

Physiotherapy Management in Pediatric Burns: A Five-Year Experience Comparing Children and Adolescents at a Tertiary Burn Center

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Correspondence: Margherita Cerboneschi, Meyer Children's Hospital IRCCS, Florence, Italy. Email: m.cerboneschi@meyer.it

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Margherita Cerboneschi¹, Marta Cervo¹, Giorgia Silli², Laura Baroni¹

¹ *Rehabilitation Unit, Meyer Children's Hospital IRCCS, Florence, Italy*

² *Rehabilitation Unit, IRCCS Materno Infantile Burlo Garofolo, Trieste, Italy*

Abstract

Introduction. Physiotherapy plays a crucial role in the management of pediatric burn patients, requiring early intervention and long-term follow-up to prevent functional limitations and manage scar-related complications. Adolescents represent a particularly challenging group, as developmental, psychological, and social factors may negatively influence engagement and adherence to rehabilitation programs. This study aimed to describe the physiotherapy tools used in pediatric burn patients and to compare physiotherapy modalities and treatment adherence between children and adolescents treated at a tertiary pediatric burn center.

Methods. A retrospective observational, monocentric chart review was conducted in accordance with STROBE guidelines. Medical records of pediatric burn patients (≤ 18 years) admitted to the Burns Center of Meyer Children's Hospital IRCCS, Florence, between 2017 and 2022 and managed by the Rehabilitation Unit were reviewed. Patients were divided into two groups based on age at admission: children (< 11 years) and adolescents (11-18 years). Data collected included demographic characteristics, burn features, physiotherapy modalities used during the acute and scarring phases, and adherence to the prescribed physiotherapy program. Adherence was assessed subjectively by treating physiotherapists during routine clinical practice. Categorical variables were analyzed using Chi-square or Fisher's exact tests.

Results. Thirty-five patients were included: 20 children and 15 adolescents. The adolescent group more frequently presented with burns involving a larger total body surface area. Most physiotherapy tools were used similarly in both groups;

however, gait training during the acute phase was more frequently applied in adolescents ($p = 0.046$), while contact media during the scarring phase were more commonly used in children ($p < 0.05$). Adherence to physiotherapy during hospitalization was generally good in both groups. During the scarring phase, children showed significantly higher adherence to splints, massage combined with skin hydration, elastic-compressive garments, and contact media (all $p < 0.05$).

Discussion. Physiotherapy management in pediatric burn patients relies on similar tools across age groups; however, adherence appears to be lower in adolescents, particularly during long-term scar management. Developmental factors and family involvement likely play a key role in treatment engagement. These findings highlight the need for age-tailored, patient-centered rehabilitation strategies to improve adherence among adolescents with burn injuries.

Keywords: Pediatric Burns, Adolescents, Physiotherapy, Rehabilitation, Treatment Adherence

Introduction

Burns remain a major public health issue in industrialized countries, particularly among children, where they are among the top five causes of accidental mortality in the European Union and account for 1% of all pediatric deaths.¹ In Italy, approximately 440 deaths due to burns are recorded annually, over 70% of which occur in the home. Among pediatric fatalities, 16% are burn-related, with the majority affecting children under the age of four.^{1,2}

Thanks to medical and surgical advances, the last three decades have seen a marked decline in burn-related mortality in children.^{3,4,5} Improved outcomes have shifted focus toward the long-term consequences of burns and the growing need for extended rehabilitation.^{6,7} These patients—many of whom are now adolescents or adults—often face complex physical, functional, and psychosocial challenges that require sustained, multidisciplinary care well beyond the acute phase.⁶ Severe burns can result in functional impairment, aesthetic disfigurement, and psychological trauma, with consequences on independence, pain perception, and mobility. The literature emphasizes the essential role of a coordinated multidisciplinary team in managing pediatric burns, both during hospitalization and in the long-term recovery process.^{3,8,9,10} Physiotherapists are key members of this team, contributing from the early stages of care

through individualized interventions to preserve range of motion (ROM), prevent contractures, and promote functional independence.¹¹

Physiotherapy intervention typically begins within 48 hours of admission and continues for months or years post-discharge, depending on the severity of the injury.^{6,12}

In the acute phase, physiotherapy tools include splinting, kinesitherapy (active and passive), therapeutic positioning, and stretching.^{13,14} These tools aim to reduce pain, prevent joint stiffness, and maintain mobility. Once wounds are healed and scar formation begins (non-acute phase), rehabilitation shifts toward scar management with techniques such as elastic-compression garments, manual or mechanical massage therapy, kinesitherapy, and silicone-based applications (contact media).^{9,13,15,16} This phase, which can last years in growing children, is crucial to improving functional outcomes and quality of life.

Within this framework, the role of the child's family is crucial. From the first days of hospitalization, family involvement is actively encouraged. This long-term engagement is essential for treatment adherence and successful rehabilitation outcomes.^{6,16}

Despite growing awareness of rehabilitation's importance, there remains significant heterogeneity among burn centers in the evaluation and treatment of pediatric patients.^{9,16} A lack of validated tools impairs

outcome measurement and limits opportunities for clinical research.¹⁶ The need for shared, evidence-based rehabilitation protocols is widely acknowledged¹⁷, and international collaborations—particularly multicenter studies—are considered essential to advancing practice.⁷

The European Club for Pediatric Burns (ECPB), founded in 1991, plays a key role in promoting standardization and cooperation across Pediatric Burn Centers.¹⁸ However, data from Italian centers remain limited.

Working in a pediatric context poses unique challenges. The care team must manage patients ranging from infancy to adolescence, each with specific developmental needs. Adolescents, in particular, experience physical, emotional, and social changes that can be exacerbated by a disfiguring and painful injury such as a burn.^{19,20,21,22} They may feel isolated or misunderstood, and the burden of ongoing treatment can further strain their mental well-being.²¹ Therapeutic approaches must therefore be tailored to this age group, balancing clinical objectives with the adolescent's individual preferences and psychological state.^{12,23}

The World Health Organization defines therapeutic adherence as “the degree to which a person's behavior corresponds to the recommendations agreed with the health professional”.²³ This concept implies an active partnership between patient and provider and is especially important during adolescence, when autonomy and self-image become more salient. Poor adherence can reduce treatment effectiveness and lead to long-term disability, while also increasing healthcare costs.^{24,25}

Despite recognition of the value of adolescent participation in treatment planning, current practice often overlooks their voices.^{26,27} Studies show that adolescents are rarely asked about their preferences or priorities^{27,28}, which can result in reduced engagement and lower adherence to physiotherapy regimens.^{29,30,31}

To explore this issue, a retrospective review of cases at the Meyer Burns Center was conducted to answer the following questions: What physiotherapy tools are most commonly used in the treatment of pediatric versus adolescent burn patients? What differences in adherence to physiotherapy treatment emerge between these two groups?

Methods

Study design and setting

This study was a retrospective observational, monocentric chart review, conducted in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational studies.

The study was carried out at the Burns Center of Meyer Children's Hospital IRCCS, Florence, a tertiary referral center for pediatric burns, in collaboration with the Rehabilitation Unit.

Study population

Medical records of pediatric patients admitted for burn injuries between January 2017 and December 2022 were retrospectively reviewed. Patients were eligible for inclusion if they met the following criteria: age ≤ 18 years at the time of injury; admission to the Burns Center during the acute phase of burn injury; documented involvement of the Rehabilitation Unit with structured physiotherapy intervention; availability of complete clinical and rehabilitation records. Patients were excluded if: they were transferred to another facility before initiation of physiotherapy; physiotherapy documentation was incomplete or unavailable; severe pre-existing neurological or musculoskeletal conditions interfered with rehabilitation assessment. Baseline demographic and clinical characteristics of the study population are reported in Table 1.

Table 1. Baseline demographic and clinical characteristics of pediatric burn patients included in the study, stratified by age group. Abbreviations: TBSA, Total Body Surface Area; n, number of patients; %, percentage; years, age expressed in years.

Variable	Children (<11 years)	Adolescents (11–18 years)
Number of patients, n	20	15
Age, mean (range), years	3.7	12.5
Sex, male, n(%)	13 (65%)	9 (60%)
TBSA category	<15% prevalent	>25% prevalent
Main burn location	Hands / Upper limbs	Lower limbs / Trunk

Based on age at admission, patients were divided into two groups: Children group, patients younger than 11 years; Adolescent group, patients aged 11–18 years.

Physiotherapy management protocol

According to the institutional physiotherapy protocol for pediatric burn patients, physiotherapy intervention was initiated during the acute phase of hospitalization and tailored to the patient's clinical condition, burn extent, and tolerance.

During hospitalization, patients received daily physiotherapy sessions, usually conducted in their rooms and in the presence of parents or caregivers. Interventions included active and passive kinesitherapy, stretching, therapeutic positioning, gait training when clinically appropriate, splinting, and caregiver education.

A personalized physiotherapy plan was developed for each patient through multidisciplinary collaboration involving the physiotherapist, attending physician, nursing staff, and family. This plan included recommended activities, positioning strategies, and preventive measures to be maintained throughout the day.

At discharge, families were provided with a home-based physiotherapy program, consisting of daily activities, postural recommendations, and – when indicated – specific exercises to be performed independently. Patients discharged home were scheduled for monthly follow-up visits during the first six months after the burn injury.

Data collection and variables

Data were extracted from electronic medical records using a standardized data extraction protocol by two independent reviewers. Discrepancies were resolved through discussion.

The following variables were collected: demographic data (age, sex); burn characteristics (anatomical location, Total Body Surface Area – TBSA – involved); phase of treatment (acute phase vs scarring phase); physiotherapy modalities used during treatment, including kinesitherapy, stretching, gait training, activities of daily living (ADL) training, splints, elastic-compressive therapy, compression garments, contact media, massage therapy (manual or mechanical), and caregiver education; adherence to the prescribed physiotherapy program.

Physiotherapy tools were considered “used”

if documented at least once during the relevant phase of care.

Assessment of adherence

Adherence to physiotherapy treatment was assessed subjectively by the treating physiotherapist during routine clinical practice. Evaluation was based on direct questioning of parents or caregivers and, when appropriate, consultation with ward staff.

Adherence assessment included: patient engagement and participation during physiotherapy sessions; overall cooperation throughout hospitalization or follow-up; reported compliance with prescribed home-based interventions; observable clinical improvement related to the physiotherapy program.

No validated adherence scale was available or routinely used during the study period. Adherence was therefore documented as a clinical judgment, reflecting real-world practice. This limitation was acknowledged in the interpretation of results.

Statistical analysis

Data were entered into a dedicated database and analyzed using descriptive and inferential statistics. Categorical variables were expressed as frequencies and percentages.

Comparisons between the children and adolescent groups were performed using the Chi-square test or Fisher's exact test, as appropriate based on sample size and expected cell counts.

A two-sided p value < 0.05 was considered statistically significant. Missing data were handled by case-wise exclusion.

Given the exploratory nature of the study and the limited sample size, no adjustment for multiple comparisons was performed.

Ethical considerations

This study was approved by the Regional Pediatric Ethics Committee. Ethical approval was granted under protocol number 21-05-2025 126/2025. The study was conducted in accordance with the principles of the Declaration of Helsinki. Given the retrospective design of the study and the use of anonymized clinical data, the requirement for informed consent was waived.

Results

During the study period, 35 patients with burns

were managed by the Rehabilitation Unit. Two age-based cohorts were identified: the children group (patients under 11 years), which included 20 patients, and the adolescent group (patients aged 11–18 years), which included 15 patients. The mean age in the adolescent group was 12.5 years, while in the children group it was 3.7 years. There was a predominance of males in both groups: 9 out of 15 (60%) in the adolescent group and 13 out of 20 (65%) in the children group. The two groups were comparable in terms of sex distribution and burn location. Burns involving a larger total body surface area were more frequently observed in adolescents, whereas children more commonly presented with burns involving less than 15% TBSA. Formal statistical comparison was limited by sample size. Both groups received standard physiotherapy interventions commonly used in pediatric burn care, as detailed in Table 2.

During the acute phase, gait training was more frequently applied in adolescents than in children ($p = 0.046$). During the scarring phase, contact media were used more often in children compared to adolescents ($p < 0.05$). No other statistically significant differences were observed between groups.

Adherence to physiotherapy treatment

Adherence to physiotherapy treatment during the acute hospital phase was generally good in both groups, with slightly higher adherence observed in the children group, although the difference was not statistically significant. In contrast, during the scarring phase, which typically involved outpatient or home-based

care, adherence was significantly higher in the children group. In particular, greater compliance was noted with the use of splints ($p = 0.023$), massage combined with skin hydration ($p < 0.01$), elastic-compressive garments ($p = 0.004$), and contact media ($p < 0.01$) (Figure 1).

Table 2. Frequency of physiotherapy modalities applied in children and adolescents during the acute and non-acute (scarring) phases of burn rehabilitation.

Physiotherapy tool	Children n/N (%)	Adolescents n/N (%)	Phase
Kinesitherapy	20/20 (100)	15/15 (100)	Acute
Stretching	20/20 (100)	5/15 (33.4)	Acute
Gait training	9/20 (45)	12/15 (80)	Acute
ADL training	9/20 (45)	6/15 (40)	Acute
Splint (hospital)	12/20 (60)	6/15 (40)	Acute
Contact media	18/20 (90)	5/15 (33.4)	Scarring
Compression garment	12/20 (60)	7/15 (46.6)	Scarring
Massage (manual/mechanical)	19/20 (95)	15/15 (100)	Scarring
Splint (home)	13/20 (65)	8/15 (53.4)	Scarring

Legend: **ADL:** activities of daily living; **TBSA:** total body surface area involved; **LPG:** LipoMassage by Endermologie®; **n:** number of patients presenting the characteristic; **N:** total number of patients in each group.

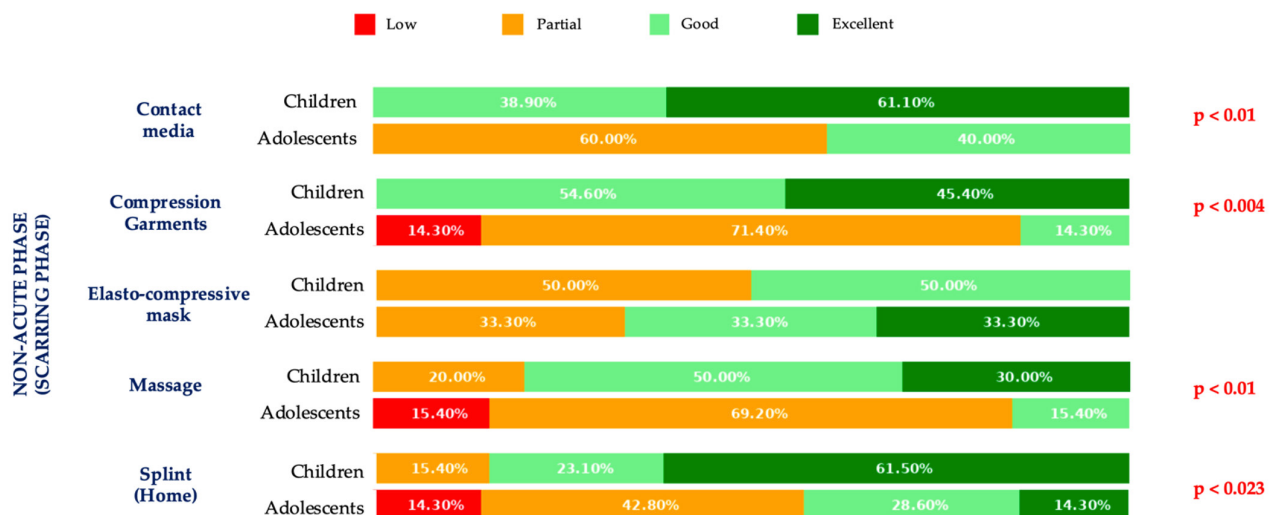


Figure 1. Adherence to physiotherapy treatment in the adolescent group and in the children group, divided according to the physiotherapy tools used, in the scarring phase

Discussion

From the available data, burns involving a higher TBSA were more frequently observed in adolescents, whereas children more commonly presented with less extensive burn injuries. This finding may be related to differences in the mechanisms of injury across age groups. In younger children, burns are more often caused by domestic accidents involving limited body areas, such as contact with hot household surfaces or scalds from boiling liquids during early feeding activities.³²⁻³⁴ In contrast, adolescents more frequently experience burn events with greater dynamics, including flame-related injuries or explosions, which may result in larger TBSA involvement.^{35,36}

Across both the acute and scarring phases, physiotherapy management strategies appeared largely overlapping between children and adolescents, in line with current recommendations for pediatric burn rehabilitation.^{11,13,32,33} Nevertheless, some age-related differences were observed. Gait training was more frequently implemented during the acute phase in adolescents, likely reflecting the higher prevalence of lower limb involvement and more extensive burns in this group. Similarly, contact media were more commonly used during the scarring phase in children, possibly due to the involvement of anatomically delicate areas prone to hypertrophic scarring and contracture development, such as the hands and fingers.^{36,37}

With regard to adherence, higher levels were observed in the children group, particularly for interventions such as splints, massage combined with skin hydration, and elastic-compressive therapy. These findings should be interpreted not only in relation to burn severity but also considering developmental stage and family involvement. In younger children, adherence to rehabilitation programs largely depends on parental or caregiver supervision, whereas adolescents may experience greater challenges related to autonomy, self-image, and resistance to externally imposed treatment regimens.^{38,39}

Previous studies suggest that involving adolescents more actively in treatment planning and periodically renegotiating rehabilitation goals may help improve engagement and adherence over time.^{39,49} Although these strategies were not formally evaluated in the present study, they represent important considerations for future research and clinical practice.

Limitations of the study

This study has several limitations that should be acknowledged. Its retrospective and monocentric design limits causal inference and reduces the generalizability of the findings to other pediatric burn centers. The relatively small sample size may have limited the statistical power to detect differences between groups and precluded multivariable analyses. The adherence to physiotherapy was assessed subjectively by the treating physiotherapists as part of routine clinical practice, in the absence of validated adherence measurement tools. Although this approach reflects real-world clinical conditions, it may have introduced observer bias and variability in assessment. In addition, potential confounding factors such as socioeconomic status, family structure, psychological distress, and pain perception were not systematically collected and could have influenced adherence, particularly in adolescents.

Finally, long-term functional and quality-of-life outcomes were not evaluated, limiting conclusions regarding the clinical impact of differing adherence patterns over time.

Conclusions

Promoting adherence to physiotherapy in pediatric burn patients, particularly adolescents, remains a complex and underexplored challenge. Although physiotherapy tools are largely shared across age groups, developmental stage and family involvement appear to play a relevant role in treatment engagement.

This study highlights age-related differences in adherence during the scarring phase, suggesting that adolescents may require more tailored and participatory rehabilitation approaches. Further research, particularly prospective and multicenter studies, is needed to better define strategies that support sustained adherence and optimize long-term outcomes in this population.

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