

Effectiveness of Physiotherapeutic Interventions in A Post-Surgical Burn Patient - A Case Study

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Abstract

Introduction: Burn injuries are a major cause of morbidity and mortality in children. In India, the figure constitutes about one-fourth of the total burn accidents. Burn injuries can lead to scar tissue formation that further leads to functional limitations. Each paediatric burn case is unique, and a tailored approach is necessary for effective physiotherapy management. Therefore, the aim of this study is to explore the effects of physiotherapeutic interventions on range of motion, scar quality, pain and anxiety in post-surgical patient with a 20% second degree superficial partial-thickness flame burn.

Case Presentation: A 9-years old female patient, admitted to Plastic surgery and Burn Unit, was recruited for the study. She had undergone skin grafting following the burn. Physiotherapeutic interventions were provided in two phases over 8 weeks, including exercises adjunct with ultrasound therapy and application of transcutaneous electrical nerve stimulation for 8 weeks lasted the treatment session for 60 minutes. The outcome measures used in this study were range of motion of following joints- right shoulder, right elbow joint and left shoulder joint, scores of Vancouver scar scale and scores of specific burn pain and anxiety scale. The assessments were taken at pre intervention 0 week, mid-intervention 4th and 8th week post intervention.

Results and Conclusion: The findings of this study showed improvements in ROM of affected joint-right shoulder joint and right elbow joint and left shoulder joint, scar tissue quality, pain and anxiety reduction. Further research is needed to establish the relationship and determine optimal interventions for burn subjects. This study concluded the effectiveness of physiotherapy in burn rehabilitation.

Keywords: Exercises, Physiotherapy, Post-surgical Burn, ROM, T.E.N.S, Ultrasound therapy,

Introduction

Burn injuries are reported to be the third most common cause of death in children aged 5-14 years, with road traffic injuries and drowning being first and second, respectively, in developing countries, and vulnerable populations [1,2]. They result from various sources, including thermal, friction, cold, radiation, electricity, and chemical exposures, causing thermal coagulative necrosis of tissues. The American Burn Association (ABA) reported an overall survival rate of 94.8% from 2000 to 2009[3]. In India, paediatric burns account for 17–25% of total burn admissions. Approximately 90% of burns are caused by household accidents [4]. As a result of improvements in care, treatment, and survival of subjects with burns, more physical therapists will become responsible for significant portion of their settings other than a hospital burn unit. The advent of the burn unit and the concentrated team care and

focused research that has been generated by these facilities have improved the outcome of the most severely burned subject, as well as reduced the average hospital stay in most cases.

Children represent a subset of the population at risk of burns particularly in the domestic setting where effective and actionable preventive measures can be designed and monitored. Unfortunately, they still form a major part of the burn casualty. They accounted for 38% and 39% of all burns cases seen at Ibadan and Cairo respectively [5]

The impact of burn injuries extends beyond the surface of the skin, affecting muscles, tendons, bones, and joints. Even small burn areas can lead to scar tissue formation and subsequent functional impairments. The development of scar tissue following burns can result in pain, decreased range of motion, and diminished quality of life for subjects.

The focus of burn care and research is currently transitioning from acute care and lowering mortality towards improving life quality and subject outcomes in the short- and long-term post burn. The emphasis on function restoration is at the forefront of all therapy initiatives, thus rehabilitation of the burn subject is essential. The age, depth and extent of the burns, the degree of wound healing, the presence of infection, and the psychosocial status of child and family all serve an indispensable part in burn rehabilitation. It begins once wound healing has been completed and to return to a functioning environment, it may take months to years of consistent effort and follow-up as the child grows back to functioning arena.

Rehabilitation focuses on scar prevention, hypertrophic scar suppression, management of heterotrophic ossification, leukoderma, and pruritis, as well as restoration of the subject's functional capacity, such as full range of motion, muscle strength, and independent mobility and activities of daily living. It also includes interventions for complex reconstruction procedures and measures to reintegrate the subject into the home and community [6,7].

As by understanding the profound physical and psychological consequences of burn injuries, it is imperative to investigate the efficacy of physiotherapeutic interventions in improving range of motion, scar quality, pain management, and alleviating anxiety in post-surgical subjects with a 20% second-degree, superficial partial-thickness flame burn. Bridging the existing gaps in knowledge, this study aims to address the need for comprehensive approaches to burn rehabilitation, focusing on optimizing subject care, reducing pain, promoting psychological well-being, and enhancing functional outcomes. By conducting this research, valuable insights can be gained to enhance the overall understanding of effective treatment strategies for this vulnerable population.

Case Description

This research article presents a case study of a 9-year-old female patient, who suffered a flame burn affecting 20% of her Total Body Surface Area (TBSA). The subject was a diagnosed case of cerebral palsy and delayed milestones but no history of epilepsy or seizures. She was admitted to the Emergency Department after the burn incident occurred while she was playing at home. The burn was a result of accidentally catching fire from a gas stove, and the patient's grandmother promptly took action by tearing up clothes to rescue the child and immediately seeking medical help. The duration of contact with the fire was estimated to be 4-5 minutes.

After initial resuscitation at a nearby hospital, the subject was subsequently admitted to the Plastic Surgery and Burn Unit for further management. On admission to the in-patient department of the burn and plastic-surgery unit, the burn was assessed and classified as a second-degree, superficial partial-

thickness flame burn, affecting approximately 20% of the subject's Total Body Surface Area (TBSA) according to Wallace Rule of Nines [8]. The burn area involved left anterior and posterior upper arm, right anterior upper and lower arm and partial anterior trunk. The subject's Glasgow Coma Scale (GCS) was recorded as Eye-3, Verbal-5 and Motor-6. The primary focus during this phase was to stabilize the her condition and ensure proper wound care and concurrent medical treatment included plans for packed red blood cell (PRBC) transfusion to improve haemoglobin levels in preparation for future skin grafting surgery. After 20 days, a split-thickness skin grafting procedure was performed to promote wound healing and reduce the risk of infection. The split-thickness skin graft was harvested from the patient's left inner thigh, which served as a suitable donor site.

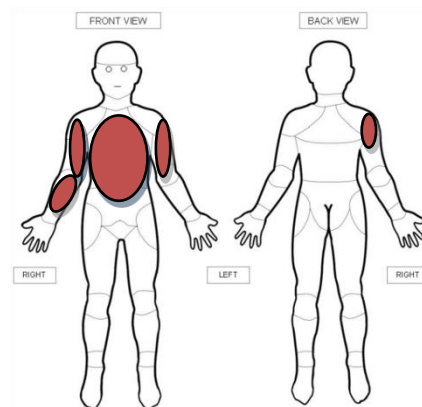


Figure 1: Burn Diagram represents the site of burn in patient

Following the successful skin grafting procedure, the subject underwent a period of recovery for 14 days before an elective operation was performed to provide wound coverage. This procedure aimed to enhance the aesthetic appearance of the healed area and further facilitate the healing process.

After 17 days post-elective operation, the patient's treatment plan included the initiation of physiotherapy. Physiotherapeutic interventions were provided in two phases over 8 weeks, including exercises adjunct with ultrasound therapy and application of transcutaneous electrical nerve stimulation for 8 weeks lasted the session for 60 minutes.

Before starting physiotherapy treatment, the patient was assessed for affected range of motion of right shoulder, right elbow joint and left shoulder joint, quality of scar, pain and anxiety using Goniometer, Vancouver scar scale and Specific Burn Pain Anxiety scale respectively. The assessments were taken pre intervention at 0 week, mid-intervention at 4th week and at 8th week post intervention.

The examination revealed restricted range of motion of right shoulder joint, right elbow joint and left shoulder joint, primarily due to burn and scar formation. The patient's left shoulder abduction ranged from 0-45 degrees, while the right shoulder abduction ranged from 0-40 degrees. Left shoulder flexion ranged from 0-30 degrees, and right shoulder flexion ranged from 0-50 degrees. Limited elbow flexion was observed, with the right side ranging from 0-20 degrees. Right elbow supination and pronation was ranged from 0-55° and 0-63° respectively.

In terms of scar quality, the Vancouver Scar Scale scored 9 on the front and right arm, and 10 on the left arm. These scores indicate moderate scar severity and characteristics. Additionally, the subject exhibited moderate anxiety, with a burn and anxiety scale score of 28.

Interventions

The physiotherapeutic interventions were provided to the patient, in two phases over 8 weeks, including exercises adjunct with ultrasound therapy and application of transcutaneous electrical nerve stimulation. The total duration of physiotherapeutic interventional program lasted for 60 minutes.

During the physiotherapeutic management in the Plastic Surgery and Burn Unit, a comprehensive approach was taken to promote healing and enhance the functional outcomes. Following interventions were implemented to achieve these goals- Positioning, elevation, range of motion exercises, and deep breathing exercises were incorporated in the physiotherapeutic regimen.

In the first week of physiotherapeutic interventions i.e. in the IPD of Plastic surgery and Burn Unit, the patient was placed in semi-reclined position in which the upper body is slightly elevated by elevating the adjustable bed, thus alleviating pressure on the affected areas. This position reduced the swelling and improved breathing. Positioning was adjusted and changed after every 4-5 hours to prevent pressure sores. The subject and her caregiver was also instructed to keep her hands elevated on pillows and to perform actively ankle toe pumps one set \times 10 repetitions, twice a day on both sides to minimize swelling and further complications.

In the second week, range of motion exercises were introduced for the upper and lower extremities. Gentle active assisted exercises were performed for the wrist and fingers to maintain range of motion, while movements involving the bilateral elbow and shoulder joints were avoided to protect the skin graft. Exercises included were wrist- flexion, extension, radial deviation, ulnar deviation with 5 repetitions and one set actively and fist making on both sides for 10 repetitions once a day in available range of motion actively. For lower limbs, patient performed active range of motion exercises of hip joint, knee joint and ankle joint bilaterally. Diaphragmatic breathing exercises every 3-4 hours were taught and instructed to be performed.

During the third and fourth week of management, passive exercises of bilateral shoulder joint and elbow joint for 5 repetitions, one set were incorporated in the interventional program with above mentioned exercises.

During the fifth week, the subject was asked to visit the physiotherapy outpatient department (O.P.D), the exercises included were gentle passive movements of Elbow Joint- flexion, extension, supination and pronation and Shoulder Joints -flexion, extension, adduction and abduction (one set \times 10 repetitions).

In the following week, static exercises, including isometric exercises for the shoulder musculature were performed by the subject. In the seventh and eighth week, additional interventions were implemented. Deep friction massage was provided to the ends of the graft to loosen adhesions and aid in scar mobilization. Active-assisted movements were initiated in the elbow and shoulder joints to improve the range of motion. Specific exercises in the physiotherapy O.P.D included shoulder wheel, shoulder pulley and finger ladder exercises.

In the sixth week and onwards, the physiotherapeutic management included electrotherapy interventions. High T.E.N.S was administered in continuous mode of higher frequency ranging from 50-100 pps with shorter duration 20-60 μ s for 10-12 minutes was applied. Ultrasound therapy in pulsed mode of frequency 3 MHz with intensity 0.3-0.5 W/cm² was applied to the scar ends on anterior aspect of right forearm and at anterior aspect of left shoulder in a spiral pattern to promote tissue healing and loosen adhesions for 6 minutes.

Results:

The findings of this case study were assessed at pre stage – 0 week, mid stage- 4th week and post stage- 8th week after the administration of physiotherapeutic interventions. The results of this study were described in the following tables.

Table 1: Description of Range of Motion at 0 week, 4th week and 8th week

Affected Range of Motion	PRE STAGE (0 WEEK)	MID STAGE (4th WEEK)	POST STAGE (8th WEEK)
Left Shoulder abduction	0-45°	0-48°	0-52°
Right Shoulder abduction	0-40°	0-43°	0-50°
Left Shoulder flexion	0-30°	0-30°	0-37°
Right Shoulder flexion	0-50°	0-51°	0-56°
Right Elbow flexion	0-20°	0-22°	0-29°
Right Elbow Supination	0-55°	0-55°	0-55°
Right Elbow Pronation	0-63°	0-67°	0-67°

Table 2: Description of scores of Vancouver Scar Scale at 0 week, 4th week and 8th week

Vancouver Scar Scale	PRE STAGE (0 WEEK)	MID STAGE (4th WEEK)	POST STAGE (8th WEEK)
FRONT	9	8	6
LEFT ARM	10	5	5
RIGHT ARM	9	6	4

Table 3: Description of scores of Specific Burn Pain Anxiety Scale at 0 week, 4th week and 8th week

Specific Burn Pain Anxiety Scale	PRE STAGE (0 WEEK)	MID STAGE (4th WEEK)	POST STAGE (8th WEEK)
	28 (Moderate Anxiety)	20 (Mild Severity)	12 (Borderline Anxiety)

Discussion:

This case study highlighted the necessity for a standardized approach to evaluate and treat subjects with flame burn injuries. The data in this study was collected using Universal Goniometer, Vancouver Scar Scale and Specific Burn Pain Anxiety Scale. The findings of this case study demonstrated the positive

effects of physiotherapy interventions in burn subjects, specifically in terms of scar formation improvement, functional ability enhancement, and pain reduction.

Optimizing range of motion in paediatric burn subjects is crucial for long-term function and development. Adequate joint mobility allows for proper growth, alignment, and development of bones, muscles and connective tissues. The findings of the study were found to be beneficial in improving the range of motion (ROM), which is in accordance with a study conducted by Deng et al that showed shorter hospital stay and improved range of motion of shoulder, elbow, wrist, knee, ankle joint with the help of physiotherapy mobility training [9]. In the present case study, the initial assessment at 0 week, revealed limited ROM in affected joints, including the right and left shoulder joint and right elbow joint. However, upon reassessment, after 8 weeks of interventions, improvements were observed in the ROM measurements. The range of motion increased in left and right shoulder abduction, shoulder flexion and right elbow flexion indicating positive outcomes from the passive ROM therapy provided.

Furthermore, scarring is a significant concern in paediatric burn injuries due to its potential impact on the child's physical, psychological, and social well-being. This case study observed that application of therapeutic ultrasound aided in scar formation improvement, which is in consistent with a study done by Francesca Liuzzi et al. which indicated the effectiveness and safety of using therapeutic ultrasound in scar healing in their study [10]. The Vancouver Scar Scale was employed to assess the quality of burn scars, with scores of 9 on the front and right arm and 10 on the left arm during the initial examination. After the 8 week duration of physiotherapeutic management involving ultrasound therapy, the scores decreased to 6 on the front side, 7 on the right arm and 8 on the left arm.

Addressing anxiety, in context to burn injuries, is of significant importance in the overall care and recovery of the subjects. Burn injuries can be extremely traumatic, leading to intense physical and emotional pain. The findings of this study showed that physiotherapy interventions helped in reducing subjects' anxiety levels due to burn, which is in line with a study conducted by T. Najafi Ghezeljeh et al., which demonstrated that music and massage therapy contributed to decreased pain and anxiety intensity in a burn patient [11]. During the initial examination, the subject exhibited moderate anxiety with a burn and anxiety scale score of 28. Following the physical therapy management, the subject's anxiety decreased to borderline anxiety with a specific burn and anxiety scale score of 10.

Overall, the subject experienced improvements in functional outcomes ultimately leading to an enhanced quality of life. However, it is important to note that this study is a single case study, limiting its generalization to a larger population. Further research involving larger sample sizes and control groups is needed to establish a stronger evidence base and determine optimal interventions for burn subjects. Additionally, the long-term effects of physiotherapeutic interventions beyond the 8 week period were not explored in this study, highlighting the need for extended follow-up and monitoring of burn subjects' rehabilitation progress.

In conclusion, this study provides valuable insights into the effectiveness of physiotherapeutic interventions in a post-surgical burn subject. This case study demonstrated improvements in range of motion, scar tissue quality, pain reduction, and overall quality of life following the interventions. These findings emphasize the significance of comprehensive physiotherapy in burn rehabilitation and highlight the need for further research to establish optimal treatment strategies and long-term outcomes for this vulnerable population.

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