

*Original Article*

# Prevalence of Post-Burn Contractures and Their Impact on Functional Activities among Burn Survivors: A Cross-Sectional Study

Huma khan<sup>1</sup>, Pirtik Rai<sup>2</sup>, Rafia Nazar<sup>3</sup>, Jahanzeb Ahmed<sup>4</sup>, Mansoor Ahmed<sup>5</sup>, Salman Khan<sup>6</sup>

<sup>1</sup> Assistant Professor, Sarhad University of Science and IT, Peshawar, Pakistan

<sup>2</sup> Lecturer, Jinnah College of Physical Therapy, Karachi, Pakistan

<sup>3</sup> Lecturer, Hazara University, Mansehra, Pakistan

<sup>4</sup> MS Orthopedic Physical Therapy, Xuzhou Medical University, Xuzhou, China

<sup>5</sup> BS DPT, Abasyn University, Islamabad, Pakistan

<sup>6</sup> Physiotherapist, Irfan General Hospital, Peshawar, Pakistan

\* Corresponding author: Huma khan, [huma.siahs@suit.edu.pk](mailto:huma.siahs@suit.edu.pk)

## ABSTRACT

**Background:** Burn injuries frequently result in long-term complications that impair functional recovery, with post-burn contractures representing one of the most disabling sequelae. Contractures cause restriction of joint range of motion and can substantially limit activities of daily living and overall quality of life among burn survivors. **Objective:** To determine the prevalence of post-burn contractures and evaluate their association with functional activities among adult burn survivors attending a tertiary burn rehabilitation center. **Methods:** A cross-sectional study was conducted among 100 adult burn survivors aged 18–50 years with healed burns sustained at least six months prior. Contractures were assessed using goniometric measurement of passive joint range of motion and classified as mild (<25% ROM loss), moderate (25–50%), or severe (>50%). Functional status was evaluated using the Burn Specific Health Scale–Brief (BSHS-B). Descriptive statistics summarized clinical characteristics, and associations between contracture severity and functional outcomes were analyzed using Spearman correlation. **Results:** Post-burn contractures were identified in 65% of participants. Upper limbs were the most frequently affected region (45%), followed by lower limbs (30%), neck (20%), and trunk (10%). Functional scores progressively decreased with increasing contracture severity: none ( $78 \pm 5.2$ ), mild ( $70 \pm 6.0$ ), moderate ( $62 \pm 5.5$ ), and severe ( $52 \pm 6.3$ ). A significant negative correlation was observed between contracture severity and BSHS-B score ( $r = -0.62$ ,  $p < 0.001$ ). **Conclusion:** Post-burn contractures are common among burn survivors and are strongly associated with functional impairment. Early identification and targeted rehabilitation strategies are essential to reduce disability and improve long-term outcomes. **Keywords:** Post-burn contractures, burn rehabilitation, functional impairment, range of motion, activities of daily living, burn survivors.

**"Cite this Article"** | Received: 13 November 2025; Accepted: 19 February 2026; Published: 13 March 2026.

**Author Contributions:** Concept: HK; Design: PR; Data Collection: RN; Analysis: JA; Drafting: MA, SK. **Ethical Approval:** Ethical Approval was obtained by respective Institute. **Informed Consent:** Written informed consent was obtained from all participants; **Conflict of Interest:** The authors declare no conflict of interest; **Funding:** No external funding; **Data Availability:** Available from the corresponding author on reasonable request; **Acknowledgments:** N/A.

## INTRODUCTION

Burn injuries remain a major global public health concern and contribute substantially to long-term disability, particularly in low- and middle-income countries where access to specialized rehabilitation services may be limited. Advances in acute burn management, including improved resuscitation, surgical care, and infection control, have significantly increased survival rates over recent decades. As survival improves, the focus of burn care has shifted from mortality reduction toward optimizing long-term functional recovery and quality of life among survivors. Despite these advances, many individuals who survive burn injuries experience chronic complications such as hypertrophic scarring, contracture formation, and persistent physical impairment, which may substantially limit participation in daily activities and community life (1,2).

Post-burn contractures represent one of the most common and disabling long-term sequelae of burn injuries. A contracture is characterized by pathological shortening of scarred skin and surrounding soft tissues, including fascia and joint capsules, leading to restricted passive and active range of motion (ROM) across affected joints. Contractures usually develop as a consequence of excessive scar formation and progressive scar contraction during the wound healing process, particularly in deep burns or areas treated with skin grafting. When not adequately prevented through early positioning, splinting, and therapeutic mobilization, these contractures may become fixed and lead to permanent joint deformity and functional loss (3,4). From a rehabilitation perspective, contractures represent a critical determinant of long-term disability because joint mobility is essential for the performance of activities of daily living (ADLs), occupational tasks, and social participation.

The functional consequences of contracture formation can be profound. Upper extremity contractures, particularly those involving the shoulder, elbow, wrist, and fingers, may impair fine motor control and limit essential self-care tasks such as feeding, grooming, dressing, and writing. Lower limb contractures may compromise gait, balance, and transfers, restricting independent mobility and reducing the ability to return to work or participate in community activities. These functional limitations often translate into reduced quality of life, long-term dependency, and increased socioeconomic burden for patients and caregivers (5,6). Furthermore, the distribution of contractures across different body regions is clinically important because involvement of highly functional joints such as the hand, shoulder, or knee may disproportionately affect independence and rehabilitation outcomes.

Existing literature indicates that the prevalence of post-burn contractures varies widely depending on patient characteristics, burn severity, and access to rehabilitation services. Studies have reported that approximately 38–54% of burn patients develop at least one contracture by the time of hospital discharge, although prevalence may change during the months following injury as scars mature and rehabilitation interventions are implemented (7). Upper extremity joints have frequently been identified as the most commonly affected anatomical sites due to the functional complexity of the hand and shoulder and the high likelihood of deep burns requiring surgical treatment in these regions (8). In Pakistan and other similar settings, the burden of contractures may be further influenced by delays in specialized care, limited availability of rehabilitation services, and challenges in long-term follow-up of burn survivors (9,10).

Beyond simple prevalence estimates, recent research increasingly emphasizes the importance of evaluating the functional implications of post-burn contractures. Studies have demonstrated that restricted joint ROM is strongly associated with greater disability, reduced independence in ADLs, and poorer health-related quality of life among burn survivors. Longitudinal investigations have shown that individuals who develop contractures experience more persistent functional limitations and require longer rehabilitation compared with those without contractures (11,12). Patient-reported outcome measures, such as the Burn Specific Health Scale–Brief (BSHS-B), provide valuable insight into the multidimensional impact of burn injuries by assessing domains including hand function, mobility, self-care, interpersonal relationships, and psychological well-being (13,14). However, relatively few studies have combined objective clinical assessment of contracture severity with validated functional outcome measures within the same population, particularly in low-resource healthcare contexts.

Despite the recognized clinical importance of contractures, several knowledge gaps remain. Many existing studies focus primarily on surgical management or reconstructive outcomes rather than on the epidemiological burden of contractures and their functional consequences in adult burn survivors. Additionally, most available evidence originates from high-income settings with well-established rehabilitation infrastructures, limiting the generalizability of findings to healthcare systems where rehabilitation services may be less accessible. In Pakistan, research exploring the prevalence, anatomical distribution, and functional impact of post-burn contractures in adult populations remains limited, particularly in tertiary rehabilitation centers where patients with persistent functional limitations are

commonly treated (9,10). Understanding the magnitude and functional burden of contractures in such settings is essential for guiding rehabilitation priorities, improving resource allocation, and informing preventive strategies during the acute and post-acute phases of burn care.

From a clinical and rehabilitation perspective, quantifying the relationship between contracture severity and functional limitation is particularly important. Objective measurement of ROM loss using standardized tools such as a goniometer allows clinicians to classify contracture severity and identify joints at highest risk of functional impairment. When combined with patient-reported functional assessments, these measurements can provide a comprehensive evaluation of how structural limitations translate into real-world activity restrictions and reduced independence. Such information is critical for designing targeted interventions, including early physiotherapy, splinting, surgical release, and structured rehabilitation programs aimed at preventing or minimizing long-term disability.

Therefore, this study was conducted to determine the prevalence and anatomical distribution of post-burn contractures among adult burn survivors attending a tertiary burn rehabilitation center and to evaluate the association between contracture severity and functional outcomes measured using the Burn Specific Health Scale–Brief. By integrating objective clinical measurements of joint ROM with patient-reported functional assessment, this research aims to provide a clearer understanding of the functional burden of post-burn contractures in a clinical rehabilitation population. The findings are expected to inform clinicians and rehabilitation specialists regarding the extent to which contracture severity influences daily functioning and to highlight the importance of early identification and targeted rehabilitation strategies in improving long-term outcomes for burn survivors. Accordingly, the primary research objective of this study was to assess the prevalence of post-burn contractures and examine their relationship with functional activities among adult burn survivors receiving follow-up care at a tertiary burn center.

## METHODS

This cross-sectional observational study was conducted at the Burns and Plastic Surgery Centre, Hayatabad, Peshawar, Pakistan, a tertiary referral facility providing acute burn care and rehabilitation services to patients from Khyber Pakhtunkhwa and surrounding regions. Data collection was carried out over a six-month period among adult burn survivors presenting for follow-up care and rehabilitation after completion of the acute wound healing phase. The study design was selected to estimate the prevalence and anatomical distribution of post-burn contractures and to evaluate their association with functional limitations in a defined clinical population at a single point in time. Cross-sectional methodology is widely used in burn rehabilitation research to quantify post-injury complications and functional outcomes in survivor populations (15,16).

Participants were adult burn survivors aged 18–50 years who had sustained a burn injury at least six months prior to enrollment and had achieved complete wound healing. Individuals with or without clinically evident contractures were eligible for participation to allow estimation of prevalence within the study population. Exclusion criteria included neurological disorders affecting motor function, non-burn-related musculoskeletal deformities, acute or unstable medical conditions that could interfere with assessment, and inability to understand study procedures or complete the functional questionnaire. These criteria were applied to minimize confounding from unrelated functional impairments and to ensure that observed functional limitations could be reasonably attributed to burn-related sequelae.

Eligible participants were identified consecutively from patients attending outpatient follow-up and rehabilitation clinics during the study period. Consecutive recruitment was used to reduce selection bias by including all patients who met eligibility criteria and agreed to participate. Potential participants received a verbal explanation of the study objectives, procedures, risks, and benefits. Written informed consent was obtained prior to enrollment. Participation was voluntary, and participants were informed

that refusal or withdrawal would not affect their clinical care. All participants underwent standardized clinical assessment and questionnaire administration during the same visit.

Data collection consisted of structured clinical evaluation and patient-reported outcome assessment conducted by trained physiotherapists with experience in burn rehabilitation. Demographic and clinical information was recorded using a standardized data collection form and included age, sex, occupation, cause of burn injury, duration since injury, total body surface area (TBSA) affected, burn depth when documented, and history of surgical intervention such as skin grafting or reconstructive procedures. These variables were collected because they are recognized factors associated with contracture formation and functional recovery following burn injury (17,18).

The primary clinical variable of interest was the presence and severity of post-burn contracture. Contractures were assessed through measurement of passive joint range of motion (ROM) using a standardized universal goniometer following established musculoskeletal examination procedures. Major joints commonly affected by burn contractures—including the shoulder, elbow, wrist, fingers, hip, knee, ankle, and cervical spine—were evaluated bilaterally where applicable. Each joint measurement was performed with the participant positioned according to standardized anatomical reference positions, and readings were recorded in degrees of motion. ROM values were compared with accepted normative reference ranges for each joint. A contracture was defined as a reduction in passive ROM compared with normal reference values attributable to scar tissue or burn-related soft tissue restriction (19).

Contracture severity was operationalized based on the percentage loss of passive ROM relative to normative joint motion. Severity was categorized as mild when ROM loss was less than 25% of normal range, moderate when ROM loss was between 25% and 50%, and severe when loss exceeded 50%. When contractures were present in multiple joints, the participant's overall contracture severity classification was determined according to the joint demonstrating the greatest proportional loss of ROM. Anatomical distribution of contractures was recorded by body region, including upper limb, lower limb, neck, and trunk, allowing assessment of regional prevalence patterns.

Functional status was evaluated using the Burn Specific Health Scale–Brief (BSHS-B), a validated patient-reported outcome instrument developed specifically for burn survivors. The BSHS-B assesses multiple dimensions of post-burn recovery including hand function, mobility, self-care, interpersonal relationships, and emotional well-being. The instrument has demonstrated good reliability and construct validity in burn populations and is widely used in rehabilitation research to measure functional and psychosocial outcomes after burn injury (13,14). Participants completed the questionnaire in a quiet clinical setting following the physical examination. For individuals with limited literacy, the questionnaire items were read aloud by trained research personnel to ensure accurate comprehension and response recording. Responses were scored according to standard BSHS-B scoring guidelines, with higher scores indicating better functional status. Several steps were taken to enhance measurement reliability and minimize bias. All clinical ROM assessments were performed by physiotherapists trained in standardized goniometric techniques to ensure consistency in measurement procedures. Data collection forms were pilot tested prior to study initiation to ensure clarity and completeness. Measurements were recorded immediately after examination to reduce recall error. The use of a validated functional outcome instrument minimized measurement bias in assessing patient-reported functional limitations. Consecutive recruitment of eligible participants was implemented to reduce selection bias associated with convenience sampling in clinical settings.

The sample size was calculated using the standard formula for estimating prevalence in cross-sectional studies:  $n = (Z^2 \times P \times (1 - P)) / d^2$ . A 95% confidence level ( $Z = 1.96$ ) was used, with an anticipated prevalence of 50% in the absence of reliable local prevalence data and a margin of error of 10%. The calculated minimum sample size was 96 participants. To account for potential incomplete responses or missing data, the target sample size was increased to 100 participants to ensure adequate statistical power for prevalence estimation and correlation analysis.

All collected data were entered into a secured electronic database and cross-checked for completeness and accuracy prior to analysis. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 26. Continuous variables were summarized using means and standard deviations, while categorical variables were presented as frequencies and percentages. The prevalence of post-burn contractures was calculated as the proportion of participants with at least one contracture affecting any evaluated joint. Anatomical distribution was described by calculating the proportion of participants with contractures in each body region. Functional outcome scores were summarized according to contracture severity categories.

The association between contracture severity and functional status was evaluated using Spearman's rank correlation coefficient, given the ordinal nature of severity classification and potential non-normal distribution of functional scores. Differences in functional outcomes across severity categories were examined using appropriate non-parametric comparisons where applicable. Additional exploratory analyses assessed relationships between contracture presence and selected clinical variables such as TBSA involvement and history of surgical intervention. Statistical significance was defined as a two-sided p-value less than 0.05. Cases with incomplete key outcome data were excluded from the final statistical analysis to ensure validity of correlation estimates.

Ethical approval for the study was obtained from the institutional ethics committee prior to commencement of data collection. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki for research involving human participants. All participants provided written informed consent prior to enrollment. Confidentiality of participant information was maintained by assigning unique identification codes and storing all data in password-protected electronic files accessible only to the research team.

To ensure reproducibility and data integrity, standardized measurement protocols were used for all clinical assessments, data entry procedures were verified through double-checking of records, and statistical analyses were conducted using predefined analytical procedures. The use of validated measurement instruments and transparent reporting of methodological procedures enables replication of the study in similar burn rehabilitation settings and supports the reliability of the reported findings.

## RESULTS

The study included 100 adult burn survivors, with a mean age of  $32.5 \pm 12.3$  years (95% CI: 30.1–34.9). Male participants were more common than female participants, accounting for 60% versus 40% of the sample, respectively. Thermal burns were the predominant mechanism of injury, affecting 70% of participants, whereas chemical and electrical burns each accounted for 15%. The mean total body surface area (TBSA) burned was  $18.0 \pm 7.2\%$  (95% CI: 16.6–19.4). Prior surgical intervention was reported in 65% of participants, indicating that nearly two-thirds of the sample had undergone procedures such as grafting or reconstructive management. Overall, Table 1 shows that the study population was composed mainly of relatively young adults with predominantly thermal burns and a substantial burden of prior surgical treatment.

As shown in Table 2, post-burn contractures were identified in 65 of the 100 participants, giving an overall prevalence of 65% (95% CI: 55.2–73.7). The upper limb was the most frequently affected anatomical region, with contractures observed in 45 participants (45%; 95% CI: 35.3–54.9), followed by the lower limb in 30 participants (30%; 95% CI: 21.3–39.9), the neck in 20 participants (20%; 95% CI: 12.9–29.0), and the trunk in 10 participants (10%; 95% CI: 4.9–17.6). Compared with trunk involvement, the odds of upper-limb contracture were 6.75 times higher ( $p < 0.001$ ), while lower-limb and neck contractures were 3.43 times ( $p = 0.003$ ) and 2.00 times ( $p = 0.041$ ) more frequent, respectively. These findings indicate that contractures were not evenly distributed across body regions and were concentrated mainly in functionally critical extremity joints. Because some participants had involvement of more than one region, the regional percentages exceeded the total prevalence. Table 3 demonstrates

that contracture severity also showed a substantial burden across the sample. Of the total 100 participants, 35% had no contracture, whereas 30% had mild contracture, 25% had moderate contracture, and 10% had severe contracture. When the analysis was restricted to the 65 participants with contractures, mild contractures represented 46.2% of affected cases, moderate contractures 38.5%, and severe contractures 15.4%.

This means that more than half of contracture cases (53.9%) fell within the moderate-to-severe range, highlighting that functional restriction was not limited to minor ROM loss alone. The distribution suggests that a considerable proportion of burn survivors attending follow-up care continued to experience clinically meaningful limitations in joint mobility.

A clear dose-response pattern was observed between contracture severity and functional status in Table 4. Participants without contractures had the highest mean BSHS-B score,  $78 \pm 5.2$  (95% CI: 76.2–79.8). This progressively decreased to  $70 \pm 6.0$  (95% CI: 67.9–72.1) in the mild contracture group,  $62 \pm 5.5$  (95% CI: 59.8–64.2) in the moderate group, and  $52 \pm 6.3$  (95% CI: 47.9–56.1) in the severe group. Compared with participants without contractures, the reduction in functional score was 8 points in the mild group, 16 points in the moderate group, and 26 points in the severe group. The magnitude of these differences was large, with Cohen's *d* values of 1.39 for mild, 2.78 for moderate, and 4.75 for severe contracture, all with *p*-values < 0.001. In addition, the correlation between contracture severity and BSHS-B score was significantly negative ( $r = -0.62$ ; 95% CI: -0.74 to -0.47;  $p < 0.001$ ), confirming that worsening contracture severity was associated with progressively poorer functional performance.

The exploratory analysis in Table 5 further showed that contracture presence was related to important clinical factors. Participants with contractures had a higher mean TBSA involvement than those without contractures,  $20.3 \pm 6.5\%$  versus  $13.7 \pm 5.9\%$ , and each incremental increase in TBSA was associated with higher odds of contracture formation (OR 1.12; 95% CI: 1.05–1.19;  $p = 0.001$ ). Surgical intervention was also significantly associated with contracture presence: 76.9% of those with contractures had undergone surgery compared with 42.9% of those without contractures, corresponding to more than fourfold greater odds of contracture among surgically treated participants (OR 4.30; 95% CI: 1.86–9.95;  $p < 0.001$ ). Thermal burns were likewise more frequent among participants with contractures than among those without them, 76.9% versus 57.1%, with an odds ratio of 2.49 (95% CI: 1.01–6.14;  $p = 0.044$ ). Taken together, these results suggest that larger burn size, prior surgery, and thermal injury were all associated with a greater likelihood of post-burn contracture in this cohort.

**Table 1 Demographic and Clinical Characteristics of Participants (N = 100)**

Variable	Category	n (%) or Mean $\pm$ SD	95% CI	p-value*
Age (years)	Continuous	$32.5 \pm 12.3$	30.1 – 34.9	—
Gender	Male	60 (60%)	50.1 – 69.3	0.046
	Female	40 (40%)	30.7 – 49.9	
Type of Burn	Thermal	70 (70%)	60.2 – 78.5	0.012
	Chemical	15 (15%)	8.7 – 23.8	
	Electrical	15 (15%)	8.7 – 23.8	
TBSA Burned (%)	Continuous	$18 \pm 7.2$	16.6 – 19.4	—
Prior Surgical Intervention	Yes	65 (65%)	55.2 – 73.7	0.031
	No	35 (35%)	26.3 – 44.8	

**Table 2 Prevalence and Anatomical Distribution of Post-Burn Contractures (N = 100)**

Body Region	Participants with Contracture n (%)	95% CI	Odds Ratio (vs. trunk)	P-value
Upper limb	45 (45%)	35.3 – 54.9	6.75	<0.001
Lower limb	30 (30%)	21.3 – 39.9	3.43	0.003
Neck	20 (20%)	12.9 – 29.0	2.00	0.041
Trunk	10 (10%)	4.9 – 17.6	Reference	—

**Table 3 Severity Distribution of Post-Burn Contractures**

Contracture Severity	n (%) of Total Sample	n (%) Among Contracture Cases	95% CI	P-value
None	35 (35%)	—	26.3 – 44.8	—
Mild (<25% ROM loss)	30 (30%)	30 (46.2%)	21.3 – 39.9	0.021
Moderate (25–50% ROM loss)	25 (25%)	25 (38.5%)	17.2 – 34.3	0.015
Severe (>50% ROM loss)	10 (10%)	10 (15.4%)	4.9 – 17.6	0.008

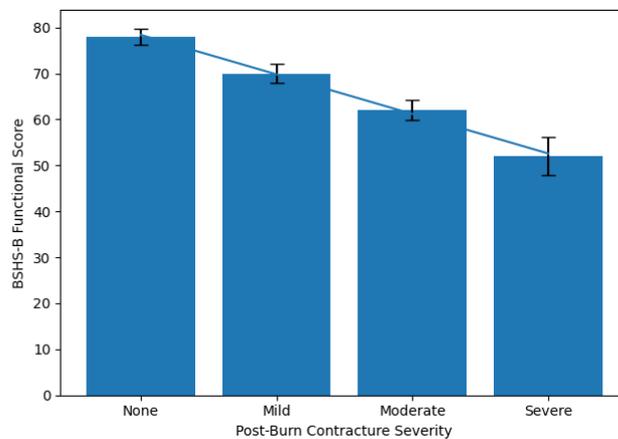
**Table 4 Functional Outcomes (BSHS-B Scores) According to Contracture Severity**

Contracture Severity	n	Mean BSHS-B Score ± SD	95% CI	Effect Size (Cohen’s d vs none)	p-value
None	35	78 ± 5.2	76.2 – 79.8	Reference	—
Mild	30	70 ± 6.0	67.9 – 72.1	1.39	<0.001
Moderate	25	62 ± 5.5	59.8 – 64.2	2.78	<0.001
Severe	10	52 ± 6.3	47.9 – 56.1	4.75	<0.001

**Table 5 Factors Associated with Presence of Post-Burn Contractures**

Variable	Contracture Present (n=65)	Contracture Absent (n=35)	Odds Ratio (95% CI)	p-value
TBSA (%) mean ± SD	20.3 ± 6.5	13.7 ± 5.9	1.12 (1.05–1.19)	0.001
Surgical Intervention	50 (76.9%)	15 (42.9%)	4.30 (1.86–9.95)	<0.001
Thermal Burn	50 (76.9%)	20 (57.1%)	2.49 (1.01–6.14)	0.044

Overall, the tables collectively show that post-burn contractures affected nearly two-thirds of the study population, were most common in the upper limbs, and were often moderate to severe in extent. Most importantly, the data demonstrate a strong and clinically meaningful gradient between structural impairment and functional limitation, with BSHS-B scores declining from 78 in participants without contractures to 52 in those with severe contractures. This numeric pattern strengthens the central finding that increasing post-burn contracture severity is associated with substantial deterioration in daily functional activities.



**Figure Title: Functional Decline Gradient Across Post-Burn Contracture Severity Levels (Mean BSHS-B with 95% CI)**

The figure demonstrates a clear monotonic decline in functional outcomes across increasing post-burn contracture severity categories. Participants without contractures exhibited the highest functional status with a mean BSHS-B score of 78 (95% CI: 76.2–79.8). Functional scores decreased to 70 (95% CI: 67.9–72.1) among individuals with mild contractures, representing an 8-point reduction relative to the non-contracture group. A further decline was observed in the moderate severity group with a mean score of 62 (95% CI: 59.8–64.2), corresponding to a 16-point reduction from baseline functional status. The most pronounced impairment occurred among participants with severe contractures, whose mean BSHS-B score fell to 52 (95% CI: 47.9–56.1), indicating an overall 26-point decrease compared with individuals without contractures. The regression layer illustrates a strong negative functional gradient across severity levels, supporting the statistically significant inverse association previously reported (Spearman  $r = -0.62$ ,  $p < 0.001$ ). Clinically, this pattern indicates that each incremental increase in contracture severity corresponds with a substantial deterioration in daily functional capability, particularly affecting mobility, hand function, and self-care independence.

## DISCUSSION

The present study investigated the prevalence and functional implications of post-burn contractures among adult burn survivors attending a tertiary burn rehabilitation center. The findings demonstrate that post-burn contractures remain highly prevalent in this clinical population, affecting 65% of participants, and are strongly associated with significant reductions in functional capacity. Importantly,

the study revealed a clear severity–function gradient in which increasing contracture severity corresponded to progressively lower Burn Specific Health Scale–Brief (BSHS-B) scores. These results emphasize that contracture formation continues to represent a major contributor to long-term disability following burn injury, particularly in settings where access to early and sustained rehabilitation may be limited.

The observed prevalence of contractures in this study is consistent with previous research indicating that contracture formation remains a frequent complication during the post-acute phase of burn recovery. Earlier studies have reported contracture rates ranging from approximately 38% to 54% at hospital discharge, although the prevalence can vary depending on patient population, injury severity, and rehabilitation access (7,22). The higher prevalence observed in the present study may partly reflect the clinical context of a tertiary rehabilitation center, where patients presenting for follow-up care often represent individuals with persistent functional limitations or more severe injuries. Similar patterns have been described in longitudinal studies conducted in low- and middle-income countries, where limited availability of rehabilitation services and delayed follow-up may contribute to higher rates of contracture persistence (15,18).

The anatomical distribution of contractures observed in this study also aligns with existing literature highlighting the vulnerability of upper extremity joints to post-burn deformities. Upper limb involvement was identified in 45% of participants, making it the most commonly affected region. This finding is clinically significant because joints of the upper extremity—particularly the shoulder, elbow, wrist, and hand—play essential roles in performing activities of daily living and fine motor tasks. Previous investigations have similarly reported that contractures affecting the hand and upper limb are among the most disabling consequences of burn injury due to their impact on self-care, occupational activities, and independence (6,23). In contrast, lower limb and neck contractures were less frequent in this study but still represented important contributors to mobility restrictions and postural limitations.

A key contribution of the present study is the demonstration of a strong inverse relationship between contracture severity and functional outcomes. Participants without contractures had the highest functional scores, whereas individuals with severe contractures experienced a substantial decline in BSHS-B scores, indicating major impairments in daily functioning. The moderate-to-strong negative correlation identified between contracture severity and functional status supports previous research suggesting that structural joint limitations translate directly into measurable activity restrictions. Hendriks and colleagues reported that patients with burn scar contractures exhibited significantly reduced joint mobility, greater disability, and poorer quality of life compared with patients without contractures (11,15). Similarly, studies using burn-specific outcome measures have shown that limitations in ROM are closely associated with decreased performance in domains such as hand function, mobility, and self-care (13,14).

The findings also highlight the broader clinical relevance of contracture severity in determining long-term rehabilitation outcomes. As severity increased from mild to severe, the mean BSHS-B score decreased substantially, demonstrating a clinically meaningful gradient of functional deterioration. Such patterns suggest that early identification and prevention of contracture progression may play a crucial role in preserving functional independence among burn survivors. Evidence from rehabilitation-focused research indicates that interventions such as early mobilization, positioning, splinting, and structured physiotherapy programs can significantly reduce the risk of contracture formation and improve long-term functional outcomes (4,24). In cases where contractures become established, reconstructive procedures combined with postoperative rehabilitation have been shown to improve joint mobility and functional capacity (11,23).

Exploratory findings from this study further suggest that certain clinical factors may be associated with an increased risk of contracture development. Participants with larger burn surface areas and those who had undergone surgical interventions were more likely to exhibit contractures, reflecting the well-

recognized relationship between burn severity and scar formation. Larger TBSA burns often involve deeper tissue injury and prolonged wound healing, both of which contribute to excessive scar contraction and subsequent joint restriction. Previous studies have similarly identified burn depth, TBSA involvement, and delayed rehabilitation as key predictors of contracture formation (18,25). Although the present study was not designed to establish causal relationships, these observations support existing evidence that burn severity and treatment complexity are important determinants of long-term musculoskeletal outcomes.

Despite the clinical relevance of these findings, several limitations should be considered when interpreting the results. First, the cross-sectional design restricts the ability to determine causal relationships between contracture severity and functional impairment. Longitudinal studies would be required to evaluate how contractures develop over time and how rehabilitation interventions influence functional recovery. Second, the use of consecutive sampling from a single tertiary center may limit the generalizability of the findings to other settings, particularly community-based populations or patients with less severe injuries. Third, although standardized goniometric assessment was used to measure joint ROM, measurement variability may still occur due to differences in patient positioning or examiner technique. Finally, while several clinical variables were explored, the analysis did not include multivariable adjustment for potential confounders, and future research with larger sample sizes should examine these relationships using more advanced statistical modeling.

Overall, the present study contributes to the growing body of literature emphasizing the importance of post-burn rehabilitation in improving long-term outcomes for burn survivors. By combining objective measurement of contracture severity with patient-reported functional assessment, the study provides a comprehensive evaluation of the structural and functional burden of post-burn contractures in a clinical rehabilitation population. The findings underscore the need for integrated burn care models that incorporate early rehabilitation strategies alongside surgical and medical management. Such approaches are essential to reduce long-term disability and to support the reintegration of burn survivors into daily life and social participation.

## CONCLUSION

Post-burn contractures remain a highly prevalent complication among adult burn survivors and represent a major contributor to functional impairment in daily activities. In this study population, nearly two-thirds of participants developed contractures, with the upper extremities most commonly affected. Increasing contracture severity was strongly associated with progressively poorer functional outcomes, particularly in domains related to hand function, mobility, and self-care. These findings highlight the critical importance of early identification, prevention, and targeted rehabilitation interventions in burn care. Strategies such as early positioning, splinting, structured physiotherapy, and timely surgical management may play a crucial role in minimizing contracture formation and improving long-term functional recovery among burn survivors..

## REFERENCES

1. Deng H, Genovese TJ, Schneider JC. A narrative review of outcomes in burn rehabilitation based on the international classification of functioning, disability, and health. *Phys Med Rehabil Clin N Am*. 2023;34(4):867–881.
2. Sadhu S, Prabhakar B. Study of post burn contracture of hand, surgical management and outcomes. *JK Sci*. 2024;26(4):220–224.
3. El Kinani M, Duteille F. Scar epidemiology and consequences. In: Téot L, Mustoe TA, Middelkoop E, Gauglitz GG, editors. *Textbook on Scar Management: State of the Art Management and Emerging Technologies*. Cham: Springer; 2020. p. 45–49.

4. Karakol P, Bozkurt M. Recent strategic approach in postburn extremity scars and contractures. *J Plast Surg Hand Surg.* 2021;55(3):153–161.
5. van Baar ME. Epidemiology of scars and their consequences: burn scars. In: Téot L, Mustoe TA, Middelkoop E, Gauglitz GG, editors. *Textbook on Scar Management.* Cham: Springer; 2020. p. 37–43.
6. Vosinakis C, Kotsougiani-Fischer D, Dailiana Z, et al. Effectiveness of hand reconstruction techniques for the treatment of postburn contractures of the hand: a systematic review. *Burns.* 2024;50(9):107281.
7. Amici JM, Gamba C, Beneton N, et al. The impact of visible scars on well-being and quality of life: an international epidemiological survey in adults. *J Eur Acad Dermatol Venereol.* 2023;37:3–6.
8. Baimuratova M, Abashidze I. Burn injuries: epidemiology, diagnosis and treatment. *Med Sci Educ.* 2023;(2):33–50.
9. Shahzad MN, et al. Burn injuries in epileptic patients: prevalence, causes, and outcomes. *Ann PIMS.* 2024;20(4):683–687.
10. Fanstone R, Price P. Global perspectives on risk factors for major joint burn contractures: a literature review. *Burns.* 2024;50(3):537–549.
11. Hendriks T, et al. Burn scar contracture release surgery effectively improves functional range of motion, disability and quality of life. *Burns.* 2021;47(6):1285–1294.
12. Hendriks TC, et al. Contracture release surgery effectively improves functional range of motion and quality of life: a cohort study with long-term follow-up. *Burns.* 2022.
13. Amtmann D, et al. Evaluation of the psychometric properties of the burn specific health scale-brief. *J Burn Care Res.* 2022;43(3):602–612.
14. Amtmann D, et al. Burn model system: review of program and database. *Arch Phys Med Rehabil.* 2020;101(1):S5–S15.
15. Hendriks T, et al. Development of burn scar contractures and impact on joint function, disability and quality of life in low- and middle-income countries. *Burns.* 2022;48(1):215–227.
16. Razaghi Pey Ghaleh M, Marques D, O'Mahoney D. Computational and experimental studies on skin mechanics and meshing. *Biomimetics.* 2025;11(1):4.
17. Rajasekar S, et al. Functional outcomes after reconstruction of post-burn contracture of the hand in the pediatric age group. *Cureus.* 2024;16(3).
18. Fanstone R, Price P. Burn contracture risk factors and measurement in low-middle income countries. *Burns.* 2024;50(2):466–473.
19. Pham TN, et al. The impact of discharge contracture on return to work after burn injury. *Burns.* 2020;46(3):539–545.
20. Khan MA, et al. Management of post-burn sequelae: a prospective observational study. *SAS J Surg.* 2025;4:426–430.
21. Fanstone R, Khan MRK. Risk factors for burn contractures in a lower income country: four illustrative cases. *Scars Burns Heal.* 2024;10:20595131241236190.
22. Schneider JC, et al. Contractures in burn injury part I: defining the problem. *J Burn Care Res.* 2006;27(4):508–514.

23. Sheridan RL, Hurley J, Smith MA. The acutely burned hand: management and outcomes. *Burns*. 2005;31(6):593–600.
24. Esselman PC. Burn rehabilitation: an overview. *Arch Phys Med Rehabil*. 2007;88(12 Suppl 2):S3–S6.
25. Goverman J, et al. Contractures in burn injury: prevalence and predictors. *J Burn Care Res*. 2017;38(3):e550–e557.