Attention to ICP values and ICP catheter care and external ventricular drain (EVD). During the manipulation of the patient always monitor the variations of the ICP and be careful not to externalize the ICP or EVD catheter. In the case of EVD, keep the system always leveled with the patient's external auditory canal, including the change of decubitus performed during care. Request assistance from the nursing team after the physiotherapeutic care to verify and level the system.

- Adequate bodily positioning with a raised headrest between 30° and 45°, and keeping the head alignment.

- Perform the passive mobilization of the upper and lower limbs, since the neuroprotection patient is sedated.

- Placement of positioning orthoses, mainly the use of splints to avoid the equine foot.

- Discussion with the nursing team about the prevention measures for pressure ulcer, especially in patients who use orthosis or positioning splints and present ulcer sticking points. Performing the change of decubitus (respecting the care described in the item placement) and use of calcaneus protectors and cushions.

- After the neuroprotection phase, with already controlled ICP and greater clinical stability, sedation is turned off to assess the patient's level of consciousness. The physiotherapist follows his therapy based on the weaning of the MV and progressive functional mobilization.

### Face fracture

- Evaluate the possible presence of nasal fluid fistula (NFF), since nasal aspiration is contraindicated in these cases.

- Care should be taken regarding the use of non-invasive ventilation (NIV). Contraindicated technique in the presence of NFF. Relative contraindication of NIV in cases of face fracture without NFF. In some cases, NIV can be used after the medical staff has been released. Preferably use the total face or performax mask, in which the support points are arranged around the patient's face and not in the areas of fractures.

- Prior to patient care, discussion with the medical staff should always be conducted. Be aware of the injuries, be sure of the effectiveness and safety of all physiotherapeutic procedures that will be performed.

- Patients with facial fractures present a risk of glottal edema after extubation. For weaning, Cuff Leak Test (also known as cuff leakage test or airway permeability) is recommended before extubation.<sup>22</sup>

### Spine fractures

- Before the patient's physiotherapeutic care, discussion with the neurosurgery and orthopedic medical teams should always be conducted.

- Many patients with cervical spine injury make use of the cervical collar (use prescribed by a doctor). The cervical collar can be removed temporarily (short period) for hygiene purposes or in some cases for proper hygiene peri-tracheostomy (TQT), but should always be replaced as soon as the procedure is finished. Only the medical staff can remove the cervical collar definitely.

- Many patients with spine fractures require block mobilization. It is recommended that this procedure be performed as a team. The physiotherapist should request assistance from the nursing team to mobilize or put the patient in position when necessary.

- For patients with spinal cord trauma, the physiotherapist should assess the level of injury. When pertinent, this professional should discuss together with the medical team the weaning of the MV and the possible need for early TQT.

- Respiratory physiotherapy with the objective of maintaining patent airways, adequate pulmonary ventilation and gas exchange, besides stimulating the respiratory muscles, facilitating the weaning of the MV.

- Motor limb/trunk physiotherapy should be performed according to the level of injury and the functional capacity of the patient.

- Removal of the patient from the bed, orthostatism and ambulation, when possible (clinically stable patients) are procedures that should always be agreed with the medical staff.

- Placement of positioning orthoses, mainly the use of splints to avoid the equine foot.

- Measures to avoid pressure ulcer: change of decubitus and use of calcaneus protectors and cushions.

### Chest trauma

- Intensive respiratory physiotherapy is an essential part of the treatment / rehabilitation and prevention of new respiratory complications in patients with chest trauma.

- In cases of major thoracic instability, due to fractures of multiple costal arcs, some care is critical to ensure the safety of the assistance offered. In this case, manual techniques of bronchial hygiene and pulmonary reexpansion should not be performed on fractured areas. Other, safer, and sometimes indicated alternatives are the use of manual lung resuscitation, respiratory enhancers, intermittent positive pressure ventilation, and NIV.

- NIV is an effective resource that can be used in the respiratory care of patients with chest trauma. The main objectives of the use of NIV are to ensure adequate thoracic stability, promote alveolar recruitment, assist in the correction of hypoxemia and respiratory acidosis, alleviate respiratory muscle work and decrease oxygen consumption. Thus, studies show that the use of NIV in chest trauma leads to improved oxygenation, decreased rates of orotracheal intubation, decreased complications/infections due to MV, shorter ICU stay and reduced mortality. The use of NIV is contraindicated in cases of non-drained pneumothorax.<sup>23-27</sup>

- It is strongly recommended that the physiotherapist review the imaging exams (CT scans and/or x-rays) before attending them and discuss them with the medical staff.

- During the treatment, the physiotherapist should pay attention to the evaluation of the type of drain (tubular or pig tail), the operation of the pleural and/or mediastinal drains according to the type of drain used (oscillation of the water column, bubbling and appearance of the fluid), and the possible presence of subcutaneous emphysema. The description in the evolution and the communication to the multidisciplinary team about the changes found in their evaluation are fundamental.

- When the patient is conscious and collaborative, the physiotherapist should advise him on the care of the drains during the movement in the bed, in order to prevent possible accidents with their exteriorization.

- There is no optimal ventilatory strategy that can be applied to all patients with thoracic trauma who require invasive MV. It is necessary to evaluate the pathophysiology and the type of lung injury after the trauma of each individual patient. Ventilatory modes with which the team is most familiar should be used, and implement a ventilatory strategy that provides adequate support, thoracic stability and simultaneously prevents MV-induced lung injury.<sup>28</sup>

- In order to prevent the failure of weaning from MV, the spontaneous breathing test

(SBT) must be performed in T-tube for at least 30 minutes. In patients with unstable thorax, the use of NIV immediately after extubation may prevent its failure, since in addition to all the physiological effects resulting from positive pressure, such as improved gas exchange and reduction of respiratory work, one can achieve better pneumatic stabilization of the thorax.

- Motor physiotherapy of limbs/trunk in the bed should be performed according to the functional capacity of the patient.

- Removal of the patient from the bed (armchair seating, orthostatism and ambulation) is fundamental for the rehabilitation of the patient with chest trauma and should be stimulated at an early stage and always released by the medical staff.

### Abdominal trauma

- The physiotherapist must know the type of medical treatment used, either conservative or surgical, and monitor intra-abdominal pressure measurements when they are performed.

- Respiratory physiotherapy (deep breathing exercises, ventilatory patterns, coughing) should be performed with the aim of preserving and optimizing pulmonary ventilation, ensuring adequate gas exchange and avoiding respiratory complications.

- In some cases it will be necessary to use NIV. It is important to emphasize that the use of NIV in high abdominal surgeries is not recommended, and can only be performed upon authorization from the medical team.

- Motor physiotherapy of limbs/trunk in bed should be performed according to the functional capacity of the patient.

- The removal of the patient from bed (armchair seating, orthostatism and ambulation) is part of the rehabilitation process, but should be performed in a supervised manner only if hemodynamics and hemoglobin levels are stable and always authorized by the medical staff.

- The physiotherapist must perform a good evaluation before attending and attend to cases of bleeding (more rigorous hematocrit control by the team), vacuum peritoneostomy and operative wound dehiscence. These situations contraindicate trunk exercises and removal of the patient from bed.

- The professional should always have a previous discussion with the medical team to become aware of the injuries, and to know if there was a prescription of the use of abdom-

inal tapes to guarantee a safe and effective therapy to the patient.

### Pelvic fractures

- The physiotherapist must know the type of medical treatment used, either conservative or surgical (external fixation), and also the classification of fractures, stable or unstable.

- The physiotherapist must have frequent discussions with the orthopedic medical team to know the particularity of the clinical case and to trace the rehabilitation program.

- Motor physical therapy should always be performed by evaluating the particularities of each lesion in advance. Initially, active and/or resisted upper limb exercises (RULE) are recommended so that this patient can more easily achieve the conditions to use some walking aid when walking is authorized. Active exercises free Eof lower limbs extremities (LLE) and isometric exercises for proximal LLE muscles can be performed.

- The physiotherapist should take care of the exercises applied and pay attention to the fact that the range of motion (ROM) of RULE may be limited by external fixation, fracture instability or pain.

- The release of the weight discharge in the seated position can be performed in some cases upon authorization from the medical staff.

### Extremity fractures

- The physiotherapist must know the type of medical treatment used, conservative (use of slings and/or castings) or surgical (external or internal fixation).

- Extremity fractures are very diverse. The physiotherapist should have frequent discussions with the orthopedic medical team to know the particularities of the clinical case and to trace the rehabilitation program.

- Motor physical therapy should always be performed by evaluating the particularities of each lesion in advance. It is recommended the mobilization of the free segments (active and/or resisted exercises) and the isometric exercises for the immobilized segments.

- The physiotherapist should take care of the applied exercises and pay attention to the fact that ROM may be limited by external fixation, plaster splints, fracture instability or pain.

- The removal of the patient from bed (sitting in armchair, orthostatism and ambulation) is part of the patient's rehabilitation and evolution process, but these procedures should be performed with care and only upon the authorization from the medical staff.

- It is important to emphasize that for patients with fractures of LLE and that make use of linear external fixation it is contraindicated to perform weight discharges in orthostatism in the affected limb. The onset of partial (weight) discharge in the affected limb occurs after internal fixation of the fracture.

- The physiotherapist should perform a good evaluation prior to attending and attend to cases of use of vacuum dressing, soft tissue lesions (discolouration), grafting areas, signs of deep vein thrombosis and signs of limb compartment syndrome. These situations may contraindicate the mobilization of the affected segment. The professional should always have a previous discussion with the medical team (know the injuries in detail) to ensure a safe and effective therapy to the patient.

### Pain

- Pain and stress reactions resulting from pain are aggravating factors of the trauma patient's condition. Untreated, or not sufficiently treated, pain can lead to a number of other problems that will make it difficult for the patient to recover.

- In a specialized ICU in the care of polytraumatized patients, the treatment of pain is a condition that demands high priority, being an inseparable part of the global conduct. It is essential that the physiotherapist in charge has an overall view of the patient's situation and his pain. Discussions with the pain team (physician and nurse) should be performed with the objective of establishing conducts according to the specific needs of each patient and that allow optimization of the rehabilitation process.

## DISCUSSION

This study suggests a model of physical therapy assistance to severe polytrauma patients in ICU. It is of great clinical relevance, considering the scarcity of literature regarding the particularities of early physiotherapeutic assistance to this specific population of patients.

Recently, Engels et al.<sup>12</sup> carried out a review of the literature and verified that none of the articles studied specifically evaluated early motor physical therapy in polytraumatized patients. Only papers addressing the role of early mobilization as part of a treatment program for specific surgical lesions and/or techniques were found. In another literature review, conducted by Khan et al.<sup>29</sup>, studies on multidisciplinary rehabilitation in polytrauma patients were investigated. No randomized and/or controlled clinical trials addressing the topic were identified. The 15 included studies were observational and conducted mainly in developed regions: 5 in the United States, 5 in Europe, three in Australia, one in New Zealand and one in Israel. No review study mentioned the type of multidisciplinary care performed, the intensity and/or frequency of therapy.

Positive results were observed by Clark et al.<sup>30</sup> in a retrospective cohort study. There was a significant decrease in complication rates (airway, pneumonia and other respiratory complications, vascular and deep venous thrombosis) after implementation of an early mobilization protocol in multi-trauma patients in the ICU. According to the authors, early mobilization, when well performed, is a safe and beneficial intervention for the multi-trauma patients in the ICU.

There are still many intensive care physicians and multidisciplinary team members who are reluctant to mobilize polytrauma patients because of safety concerns, feasibility of therapy, and a lack of scientific evidence about the physiotherapist's performance in these cases. These patients often have multiple lesions, whose proper treatment encompasses knowledge of several different surgical specialties. This makes it more difficult to understand the implications of early mobilization in each type of injury and decision-making by a single intensivist, and a joint evaluation of different specialties is necessary.

Additionally, for polytraumatized patients, a number of challenges are encountered when considering early motor physical therapy. Specific lesions and/or the association of multiple severe lesions and their own treatment may restrict the ability to mobilize patients early, including paralysis, grafting areas, fracture or pain instability, use of splints, external fixation, skeletal traction, and immobilizing devices.<sup>12</sup>

In most cases, there is no literature to guide decision making about early motor physical therapy in relation to these severe

patients with complex lesions. According to Engels et al.<sup>12</sup>, decisions should be based on biological reasoning (anatomy, physiology and biomechanics of injury), knowledge and experience of intensive care physicians and surgeons, and taking into account the evidence of benefits of early mobilization already demonstrated for specific traumatic injuries and in studies with other critical patient populations.

The task force of the European Respiratory Society and European Society of Intensive Care Medicine established in 2008 a hierarchy of ICU mobilization activities, based on a sequence of exercise intensity: change of position and functional positioning, passive mobilization, active-assisted exercises and active, use of cycloergometer in bed, sit at the edge of bed, orthostatism, walking stationary, transfer from bed to armchair, exercises in the armchair and walk. The task force further recommends that the physiotherapist be the professional responsible for the implementation and management of the mobilization plan.<sup>9</sup>

More recently, in 2012, the Physiotherapy Department of the Association of Brazilian Intensive Care Medicine (AMIB - *Associação de Medicina Intensiva Brasileira*) also published its recommendations for motor physical therapy in critically ill adult patients.<sup>6</sup> However, as mentioned previously, the literature is rather scarce when specifically deals with early physiotherapeutic assistance to the polytraumatized patient.

The participation of the physiotherapy team in daily clinical discussions with the medical staff (intensivists, orthopedists and neurosurgeons) is one of the activities that should be stimulated by the ICU physiotherapists. These meetings are fundamental to know the particularities of the injuries of each clinical case, to define therapeutic goal and to trace the rehabilitation program. It is argued that it is mandatory for the physiotherapy team to have an understanding of the different traumatic injuries and the respective care provided to their patients in order to prevent damages and maximize the therapeutic benefits.

The service in which this study was developed does not have some resources used in the early mobilization of critical patients such as orthostatic board, cycle ergometer and electrostimulation, so they were not included in the physiotherapeutic assistance model. Another very important aspect is the adequate documentation of the activities developed by the physiotherapists in the patients' medical records. This item should be a team habit, including additional precautions during early mobilization and possible adverse events during physiotherapy sessions.

## CONCLUSION

Physical therapy is part of the rehabilitation and restoration process of the patient's functional performance after multiple traumatic injuries and hospitalization. Early physiotherapy is a new area with little evidence to date regarding trauma patients. The proposed model became routine and consolidated the physiotherapeutic action in the respective care unit. The physiotherapy team started working 24 hours a day. The model enabled the standardization of physiotherapeutic assistance and greater safety for the severe polytrauma patient.

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