

Impact of Early Versus Delayed Physiotherapy on Functional, Pain, and Psychological Outcomes in Adult Burn Patients

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ABSTRACT

Background: Burn injuries can lead to chronic disability, chronic pain and psychological trauma, especially in low-resource communities where rehabilitation facilities are often not provided promptly. This study aimed to assess the benefits of early physiotherapy started within 72 hours after admission on functional recovery, pain and psychological outcomes for burn patients.

Methodology: This is a quasi-experimental study in the Burn Care Centre, Pakistan Institute of Medical Sciences (PIMS), Islamabad from January to August 2023. All 100 burn patients were divided into two comparison groups according to physiotherapy timing of initiation: early (T1) and late (T2). The physiotherapy for Group A was initiated within 72 hours from admission and in Group B after 10 days. The rehabilitation protocol consisted of passive range of motion exercises, isometric muscle strengthening, respiratory exercises and pain management. The outcomes measured were muscle strength (Medical Research Council [MRC] score), mobility, functional independence, pain (Visual Analogue Scale [VAS]), anxiety and depression (Hospital Anxiety and Depression Scale [HADS]), and joint flexibility at discharge and three months after discharge.

Results: Patients with early physiotherapy had significantly higher muscle strength, mobility, and functional independence and pain scores at discharge than patients with delayed physiotherapy. Mean HADS anxiety scores decreased from 8.1 ± 2.0 to 5.2 ± 1.5 , while HADS depression scores declined from 7.5 ± 1.8 to 4.6 ± 1.4 (both $p < 0.001$). Failure to achieve a straight joint at discharge was similar between the groups, but early physiotherapy group showed significantly better joint flexibility at three months ($92.1\% \pm 3.8\%$ vs. $78.5\% \pm 5.2\%$; $p < 0.001$).

Conclusion: Early physiotherapy intervention (within 72 hours of burn injury) helps to improve functional outcomes, lessen pain and improve psychological outcomes. The results are in favor of the integration of early rehabilitation into the standard care of burns, especially in developing countries where the benefits of timely physiotherapy on long-term patient outcomes could be significant.

Keywords: Contractures, Early Physiotherapy, Low-resource setting, Pain, Rehabilitation

Authors' Contribution:

^{1,2}Conception; Literature research; manuscript design and drafting; ^{3,4}Critical analysis and manuscript review; ^{5,6}Data analysis; Manuscript Editing.

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Introduction

Despite improvements in the prevention of burns, the care of the acute burn and reconstructive management, burn injuries continue to be a major public health problem worldwide. In addition to the

acute survival risk, burn injuries are known to cause significant long-term morbidity such as physical disability, chronic pain, psychological distress, extended hospital stays and diminished quality of life, especially in low and middle income countries

(LMICs) where the burden is likely to rise with population ageing and growth by 2050.¹ Patients who have suffered large burns (TBSA $\geq$ 40%) have a higher rate of functional impairment, mortality and complicated rehabilitation than those who have suffered less severe burns.²

The most debilitating late complications of burn injury include joint contractures, weakness of muscles, limited range of motion, and limited independence of function. The prevalence of joint contractures ranges from 18% to 85% and are typically observed in shoulder, elbow, knee, and ankle joints which are clinically important for daily functioning with associated impairments affecting gross motor function (e.g., walking, lifting, transfers) and fine motor function (e.g., writing, dressing, feeding, personal hygiene). As a result, many burn survivors remain reliant on care-givers, and take a long time to return to work or participate in social and occupational activities.³

Ongoing pain adds to the challenges of recovery following a burn injury. Procedural pain during wound management and chronic pain later are common issues faced by burn survivors. Burn survivors suffer not only from physical disabilities but also from psychological morbidity, which can also affect their ability to participate in rehabilitation programs, slow down recovery of function and compromise compliance with treatment.⁴ Anxiety, depression and post-traumatic stress disorder (PTSD) are common consequences of burn injuries and have a negative impact on emotional functioning, rehabilitation participation, and quality of life. Meta-analytic studies have found that over half of burn survivors suffer from depression and a large percentage of adults treated at tertiary burn centers have PTSD, which can further prolong recovery.^{5,6}

Early rehabilitation has now been firmly established within the management of burns due to the impact it has on the physical and psychological effects of a burn injury. The interventions implemented in the acute phase of physiotherapy (passive and active

range of motion exercises, positioning, splinting, strengthening exercises, respiratory exercises, and pain management) have the aim of maintaining joint mobility, preventing the development of contractures, improving muscle strength, alleviating pain, and granting independent functional capacity.^{7,8} Although, previous research has shown that structured rehabilitation programs can enhance mobility, activities of daily living, and long-term functional outcomes, many LMICs still face challenges to access comprehensive rehabilitation, including a lack of trained rehabilitation professionals, delayed referrals, limited healthcare resources, and prolonged periods of immobilization, which can all lead to poor outcomes. Prospective studies of rehabilitation delay in resource poor areas have demonstrated increased contracture formation, decreased joint function, decreased quality of life, and decreased return to work rates.^{9,10}

While the advantages of rehabilitation following a burn injury are well known, there are relatively few studies that have focused on the effects of commencing physiotherapy within the first 72 hours after admission in a resource-limited environment. In addition, most of the research that is available has concentrated mainly on the physical, and only a scant amount of research has been focused on psychological outcomes in conjunction with the resolution of functional outcomes. Measuring the impact of early physiotherapy on physical function, pain, and mental well-being is crucial for creating evidence-based treatment plans to be adopted in burn centers in LMICs.

The objective of the present study was to assess the effect of early physiotherapy (within 72 hours of admission) on the functional outcomes, pain and psychological status of adult burn patients. The secondary objectives were to measure muscle strength, mobility, functional independence, joint flexibility and to prevent the onset of long-term contractures. We suspected that early physiotherapy would lead to better functional

recovery, less pain, better psychological outcomes and better preservation of joint mobility than delayed physiotherapy.

Methodology

This quasi-experimental comparative study was done in Burn Care Unit, of Pakistan Institute of Medical Sciences (PIMS), Islamabad between January and August 2023. A total of 100 Adults aged 18–60 years with deep partial-thickness or full-thickness burns involving the upper and/or lower limbs, with a TBSA of 15–50%, who required inpatient care, were eligible for inclusion. Those who were in good medical condition for physiotherapy, and were hemodynamically stable, were included. The exclusion criteria were pre-existing drug and alcohol abuse, neuromuscular disorders, severe cognitive impairment, unstable fractures, uncontrolled cardiovascular disease, deep sedation preventing participation and delayed presentation (>72 hours after injury).

According to the starting time of physiotherapy, the participants were allocated. Rehabilitation was started within 72 hours of admission in the early physiotherapy group while in the delayed physiotherapy group, rehabilitation started 10-14 days after the admission following wound stabilization/graft fixation.

The rehabilitation program was standardized and carried out by trained physiotherapists, who had a specialized training in burn rehabilitation. It involved passive range-of-motion (PROM) activities, isometric muscle strengthening, stretching activities, positioning, respiratory physiotherapy, and pain management. PROM exercises were performed twice a day (10–15 repetitions/day at affected joints) and isometric strengthening exercises were carried out using 3–5 sets of 10 submaximal contractions, using the major muscle groups in the upper and lower extremities. Stretching exercises were undertaken for 5-10 minutes for each affected joint, to maintain

extensibility of the soft tissue. To prevent pulmonary complications, respiratory physiotherapy was given 2-3 times a day which comprised diaphragmatic breathing, thoracic expansion and incentive spirometry.

The treatment sessions lasted around 20–30 minutes, and were custom-designed based on the patient's wound healing process, pain tolerance, and overall medical condition. The level of therapy was gradually increased as tolerated. Modification and discontinuation of sessions occurred when hemodynamic instability, severe pain, graft compromise or active infection was present. The delayed group was treated with routine burn treatment, which consisted of wound care, splinting, positioning, infection control and analgesia until rehabilitation commenced. After the onset of the physiotherapy, both groups were treated in the same manner.

By trained assessors, outcome assessment was done at baseline, following the 14-day intervention, at discharge. Medical Research Council (MRC) scale, Intensive Care Unit Mobility Scale (ICUMS), Visual Analog Scale (VAS), Functional Independence Measure (FIM), and Hospital Anxiety and Depression Scale (HADS) were used to assess muscle strength, mobility, pain, functional independence, and psychological status, respectively. Joint range of motion was assessed with a standard goniometer according to the AAOS guidelines and contracture was considered as range of motion that is at least ten degrees less than normal. They were assessed for contracture status at follow-up.

Data was analyzed with SPSS version 25. A p value of < 0.05 was considered statistically significant.

The study was approved by the Institutional Review Board of Isra University Islamabad on 13-10-2022. The study was carried out in compliance with the Declaration of Helsinki.

Results

100 patients with moderate to severe burns were recruited and randomly divided into two groups

according to the time when physiotherapy started. Group A (50 patients) began physiotherapy treatment within 72 hours of hospital admission while Group B (50 patients) started physiotherapy treatment 10–14 days after admission.

Baseline demographic and clinical differences between the two groups were comparable (Table 1). The mean age was 33.4 ± 10.4 years in Group A and 34.6 ± 10.9 years in Group B ($p = 0.71$), with similar gender distribution (28 males/22 females vs. 26 males/24 females; $p = 0.68$). The mean total body surface area (TBSA) burned was $28.5 \pm 7.3\%$ in Group A and $27.9 \pm 6.8\%$ in Group B ($p = 0.61$). There were no significant differences in the presence of upper or lower limb burns, with 70% and 68% of patients in Groups A and B, respectively, with burns to the upper parts of their body and 62% and 66% of patients in Groups A and B, respectively, with burns to the lower parts of their body. ICU admission rates were also comparable (30% vs. 28%; $p = 0.82$). This was as expected as the time elapsed between burn injury and commencement of physiotherapy was significantly shorter in Group A than in Group B (2.1 ± 0.5 days vs. 10.6 ± 2.4 days; $p < 0.001$). Patients receiving early physiotherapy had significantly better functional outcomes at discharge than the patients who received delayed rehabilitation (see Table 2). Group A achieved significantly higher muscle strength (MRC score: 53.7 ± 3.1 vs. 45.6 ± 5.8 ; $p < 0.001$), mobility (ICUMS: 8.5 ± 0.9 vs. 6.2 ± 1.3 ; $p < 0.001$), and functional independence (FIM: 109.4 ± 5.2 vs. 94.6 ± 7.3 ; $p < 0.001$). Pain severity was significantly lower in Group A (VAS: 2.8 ± 1.1 vs. 5.1 ± 1.3 ; $p < 0.001$), and fatigue severity scores were also lower (3.9 ± 0.7 vs. 5.4 ± 0.8 ; $p < 0.001$).

Psychological outcomes were also significantly better in the early physiotherapy group with lower scores of anxieties (HADS-Anxiety: 5.2 ± 1.5 vs. 8.1 ± 2.0 ; $p < 0.001$) and depression (HADS-Depression: 4.6 ± 1.4 vs. 7.5 ± 1.8 ; $p < 0.001$). Three-month follow-up data were available for 95 patients, 48 of which belonged to Group A, and 47 in Group B (Table 3). The patients who were treated with early

physiotherapy showed significantly higher recovery of the joint motion range of motion than the patients in the delayed physiotherapy group ($92.1 \pm 3.8\%$ vs. $78.5 \pm 5.2\%$; $p < 0.001$). Contracture development was significantly lower in Group A (3 [6.2%] vs. 11 [23.4%]; $p = 0.01$). Patients who received early physiotherapy had significantly better functional independence (89.5% vs. 66.0%, $p < 0.001$). Patient satisfaction scores were also significantly higher in Group A (8.6 ± 1.1 vs. 6.7 ± 1.3 ; $p < 0.001$).

Table I: Baseline Demographic and Clinical Characteristics of Participants (n=50)

Characteristic	Group A	Group B	p-value
Age(years)	33.4 ± 10.4	34.6 ± 10.9	0.71
Gender (Male/Female)	28 / 22	26 / 24	0.68
TBSA Burned (%)	28.5 ± 7.3	27.9 ± 6.8	0.61
Upper Limb Burns (%)	35 (70%)	34(68%)	0.83
Lower Limb Burns (%)	31 (62%)	33(66%)	0.68
ICU Admission (%)	15(30%)	14 (28%)	0.82
Days Since Burn at Enrollment	2.1 ± 0.5	10.6 ± 2.4	<0.001

Table II: Functional, Pain, Fatigue, and Psychological Outcomes at Discharge

Outcome Measures	Group A (Early Physio)	Group B (Delayed Physio)	p- value
MRC Score (max 60)	53.7 ± 3.1	45.6 ± 5.8	<0.001
ICUMS Score (max 10)	8.5 ± 0.9	6.2 ± 1.3	<0.001
FIM Score (max 126)	109.4 ± 5.2	94.6 ± 7.3	<0.001
VAS Pain (0-10)	2.8 ± 1.1	5.1 ± 1.3	<0.001
FSS (Fatigue Severity)	3.9 ± 0.7	5.4 ± 0.8	<0.001
HADS-Anxiety	5.2 ± 1.5	8.1 ± 2.0	<0.001
HADS-Depression	4.6 ± 1.4	7.5 ± 1.8	<0.001

Table III: Functional Outcomes at Three-Month Follow-up

Follow – up Outcomes	Group A (n = 48)	Group B (n =47)	p- value
Retained ROM (%)	92.1 ± 3.8	78.5 ± 5.2	<0.001
Contracture Development	3(6.2%)	11(23.4%)	0.01
Independent ADL (%)	89.5%	66.0%	<0.001
Patient Satisfaction (1- 10)	8.6 ± 1.1	6.7 ± 1.3	<0.001

Discussion

The clinical implication of the present study is that early initiation of physiotherapy is advantageous in the treatment of burnt patients. Patients who were enrolled in physiotherapy within 72 hours after injury exhibited much more strengthened the muscle, mobility, the range of motion and psychological status than patients after 10 days in treatment. The results of these experiments are consistent with the randomized controlled trial by David R Schieffeler et al, in which early exercise training in the acute phase of severe burn injury greatly reduced muscle wasting and increased muscle strength. The study was specific in terms of reporting the QMLT and RF-CSA were improved from 6 to 12 weeks after the intervention with p values of 0.010 and <0.001, respectively. Moreover, muscle force increased greatly more in the exercise group compared with the control group (β coefficient: 3.102 N, $p < 0.001$), suggesting that early physiotherapy can prevent a deterioration of muscle function.¹¹

Additionally, Ulric et al. carried out a systematic review and meta-analysis to assess the effectiveness of exercise treatments supervised by physiotherapists on burn therapy. However, the investigation revealed that consistent exercise regimens enhanced patients' muscular strength and aerobic capacity. Although more specific p values were not mentioned in the summary, it is emphasized that physical outcomes in burn survivors will be substantially improved by combining aerobic and resistance training modalities, as the message of early and comprehensive physiotherapy continues.¹²

A clinical practice guideline by Robert Cartotto et al. supports the implementation of early mobilization and rehabilitation (EMR) in critically ill adult burn patients admitted to the ICU. The guideline defines EMR as structured rehabilitation interventions initiated within 14 days of injury, including muscle activation, active exercises, bedside sitting,

standing, and walking as tolerated. Based on a systematic review and multidisciplinary expert consensus, the authors conditionally recommended EMR to reduce ICU-acquired weakness and delirium, although evidence was insufficient to draw conclusions regarding its effects on the duration of mechanical ventilation, hospital-acquired pressure injuries, or skin graft integrity. These recommendations further reinforce the importance of early rehabilitation in improving functional recovery among critically ill burn patients.¹³

On the other hand, Murat Ali Çınar et al studied the effects of early physiotherapy on biochemical parameters in major burn patients and revealed that prealbumin and fibronectin marker levels were improved significantly in the api treatment group where p value less than 0.05, but they could not report significant muscle strength enhancement or functional outcome. This mismatch could be caused by differences in the patient group, study design, or the physiotherapy methods used, as well as process requirements for standardized rehabilitation procedures.¹⁴ Among these, a study assessing the efficacy of early rehabilitation for pediatric burn victims was published in the World Journal of Clinical Cases. It turns out, however, that only 38.5 % of children who received early intervention (less than one month post injury) demonstrated significant improvement (more than 75%) on total active range of motion. Running the comparison of early intervention and late intervention (after 1 month), however, only 15.4% of the late intervention respondents achieved similar levels of improvement. The difference between the early intervention and the late intervention groups was significantly different with the level of significance of 0.021. This study emphasizes the significance of timely rehabilitation on the functional outcome of pediatric burns patients.¹⁵

A randomized controlled trial by Ahmad Mirza Aghazadeh Attari et al. further demonstrated the benefits of early mobilization in burn rehabilitation. Conducted among 126 burn patients, the study

found that participants receiving an early mobilization protocol in addition to standard care achieved significantly higher Functional Independence Measure (FIM) and Burn Specific Health Scale-Brief (BSHS-B) scores at hospital discharge and at the 3-month follow-up compared with those receiving routine care alone ($p < 0.001$). These findings suggest that early mobilization enhances functional independence and health-related quality of life, supporting its integration into standard burn rehabilitation protocols.¹⁶

The study has few limitations. The results may not be as broadly applicable as they could be because the study was limited to one burn hospital and had a small sample size. There may have been prejudice because neither the subjects nor the therapists were blinded. Certain results, particularly in the psychological domain, were dependent on subjective evaluations. Long-term results could not be assessed because the follow-up period was only three months. Furthermore, individual differences in pain management, grafting methods, and wound healing were not entirely controlled and might have affected the outcomes.

Conclusion

Compared to delayed physiotherapy, early physiotherapy beginning for burn patients greatly improves functional mobility, muscle strength, psychological well-being, and pain outcomes. At follow-up, patients who received early rehabilitation continued to have improved range of motion and increased independence in everyday activities, despite the initial lack of a statistically significant difference in contracture rates. In order to improve healing and long-term results, these findings lend credence to the inclusion of early, structured physical therapy in routine burn care.

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