



Impact of Early Rehabilitation on Functional Recovery from Acute Musculoskeletal Injuries

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Summary

Acute musculoskeletal injuries represent one of the main causes of temporary disability in the working population. This article analyzes the impact of early rehabilitation on the functional recovery of patients with this type of injury. Through a literature review and an observational study with patients treated in physiotherapy centers, it was evidenced that the early initiation of therapeutic intervention significantly improves functionality, reduces recovery time and decreases the risk of chronic complications. It is concluded that the systematic implementation of early rehabilitation programs should be considered as an integral part of the initial clinical management of these injuries.

Keywords: early rehabilitation, musculoskeletal injuries, functional recovery, physiotherapy, acute pain.

Introduction

Acute musculoskeletal injuries (AML) represent a considerable burden on public and private health systems worldwide, constituting one of the main causes of medical consultations, absenteeism from work, and reduced quality of life of patients (Almeida et al., 2021). These injuries range from sprains, muscle tears, and simple fractures to severe contusions, being common in both active young populations and older adults. The traditional clinical approach usually focuses on immediate symptomatic relief, through the use of analgesics, rest and physical measures such as ice and compression;

however, recent research has questioned the exclusive efficacy of this passive approach (Petersen et al., 2023).

Emerging evidence suggests that early initiation of physical rehabilitation programs may play a critical role in the optimal functional recovery of injured tissues, by promoting neuromuscular reorganization, reducing edema, stimulating range of motion, and preventing joint stiffness (Rodríguez-Fernández et al., 2020). Clinical studies have shown that structured rehabilitation in the first 48 to 72 hours after injury significantly improves clinical outcomes compared to delayed intervention (Thompson et al., 2022).

In turn, prolonged absolute rest has been shown to contribute to muscle atrophy, loss of proprioception, and the development of persistent pain, reinforcing the need to rethink initial treatment guidelines (Khan et al., 2021). In this context, early rehabilitation not only acts as a therapeutic tool, but also as a preventive one, by reducing the risk of chronic pain and long-term functional disabilities (González-Suárez & Martínez-García, 2023).

Despite these advances in the literature, there are still controversies among health professionals regarding the optimal time to initiate physical intervention and the most effective techniques according to the type of injury. Therefore, the present study seeks to deepen the analysis of the impact of early rehabilitation on the functional recovery of patients with AML, contributing with empirical evidence that supports the systematic incorporation of these strategies in clinical protocols.

Theoretical framework

1. Acute musculoskeletal injuries: definition and classification

Acute musculoskeletal injuries (AML) are characterized by sudden damage to structures such as muscles, tendons, ligaments, or bones, commonly caused by trauma, overload, or sudden movements (González-Murillo et al., 2021). They are divided according to the tissue affected into: muscle injuries (tears or contractures), tendon injuries (tendinitis, ruptures), ligaments (sprains) and bone injuries (non-complex fractures).

These injuries generate intense pain, edema, functional limitation and loss of strength, which compromises the patient's mobility and independence. In acute phases, the clinical objective is to control pain and inflammation, while in subacute and chronic phases, the aim is to restore function and prevent sequelae (Martínez-Rivera & López-Gallego, 2023).

2. Early rehabilitation: fundamentals and benefits

Early rehabilitation is defined as physiotherapeutic intervention that begins within the first 48 to 72 hours after the injury event, focused on active mobilization, load control, and restoration of joint range, without compromising tissue healing (Zhao et al., 2022).

Recent studies highlight its clinical benefits:

- Reduction of perceived pain and edema.
- Prevention of muscle atrophy and proprioceptive loss.
- Improvement in joint mobility and early functional reintegration.

According to Pérez-Figueroa et al. (2020), the early initiation of therapeutic exercises improves the expression of regenerative cytokines and accelerates the recovery of connective tissue, particularly in lower limb injuries.

In addition, early rehabilitation positively influences the patient's psychosocial aspects, reducing anxiety, fear of movement (kinesiophobia), and promoting adherence to treatment (Smith et al., 2023).

3. Contemporary therapeutic approaches

Modern physiotherapy in acute injuries uses multiple tools, adapted according to the type and severity of the injury. A comparison table is presented below:

TECHNIQUE	MAIN OBJECTIVE	TIME OF APPLICATION	CLINICAL EVIDENCE (LAST 5 YEARS)
ASSISTED MOBILIZATION	Prevent joint stiffness and loss	24–72 hours after injury	Effective on sprains and tears (Kim et al., 2021)
CRYOTHERAPY	Control of pain and initial inflammation	First 24 hours	Improves comfort and reduces the use of NSAIDs (Vasquez et al., 2020)
ELECTROSTIMULATION	Maintain muscle tone without overload	During the first week	Improves strength in inactive workers (Martínez-Rivera & López-Gallego, 2023)
ACTIVE STRETCHING	Restoring flexibility	From the second week	Prevents contractures (González-Murillo et al., 2021)
PROGRESSIVE THERAPEUTIC EXERCISE	Regain strength and function	From week 2 or 3	Reduces time to return (Zhao et al., 2022)

4. Physiology of tissue recovery

During recovery from an LMEA, the body goes through three phases: inflammatory (1–3 days), proliferative (3–10 days), and remodeling (10 days to weeks/months). Rehabilitation must respect these biological times. Intervening too early with excessive load can compromise repair, but prolonged rest also delays regeneration (Smith et al., 2023).

Zhao et al. (2022) stress that early mobilization favors angiogenesis and stimulates collagen reorganization, while prolonged immobilization causes fibrosis.

Methodology

1. Study design

This study is framed within a quantitative approach with an observational, prospective and longitudinal design. This approach was selected to observe and compare the effects of early versus delayed rehabilitation in patients with acute musculoskeletal injuries, without directly manipulating the independent variables, following the model of non-randomized clinical studies in a real-world context (Arias-Pérez & Blanco-Hernández, 2021).

2. Population and sample

The population consisted of adult patients (18–60 years old) who attended three physiotherapy centers in Bogotá, Colombia, with a diagnosis of acute muscle, tendon or joint injuries confirmed by ultrasound or MRI. Patients with chronic lesions, associated neurological pathologies or who did not complete treatment were excluded.

A non-probabilistic convenience sampling was applied, integrating a total of 80 participants, distributed in two groups:

Group	N	Criterion
Early rehabilitation	40	Initiation of treatment within the first 72 h
Late rehabilitation	40	Onset after 7 days from injury

Source: Authors' elaboration based on clinical records (2023).

3. Intervention procedure

Both groups received standardized rehabilitation protocols, adjusted to each type of injury, over a period of 4 weeks, with 60-minute sessions, three times a week. The difference was at the **time of initiation of treatment**.

Protocols applied:

TECHNIQUE	WEEK 1	WEEK 2	WEEKS 3–4
CRYOTHERAPY	10 min at the start of each session	Only in case of acute pain	Suspended
ACTIVE MOBILIZATION	Mild assisted exercises	Full range without pain	Progression with mild resistance
ELECTROTHERAPY	TENS in muscle injuries	TENS + isometric contractions	Suspended if active function is present
STRETCHING	Not Applied	Controlled liabilities	Active and dynamic
THERAPEUTIC EXERCISE	Progressive Walking and Charging	Balance and strengthening	Custom functional circuits

Source: Adapted from standardized clinical protocols in sports physiotherapy (Pérez-Gutiérrez et al., 2022).

4. Data collection instruments

Validated tools were used for the objective measurement of clinical outcomes:

- **Visual Analogue Scale (VAS):** for the assessment of perceived pain on a scale from 0 (no pain) to 10 (maximum pain) (Martínez-Rivera & López-Gallego, 2023).

- **SF-36 questionnaire (physical functionality):** items related to mobility, strength, and daily activities (González-Suárez & Martínez-García, 2023).
- **Clinical record of recovery time:** days elapsed from onset to functional discharge, determined by the physiotherapist.

5. Statistical analysis

The data were processed with **SPSS v.27** software. Normality tests (Kolmogorov-Smirnov) were applied and then **Student's t-tests** were used for independent samples in continuous variables and **chi-square** tests for categorical variables. A statistical significance level of $p < 0.05$ was established, consistent with similar clinical studies (Thompson et al., 2022).

Results

Analysis of the data revealed statistically significant differences between the group that received early rehabilitation (within the first 72 hours) and the late rehabilitation group (after 7 days). Three main variables were assessed: **functional recovery time**, **pain levels (VAS)**, and **physical function (SF-36)** at the start and end of treatment.

1. Functional Recovery Time

Patients in the early rehabilitation group had a **mean recovery time of 21.3 ± 5.6 days**, compared to **34.7 ± 6.9 days** in the control group. The difference was statistically significant ($p < 0.01$), as shown in the table below:

Table 1. Functional Recovery Time Comparison

Group	Average (days)	Standard deviation (SD)	P-Value
Early rehabilitation	21.3	± 5.6	
Late rehabilitation	34.7	± 6.9	< 0.01

Source: Data obtained from clinical analysis with SPSS v.27 (2024).

These results are consistent with what was reported by Zhao et al. (2022), who found that early intervention significantly reduces the duration of functional immobility in patients with acute soft tissue injuries.

2. Pain Levels (EVA Scale)

The reduction in pain was more pronounced in the intervention group. At baseline, both groups had similar pain levels (≈ 7 points). However, at the end of treatment, patients in the early rehabilitation group showed a **mean residual pain of 1.3 ± 0.8** , compared to **2.9 ± 1.1** in the late rehabilitation group ($p < 0.05$).

Table 2. Pain Level Comparison (VAS)

Measurement	Rehab. Early (Mean $\pm$ SD)	Rehab. Late (Mean $\pm$ SD)	P-Value
Initial pain	7.1 ± 1.0	7.0 ± 1.2	0.82
Final pain	1.3 ± 0.8	2.9 ± 1.1	< 0.05

These results are consistent with the findings of Smith et al. (2023), who conclude that early physiotherapeutic intervention has an analgesic impact mediated by central pain control mechanisms.

3. Physical Functionality (SF-36)

The SF-36 questionnaire showed an overall improvement in both cohorts, but was significantly greater in the early rehabilitation group. The domains of **physical mobility, pain limitation, and general functional capacity were evaluated.**

Table 3. Improvement in SF-36 functional index (start vs. end)

DOMAIN	GROUP	INITIAL SCORE	FINAL SCORE	IMPROVEMENT (%)
PHYSICAL MOBILITY	Rehab. early	45.2	78.6	+74%
	Rehab. Late	44.7	65.1	+45%
LIMITATION DUE TO PAIN	Rehab. early	38.3	74.5	+94%
	Rehab. Late	39.0	61.7	+58%
GENERAL FUNCTIONALITY	Rehab. early	41.6	76.8	+84%
	Rehab. Late	42.3	64.2	+51%

Source: Authors' elaboration based on the application of the SF-36 questionnaire.

Pérez-Figueroa et al. (2020) reported similar findings, showing that physiotherapy programs initiated during the early inflammatory phase result in greater recovery of physical autonomy.

4. Complications and adherence

The late rehabilitation group had a **higher frequency of secondary complications** such as joint stiffness (15%) and relapses (10%), compared to 5% and 2.5% respectively in the early group. **Adherence to treatment** was higher in the early group (95%) than in the control group (83%), suggesting a positive link between early pain relief and motivation to continue the therapeutic program (González-Suárez & Martínez-García, 2023).

Conclusions

The results obtained in this study allow us to conclude that **early rehabilitation** represents an effective, safe and clinically recommended therapeutic strategy in the treatment of acute musculoskeletal injuries. Its application within the first 72 hours

after the traumatic event leads to **significant improvements in recovery time, pain perception and** the patient's general physical functionality.

First, it was shown that starting treatment in early stages decreases the average number of days needed to achieve functional discharge by more than 35%, compared to those patients who started rehabilitation late. This reduction in recovery time not only represents a clinical benefit, but also an economic and social one, as it favors the patient's faster return to their work and daily activities (Zhao et al., 2022).

Second, the data confirmed that early rehabilitation is associated with **a more effective reduction in perceived pain**, which is key to ensuring therapeutic adherence and preventing phenomena such as central sensitization, responsible for the development of chronic pain (Smith et al., 2023). This improvement in physical comfort during treatment is especially important in vulnerable populations such as athletes, older adults or manual workers.

Third, patients treated early showed **greater increases in their functional scores** (SF-36 index), particularly in the mobility and physical ability domains, suggesting that early intervention not only accelerates healing, but also favors a **comprehensive recovery of motor** skills. This supports what González-Suárez and Martínez-García (2023) observed, who argue that efficient rehabilitation must go beyond pain control, seeking the restoration of functional independence.

In addition, a **lower frequency of secondary complications** (such as joint stiffness and relapses) was observed in the early rehabilitation group, indicating that this strategy also has a **preventive role** in the face of chronic clinical symptoms, a phenomenon reported in the literature as a frequent cause of persistent disability (Pérez-Figueroa et al., 2020).

Consequently, this study supports the integration of early rehabilitation protocols into routine clinical practice, as part of the initial management of acute musculoskeletal injuries. Likewise, it is recommended that physiotherapy services and emergency units **train their staff and structure immediate intervention protocols**, respecting the biological phases of the tissue healing process.

Finally, it is suggested that future research expand the sample, include pediatric and geriatric populations, and analyze the effects of early rehabilitation on different types of injury (tendon, bone, ligament), as well as its long-term psychological and occupational impact.

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