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The Effect of Early Exercise Training on Activities of Daily Living (ADL) And Quality of Life in Patients with Hand Burns - A Randomised Controlled Trial

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ABSTRACT

Hand burns often result in significant impairments in function, affecting an individual's ability to perform ADLs and reducing overall QOL. Early rehabilitation, including structured exercise programs and occupational therapy, is considered essential for minimizing disability and promoting recovery. This study aims to assess the effect of early exercise training combined with conventional occupational therapy on ADL performance and quality of life in patients with hand burns. A total of 52 participants with hand burns, aged between 18 and 60 years, were selected based on defined inclusion and exclusion criteria and randomly assigned to experimental and control groups.The experimental group received early exercise training, splinting, and ADL training along with conventional occupational therapy, while the control group received only conventional ROM exercises. Both groups showed improvements post-intervention, but the experimental group demonstrated significantly greater gains in ADL performance and QOL. The increase in Barthel Index scores and SF-36 physical and mental component scores was more pronounced in the experimental group, indicating the effectiveness of early, targeted intervention. The Barthel Index scores increased substantially from pre- to post-intervention in both samples analysed. Early exercise training combined with occupational therapy significantly improves functional independence and enhances quality of life in patients with hand burns. This supports the need for early, structured rehabilitation as part of standard burn care protocols.

KEY WORDS: ACTIVITIES OF DAILY LIVING (ADL), BARTHEL INDEX, EARLY EXERCISE TRAINING, HAND BURN, SF-36.

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INTRODUCTION

The skin is the biggest organ of the human body, spanning approximately 2 square meters in a median grown-up. It includes primary layers—the epidermis and the dermis—below which can be important skin appendages, such as hair follicles, sweat glands, and sebaceous glands. These deeper systems act as reservoirs of proliferating epithelial cells (keratinocytes), which migrate to the wound or clot website and play a crucial role inside the recuperation process [1].

When this shielding barrier is damaged, the skin will become liable to harmful microorganisms, that could boom the hazard of infection and, in severe instances, development to sepsis. After a burn injury, tissue repair begins within hours, but excessive fluid loss from the wound can delay the healing process. Even minor burns may lead to long-term functional impairment and cosmetic concerns [2,3]. Burn injuries have been documented as a medical concern since ancient times. Historical records, such as prehistoric cave art, Egyptian medical papyri, and early Chinese medical illustrations, describe burn care practices. Classical physicians, including Hippocrates, Celsus, and Galen, outlined treatments involving ointments, dressings, and various therapeutic methods [4].

Burns are categorized into "partial-thickness" and "full-thickness" types. Superficial partial-thickness burns—affecting only the dermis and the top portion of the epidermis—generally heal within 10–14 days with little to no scarring, as most skin appendages remain undamaged. Deep partial-thickness burns make bigger into the lower dermis, harming a wider variety of appendages, and may require 3–6 weeks to heal, with a better likelihood of hypertrophic scarring. Full-thickness burns involve complete destruction of all pores and skin layers and regularly necessitate surgical intervention for recovery [5].

Burn causes include thermal, electrical, chemical, and radiation exposure. Thermal burns, making up about 90% of cases, vary in depth depending on temperature and duration of contact. Electrical burns account for less than 5%, occurring more frequently in children and male labourers, with severity influenced by current type, voltage, amperage, contact duration, and current pathway. Chemical burns, around 3% of cases, typically happen in homes or industrial settings. Alpha particles, being heavy helium ions, travel only a short distance in air and cannot penetrate the skin's keratin layer [6].

Hands, essential for daily function, are particularly vulnerable to burns. Although, they are involved in over 80% of severe burn cases. The American Burn Society classifies hand burns as "major injuries," and they account for 6% of total hand-related injuries. Losing hand functionality can lead to a 54% loss of overall functional ability [7]. Such injuries not only impair physical function but also have biological, social, and psychological consequences, reducing quality of life and affecting social and occupational participation. Even minor burns to the hands warrant a comprehensive treatment approach due to their potential impact on function, appearance, and emotional well-being8.

Early intervention and rehabilitation are key to optimal outcomes. Treatment may include passive motion exercises, targeted therapies, surgical repair, and skin grafting, requiring collaboration between plastic surgeons, physical therapists, occupational therapists, and psychologists. Ideally, the multidisciplinary team should be involved from the first day of hospitalization [9,10].

Health-related quality of life (HRQL) is a vital outcome measure for burn recovery, encompassing the affected person's physical, intellectual well-being. Burns could severely affect daily functioning in both the short and long term. While some HRQL domains improve over time, others—such as physical and emotional role participation—may remain impaired, highlighting the lasting psychological and physical burden of burn injuries [7].

Loss of autonomy in activities of daily living (ADL) can harm mental health and self-esteem, disrupt social interaction, and reduce family engagement. In burns affecting the hand and its small joints, limitations in active range of motion (AROM) can significantly impact occupational performance and functional independence9. Even burns involving a single joint in the upper limb can greatly hinder ADL performance. Restoring functional ROM, strength, and mobility is essential to prevent scar contractures that could interfere with everyday activities [5].

Hand burns can significantly impact an individual's ability to perform daily activities and maintain their quality of life [11]. Early exercise training may play a crucial role in rehabilitation, but its specific effects on ADL and quality of life in patients with hand burns12. Thus, this study aims to investigating the effects of early exercise training and to contribute to the development of effective rehabilitation strategies for patients with hand burns, ultimately improving their functional outcomes and quality of life.

MATERIAL AND METHODS

A randomized control trial comparing the effect of Early exercise training intervention with control group was designed. This study was reviewed, discussed, and approved by the Santosh Occupational Therapy Institutional Ethical Committee (Ref No.-SCOT/NOV-24/ECOrtho-03). Using Cochran's formula with a 95% confidence level and 5% margin of error, the minimum sample size was calculated to be approximately 52 participants. Participants were selected

from Dr Rawal's burn unit Lajpat Nagar Delhi as per the inclusion and exclusion criteria. Prior to participation, the study procedure was explained to the participants, and written informed consent was obtained. The participants were then randomly assigned to the control group and experimental group by a random sampling method.

As per inclusion criteria, individuals in the age range of 13–18 years and above who had sustained burn injuries, with partial-thickness (second-degree) to full-thickness burns involving more than 10% of the total body surface area (TBSA), were included in the study. Patients with thermal, chemical, electrical, or radiation burns, and those who had been hospitalized for treatment including surgery or skin grafts, were also included.

As per exclusion criteria, individuals with pre-existing physical or cognitive disabilities affecting ADL performance unrelated to the burn injury, those with burns involving less than 10% TBSA, and patients with severe comorbid medical conditions such as terminal illness or uncontrolled chronic diseases that could interfere with assessment of burn recovery were excluded from the study.

In the experimental group, participants received an Early exercise training of structured occupational therapy intervention program which included edema reduction techniques, positioning and splinting (if necessary), range of motion exercises (both passive and active), active resistive exercises, stretching exercises, and practicing of activities of daily living (such as using a spoon, getting dressed, writing, opening and closing bottles, using zippers and buttons). These exercises were provided for 30 minutes, two times a day, over a duration of 12 weeks [5].

In the control group, participants performed only scheduled range of motion exercises for the upper extremity including flexion-extension, abduction-adduction, and internal-external rotation of the upper limb, for 30 minutes per session, twice a day, over a duration of 12 weeks [13].

Outcome Measures: The following outcome measurements were taken at baseline and again after 12 weeks of training. The assessment tools included the Barthel Index (BI) which is a validated tool, it provides an objective assessment of functional ability, making it an ideal outcome measure in clinical research and practice14. As an outcome measure, the Barthel Index is widely recognized for its simplicity, reliability, and validity. The BI's focus on daily functioning makes it particularly useful for assessing quality of life improvements in patients recovering from injuries or illnesses impacting physical ability14 and the SF-36 Health Survey (Short Form-36) is tool used for assessing QOL and overall health status across physical and mental health domains. It's known for its solid psychometric properties, making it a popular choice for both clinical and research settings [15].

Table 1: Descriptive Statistics of Control and Experimental Groups for Barthel Index and SF-36 (Pre- and Post-Test)

Stats		Control Group				Experimental Group			
		Mean	N	Std. Deviation	Std. Error Mean	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Barthel Pre	48.73	26	16.208	3.179	44.54	26	16.053	3.148
	Barthel Post	57.92	26	16.052	3.148	70.81	26	16.798	3.294
Pair 2	SF-36 Pre	44.635	26	8.812	1.7282	42.019	26	7.9416	1.5575
	SF-36 Post	51.615	26	8.8942	1.7443	66.077	26	7.7701	1.5238

RESULTS

The analysis of this study was conducted at a significance level of 0.05. The sample consisted of 26 participants. The mean age in the experimental group was 36.23 years and in the control group, 40.76 years. Gender distribution showed 17 females and 9 males in the experimental group, and 11 females and 15 males in the control group.

To examine the statistical significance of these changes, both Wilcoxon Signed-Rank Test and Paired Samples t-tests were performed.

Wilcoxon Signed-Rank Test revealed that all 26 participants demonstrated positive ranks for both the Barthel Index and SF-36 scores, meaning every individual improved following the intervention. There were zero negative ranks and zero

ties, indicating consistent improvement across the cohort. The mean rank was 13.50, and the sum of ranks was 351.00 for both measures, highlighting strong effectiveness of early exercise training in improving functional independence and quality of life.

Paired Samples t-test revealed that for the Barthel Index, the mean difference between pre- and post-test scores in the experimental group was -26.269 (SD = 5.088; SEM = 0.998). The 95% confidence interval ranged from -28.324 to -24.214, with a t-value of -26.328 (df = 25) and a p-value < .001, confirming highly significant improvement.

Table 2 Comparison of Control and Experimental Group

Stats Table 6.0		Paired Differences					t	df	Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper			One-Sided p	Two-Sided p
Pair 1	Barthel Pre - Barthel Post	-26.269	5.088	.998	-28.324	-24.214	-26.328	25	<.001	<.001
Pair 2	SF-36 Pre - SF-36 Post	-24.0577	1.9252	.3776	-24.8353	-23.2801	-63.717	25	<.001	<.001

For the SF-36, the mean difference between pre- and post-test scores was -24.058 (SD = 1.9252; SEM = 0.3776). The 95% confidence interval ranged from -24.8353 to -23.2801, with a t-value of -63.717 (df = 25) and a p-value < .001, again demonstrating strong and statistically significant improvement in quality-of-life outcomes.

A comparative evaluation was conducted between the control group and the experimental group to assess the differential effects of early exercise training.

For ADL (Barthel Index) Control Group: Mean improvement of -9.192 (95% CI: -10.357 to -8.027; t = -16.248; p < .001). Experimental Group: Mean improvement of -26.269 (95% CI: -28.324 to -24.214; t = -26.328; p < .001).For QoL (SF-36)Control Group Mean improvement of -6.9808 (95% CI: -7.4101 to -6.5515; t = -33.491; p < .001).Experimental Group Mean improvement of -24.058 (95% CI: -24.835 to -23.280; t = -63.717; p < .001).

The experimental group consistently outperformed the control group in both functional and quality of life domains. These differences indicate that while both groups benefited from standard care, the addition of early exercise training led to significantly greater improvements in recovery outcomes. Across all statistical analyses, the data strongly support the effectiveness of early exercise training in enhancing both functional independence and quality of life in patients recovering from hand burns. The absence of negative outcomes, combined with the uniform direction and magnitude of improvements, reinforces the conclusion that early rehabilitation interventions play a critical role in optimizing patient recovery.

DISCUSSION

The present study explores the effect of Effect of Early Exercise Training on Hand Burns. In this study, 52 pre-diagnosed participants were selected from Dr Rawal's burn unit based on inclusion criteria.

The Barthel Index scores increased substantially from pre- to post-intervention in both samples analysed. In one subset, scores improved from a mean of 48.73 to 57.92, and in another, from 44.54 to 70.81, indicating not only consistency but also a potentially dose-dependent or time-sensitive effect of early exercise. These changes were further validated by the paired t-test results, which reported a mean difference of -26.269 in the experimental group (p < .001), far greater than the -9.192 mean difference observed in the control group.

Such functional improvements are critical in burn rehabilitation, as patients often face severe impairments in mobility and daily function. This study advances the literature by offering more statistically consistent and universal improvements—evident in the Wilcoxon results where all 26 participants showed positive ranks, without any deterioration or stagnation in performance.

Khanipour et al. (2023) did a study to investigate the effects of occupation-based intervention on hand and upper extremity function, daily activities, and quality of life in people with burn injuries the study showed that the occupation-based interventions are as effective as traditional therapeutic interventions for the improvement of hand and upper extremity function, ability to perform daily activities, and quality of life in people with burn injuries [16].

Najafi et al (2019) did a study to find out the effect of range of motion exercises on activity daily living and quality of life in patients with burns, the results indicate the effective role of range of motion exercises on improving the activity daily living and quality of life of patients with burns in all aspects. Thus, it is recommended to use range of motion exercises in providing appropriate care for burn patients in hospitals and burn centers [17].

This study particularly noteworthy is the uniformity and strength of statistical outcomes. All participants demonstrated improvement (positive ranks only), with no ties or negative ranks, suggesting homogeneous benefits of the intervention across the cohort. This level of consistency is rarely reported in clinical rehabilitation studies, which often observe mixed responses due to individual variability. The low standard errors of the mean (SEM) across time points and measures further reflect precise estimates of population-level changes, strengthening confidence in the findings.

Moreover, by using both non-parametric (Wilcoxon) and parametric (t-test) approaches, the analysis ensures that conclusions are not method-dependent. The fact that both statistical approaches converge in their conclusions adds methodological robustness to the study. Despite its promising results, the study had certain limitations. This study did not have sufficient follow-up for the long-term impact of early exercise training on ADL and QOL post burn injury.

Although the study included 52 participants, a larger sample would provide more generalizable results and increase statistical power. Future research should include participants from multiple hospitals or rehabilitation centers to enhance the generalizability and external validity of the findings, larger and more diverse sample would improve the statistical power and help identify subgroup-specific responses to intervention (e.g., age, gender, burn depth). Post-discharge follow-up assessments are necessary to evaluate the sustainability of improvements in ADL and quality of life over time.

CONCLUSION

This study clearly demonstrates that early exercise training significantly improves both functional independence (Barthel Index) and quality of life (SF-36) in patients with hand burns. Between groups, the experimental group received structured early exercise and showed markedly greater improvements than the control group. Higher mean score differences, stronger statistical significance, and consistent positive outcomes across all participants, early exercise proves to be the more effective intervention in burn rehabilitation.

Ethical Clearance
Ref No.-SCOT/NOV-24/ECOrtho-03 ,11/11/2024.

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