Standard of Care: Inpatient Physical Therapy Management of Patients with Burns

ICD 9 Codes:

942 Burn of trunk
943 Burn of upper limb, except wrist and hand
944 Burn of wrist(s) and hands(s)
945 Burn of lower limb(s)
946 Burn of multiple specified sites
948 Burns classified according to extent of body surface involved
949 Burn, unspecified
991 Effects of reduced temperature (i.e. frostbite)
695.1 Erythema multiforme, Toxic epidermal nectolysis (TEN)
Others may also apply (e.g. various extensive wound diagnoses)

Case Type / Diagnosis:

This standard of care applies to patients who are admitted to the Brigham and Women's Hospital (BWH) for the management of their burns. A burn injury can be sustained through a variety of sources including thermal/heat (flame, flash, scald, and steam), chemicals, radiation, sunlight, or electricity. Burn-like injuries can also occur due to reduced temperature [frostbite [8]] and as a reaction to medication [toxic epidermal necrolysis—TEN, also known as Steven-Johnson syndrome [8]]. In addition to injury to the skin, patients can also sustain damage to their respiratory system due to inhalation injuries that require intensive management. Burns can range from a minor injury covering 1% of a patient's body to a severe burn covering 90%-100% of the total body surface area. Patients are also admitted to BWH for ongoing reconstructive procedures in the months and years following a burn injury; these can include contracture releases, grafting procedures, muscle flaps, and debridements. The burn service at BWH can also manage patients with extensive non-healing wounds [i.e. such as those that occur from Graft vs. Host disease (GVHD) involving the skin]; refer to the integument standard of care for details.

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Burns are classified by depth of injured tissue as detailed in the table below:

	Appearance	Area Affected	Sensation	Blanching	Wound Closure
First Degree (Superficial)	Pink or red; May be dry or moist	Epidermis	Intact, painful	Present	Typically heals within 3-5 days with no scarring
Second Degree (Superficial partial thickness)	Bright pink or red, wet, blisters	Epidermis and portion of dermis	Intact, painful and sensitive to change in temperature and exposure to air or touch	Present	Heals by re-epithelialization in 10-14 days; typically no scarring or grafting needed
Second Degree (Deep Partial Thickness)	Mottled, red and waxy white; wet	Epidermis and deeper portion of dermis	Variable; may be intact with areas of diminished sensation	Diminished	Heals by re-epithelialization in 14-21 days or longer; scarring is likely if burn in > 30% TBSA
Third Degree (Full Thickness)	White or tan; dry and leathery, non-pliable	Entire epidermis and dermis	Painless; may be sensitive to deep pressure; anesthetic to temperature	Absent	Skin graft required
Fourth Degree	May be charred or dry	Deep soft tissue damage to fat, muscle, tendon, fascia, nerve and/or bone	Absent	Absent	Excision of necrotic tissue and skin graft required, possible amputation in some cases

- The following criteria categorize patients that require care at a specialized inpatient burn center [15]:
  - Patients who sustain partial thickness burns greater than 10% of total body surface area (TBSA) require more intensive medical monitoring and intervention due to effects of significant edema. They are more likely to have mobility and movement issues and will require early PT/OT intervention.
  - Patients who sustain burns of the neck and face are at higher risk for significant edema that can cause respiratory distress. They may need to be intubated for an extended period.
  - Patients who sustain burns involving the hands, feet, genitalia, perineum, or major joints are at higher risk for decreased healing, hypertrophic scarring and contractures. These parts of the body are crucial for normal function and require specialized intervention for best recovery.
  - Patients who sustain full-thickness (i.e. third degree) burns are at significantly higher risk for decreased healing, hypertrophic scarring and contractures. They almost always need complex wound care and surgical intervention. These patients also require intensive nutritional support and hemodynamic monitoring. They require more specialized, intensive PT and OT intervention for optimal progress.
  - Patients with electrical burns, including lightning injury are at risk for cardiac symptoms such as arrhythmias due to the electrical current. In addition, the path of an electrical current can cause deeper, less obvious injuries that can affect vital organs and deep muscles. Frequent surgical debridement as well as hemodynamic monitoring is essential.

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- Patients who sustain chemical burns require more intensive management. The chemical can be absorbed into the skin and cause damage for an extended period of time. These patients often require specialized cleansing procedures and close monitoring.
- Patients with inhalation injuries often require ventilation and intensive pulmonary hygiene.
- Patients who sustain a burn and also have pre-existing medical disorders require more intensive management and frequently have slower progress. Their medical status can complicate management and prolong recovery.
- Patients with burns and concomitant trauma (such as fractures) in which the burn poses the greatest risk of morbidity or mortality require higher intensity of care.
- Patients with burn injuries who will require special social, emotional, or long-term rehabilitative intervention.[15]

Phases of Burn Care:

Burn management can be divided into three phases. An interdisciplinary approach including Physical and Occupational Therapist involvement is essential in all three phases [9]:

- **Emergent or Resuscitative Phase**

  Medical Assessment
  - Assess for the presence of an inhalation injury and secure airway
  - Assess size of burn (TBSA) using the **"Rule of Nines:"**
    - Head = 9%
    - Trunk = 36%
    - Upper extremity = 9% each
    - Perineum = 1%
    - Lower extremity = 18% each
  - Assess and classify of burn depth
  - Begin fluid resuscitation
  - Maintain body temperature (prevent hypothermia)
  - Achieve cardiopulmonary stability
  - Establish adequate tissue perfusion and monitor for compartment syndrome. Escharotomies may be necessary to prevent tissue, muscle and nerve death
  - Debridement of necrotic, dirty, or infected wounds

  Physical Therapy Management

  Intervention may focus on positioning until patient is stabilized.
- **Acute Phase:** (after emergent phase and until wounds are closed)

  Medical Management
  - Ongoing wound debridement, assessment for evolution of wound depth
  - Skin grafting (when indicated—use of autograft, allograft, cultured skin)
  - Infection control and rigorous wound care
  - Nutritional support sufficient to meet wound-healing needs

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Physical Therapy Management
Comprehensive intervention addressing positioning, stretching, mobility, ongoing skin assessment and scar management, education, balance, endurance, respiratory conditioning

- **Rehabilitative Phase Medical Goals**: (follows acute phase until scar maturation)
  - Surgical release of contractures
  - Nutritional support
  - Reconstructive or plastic surgery to maximize function and cosmesis

Physical therapy Management
Intensive rehabilitation program—scar management, range of motion (ROM) and stretching with techniques, mobility training as needed, education re: self-management

Indications for Treatment:

Patients with burn injuries involving superficial, partial, or full thickness skin with potential extension into fascia, muscle, or bone, and at risk for contracture and scar formation will require intervention. These burns can result in impairments such as loss of joint ROM, peri-articular or intra-articular joint changes, sensory loss, edema, pain, impaired ventilation/aerobic capacity, impaired activity tolerance, impaired balance, coordination, and strength. They can cause functional deficits such as impaired mobility, difficulty performing activities of daily living (ADL's) and instrumental activities of daily living (IADL's). Patients also lack knowledge about wound healing, self-care, and coping/adjustment strategies following burn injury.

Contraindications / Precautions for Treatment:

Contraindications:

- Presence of femoral IV access
  - venous access will make repetitive hip ROM contraindicated as it can cause introduction of bacteria into access
  - arterial access precludes any hip ROM as it increases the risk of arterial bleeding from site

Precautions:

- Unstable heart rate, blood pressure, respiratory status and fevers of more than 102 degrees can prevent Physical Therapy intervention. Both tachycardia and fevers can be a result of the patient's hypermetabolic state and do not always preclude intervention. Patients with burns have a harder time maintaining a stable body temperature due to the presence of open wounds [19]
- ROM precautions and restrictions must be known prior to starting each treatment session, due to one or more of the following reasons:
  - Cultured Skin (CEA or "cultured epidermal autografts")—ROM to area of CEA is contra-indicated for the first 10-14 days and prior to initial takedown to avoid graft disruption
  - Autologous skin grafts—Differentiate between full and partial thickness grafts. Joints crossed by grafts are immobilized for 5-7 days
  - Flaps—total immobilization to promote viability; await physician clearance prior to resuming ROM

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- Infection control: All caregivers should practice universal precautions. Additional measures are taken for burn patients. Due to the fact that their burns cause a large number of open wounds, they are at higher risk for infection.
    - Full burn precautions: All staff must wear a gown, gloves, surgical mask, and hat when working with a patient who does not have their wounds fully dressed
    - Partial Burn Precautions: Gloves and a gown are required for any patient
    - It is necessary to practice excellent hand hygiene and cleaning of all equipment used during treatment

Evaluation:

Medical History: Pertinent past/ongoing medical issues that may impact response to treatment

History of Present Illness/Hospital Course:

- Mechanism of injury
- Nature of burn (thermal, chemical, electrical, allergic reaction)
- Extent of Burn (TBSA, location, depth)
- Burns that cross joints
- Evidence of inhalation injury (singed eyebrows, nasal hairs, soot in sputum)
- Relevant medications (e.g. pressors, fluid resuscitation, pain medications, sedation)

Social History:

- Specifics about home environment, architectural barriers
- Family support, normal role in family
- Baseline level of function
- Adaptive equipment use
- Psycho/social issues, substance abuse issues

Medications:

- Pressors
- Fluid resuscitation
- Pain medications (Fentanyl, Morphine, Dilautid, Neurontin, NSAIDS)
- Sedation (Versed, Fentanyl)
- Topicals for care of wounds (See Appendix)

Examination:

Integument

- Risk for scarring is related to depth of burn and rate of healing. Also certain skin types are more prone to scarring, such as skin of darker pigment[20]
- Determine if use of cultured skin cells (CEA) is planned and refer to special precautions and considerations that apply[17]
- Assessment of scarring[16]

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Musculo-skeletal

- ROM is measured using goniometric measurements
- Strength is measured using manual muscle test (MMT) if patient is able to participate in exam. If not, assess functional and spontaneous motion by observation and reassess more specifically later in course
- Posture/alignment can be assessed by observation when patient is able to sit or stand. Asymmetries can indicate scarring
- Functional mobility (assistive devices as needed)**:**
    - appropriate assistive devices
    - pre-ambulation equipment such as tilt table
    - lift devices as needed

Neuro-muscular

- Pain**:** (if able to communicate by pain scale; if not assess by monitoring heart rate, blood pressure, respiration rate, facial grimacing, gesturing). Communicate with nursing re: need for additional pain medication, instruct patient in deep breathing and relaxation for pain control. Plan treatment sessions to coincide with either pre-medication or the ability to receive bolus pain medication. Engage the patient and the staff in coordinating the optimal time for intervention with their pain control regime. In the acute phase of treatment, patients are often receiving a large number of narcotic medications which can be sedating and keep patient obtunded for an extended period which impacts components of Physical Therapy treatment. Intervention at this time is often more passive (i.e. passive ROM, positioning). The medication, Fentanyl, is frequently used during dressing changes and therapy interventions due to its short half-life. Later in the course, patients are changed to oral narcotics and NSAIDS.
- Sensation**:** Assess patients ability to perceive light touch as burns heal and as patient is able to communicate [7]

Cardio-Pulmonary

- Respiratory status including presence of inhalation injury and the level of ventilatory support required, presence of rhonchi or rales

Mental Status and Cognition

- Level of consciousness
- Orientation
- Safety judgment
- Ability to follow direction

Psychological Considerations

- Coping with altered body image and appearance
- Learning style
- Patient's goals for recovery
- Impact of psychiatric disorders on participation and recovery[22]

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Assessment:

Problem List (Impairments and dysfunctions)

- Impaired range of motion/risk for contractures
- Edema
- Risk for hypertrophic scarring
- Impaired mobility
- Impaired respiratory status
- Impaired endurance
- Impaired integument
- Impaired balance
- Need for optimal positioning
- Knowledge deficit re: aspects of burn rehab and self-care
- Pain

Prognosis: Over the last thirty years, medical technology and interventions have improved, increasing the survival rate of patients with large percentage burns. Between 1995 and 2005, 94.4% of patients admitted to a burn center survived [6, 18]. This being said, prognosis can be highly variable. Some considerations that impact prognosis are depth of burn, surface area involved, type of burn (chemical and electrical may increase length of stay), presence of an inhalation injury, significant psychiatric or substance abuse issues and co-morbidities such as history of smoking, diabetes. "Risk factors most strongly associated with death are increasing total body surface area (TBSA), inhalation injuries and increasing age".[21]

People with first degree (superficial partial thickness such as sunburn) are rarely admitted to the hospital. Those with second degree burns (partial thickness) may be admitted for several days for local wound care. Those with deeper burns (full thickness) may require surgical grafting which increased length of stay and risk of long-term disability. An inhalation injury may require an extended period of intubation.

Attaining a high quality of life is a challenge for burn survivors. Once they are medically stable and healed, the goal of regaining their previous roles and activities takes intensive work, motivation and guidance of healthcare professionals. Little research has been done on quality of life after a burn injury, but a study done in 2005 showed that "participants in the present study had little or no difficulty resuming functional mobility and self-care activities of daily living" [22]. This study suggests that patients with larger burns can "achieve functional independence and reasonable quality of life in the long term" [22].

Suggested Goals:

Timeline is highly variable depending on prognosis noted above. Goals should be objective and measurable.

1. ROM WNL
2. optimal positioning
3. appropriate splints/positioning devices, pressure garments/pads
4. minimize hypertrophic scarring
5. strength at least 3/5 in affected areas, 3-5/5 in unburned areas

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6. optimal posture (upright, symmetrical)
7. independent mobility with appropriate device
8. tolerates full PT treatment with adequate ventilation and oxygen saturation
9. demonstrates knowledge of healing process, activity progression, independent exercise/stretching program

Treatment Planning / Interventions

Established Pathway	___ Yes, see attached.	_X_ No
Established Protocol	___ Yes, see attached.	_X_ No

Interventions most commonly used for this case type/diagnosis.

This section is intended to capture the most commonly used interventions for this case type/diagnosis. It is not intended to be either inclusive or exclusive of appropriate interventions.

- ROM, stretching
    1. AROM attempted, specific measurements
    2. stretching
- Positioning:
    1. appropriate splints, bivalve casts (prefabricated and custom)[12]
    2. other devices (slings, foam wedges, pillows, rolls)
    3. bed options can assist with positioning and intervention (high/low, reverse trendelenburg, knee and head elevation)
    4. can use bedside tables and slings to position UE's in abduction as axillae are at especially high risk for contractures
- Scar management is managed in several ways:
    1. Compression
        a. Ace wraps or elastic tubular bandage (e.g. Tubigrip®) use can be initiated immediately for edema control pre and post grafting
        b. Pressure garments (e.g. Jobst®) and silicone gel sheeting use can be started three weeks after grafting procedure and when open areas are less than nickel-sized
    2. Scar massage can be initiated when areas are fully healed and skin is no longer “translucent”
    3. Positioning/sustained stretch can be initiated at any time
- Mobility progression using appropriate DME, lifts
- Endurance activities
- Respiratory conditioning
- Structured schedule

Frequency & Duration: These patients are typically seen 5-7 times weekly. Duration is dependent on extent and severity of burns and need for intensive acute care intervention. Length of stay can vary from 2-3 days for a localized burn (such as partial thickness burn to hand or foot) to many weeks to months for a high percentage, deep burn that requires multiple surgical procedures and prolonged intubation.

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Patient / family education:

- Burn patient and family education book is available from the Trauma Nurse Specialist
- Discussion with patient and family re: Physical Therapy involvement with patient and expected progression
- Discussion with patient and family re: optimizing patient's independent mobility and self-care and providing the appropriate level of assistance to the patient
- Instruction of patient and family in appropriate exercises and activities with written exercise program and exercise/activity log
- Discussion of longer term issues common following a burn injuries
    1. phases of burn healing, estimated time line, risk of scarring
    2. ways to minimize scarring and contracture
    3. proper management of pressure garments, DME
    4. proper skin care and protection

Recommendations and referrals to other providers:

- Occupational Therapy
- Speech Therapy
- Social Work/Care Coordination
- Psychiatry
- Orthopedic Technician
- Translators
- Outside resources for the measurement and fit of compression garments (e.g. Compass Healthcare 617/566-6772)
- Outside Resources such as support groups (e.g. the Phoenix Society). Visits by known burn survivors that can talk with patient and family can be arranged by the social worker

Re-evaluation

Standard Time Frame-10 days or less if appropriate
Other Possible Triggers- A significant change in signs and symptoms, new surgical procedure, significant progress in PT intervention requiring re-assessment

Discharge Planning

Commonly expected outcomes at discharge:

- Return to independent function
- Maximal range of motion
- Minimal hypertrophic scarring
- Patient is independent with exercise program and skin management

Transfer of Care (if applicable)

- Rehabilitation facility
- Home with services
- Home with family assistance
- Home with independent program

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- Upon discharge, most patients are seen regularly at the Burn Clinic which is a wound care clinic staffed by nurses. They can facilitate referral to other services as needed. These patients are sometimes seen in the BWH outpatient rehabilitation clinic by Physical Therapy and Hand Therapy

Authors: Alisa G. Finkel PT
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Reviewed by: Barbara Odaka PT
Melanie Parker PT
Merideth Donlan PT

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APPENDIX TOPICAL BURN THERAPY (from Stefan Strojwas, BWH Nurse Educator, 7CD)

AGENT	DESCRIPTION	ACTIONS	ADVANTAGES	DISADVANTAGES	CONSIDERATIONS
Acticoat	Silver impregnated gauze	Antimicrobial	Can remain in place up to 3 days so decreases dressing time	Needs to be applied wet	-deep dressing moist with sterile water -monitor pt. Temperature due to wet dressings
Bacitracin	Bactericidal ointment	Gram +/- effective	Nonpainful and easy to apply	May be nephrotoxic	Monitor serum BUN and Cre
Betadine	Iodine complex, solution or ointment	Antimicrobial for gram +/-	Effective against organisms not controlled by Silvadene	May cause metabolic acidosis, can be painful to apply	May form crust around would which needs to be removed
Biobrane	Bio-synthetic wound covering, good for partial thickness burns, clean wound beds	Controls water loss & minimizes bacteria growth	Decreases pain, remains in place until re-epithelialization occurs. Allows for movement	Wound surface must be debrided and clean before application	Need to observe for signs/symptoms of infection and adherence
Cadaver Skin	Temporary wound covering	Reduces heat and water loss, controls pain	Easy to apply, prepares wounds for grafting	Not always available	Need to observe for infection
Fine Mesh Gauze	Sterile	Carrier for ointments/creams. Gentle debridement when removed	Allows for specific placement	May stick to wounds causing pain	

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AGENT	DESCRIPTION	ACTION	ADVANTAGES	DISADVANTAGES	CONSIDERATIONS
Gentamycin	Antibiotic cream	Antibiotic, effective against many organisms	Effective against pseudomonas	May be nephrotoxic	Monitor serum BUN and Cre
Lotrimin	Antifungal cream	Interferes with fungal DNA	Can be used with other topicals	May cause burning and redness	Affected area must be fully covered
Neomycin	Antibiotic solution	Wide spectrum, used after grafting	Combats most organisms, easy to apply	Can cause shivering	Monitor Cre, Check pt. For temperature changes
Pig skin	Temporary wound covering	Reduces heat & water loss, reduces pain, prepares wound for grafting	Readily available, easily applied	May cause sensitivity reaction	Observe for infection
Silvadene (Silver sulfadiazine	Antimicrobial cream	Binds to organism's cell membranes and interferes with DNA	Wide spectrum for gram +/-. Does not delay eschar separation	Shallow penetration, depresses granulocyte formation	Check for sulfa allergies,
Silver nitrate	5% silver salt antimicrobial solution	Antimicrobial	Easy application, delays granulation hypertrophy	Shallow penetration, stains and stings. May cause hyponatremia, hypochloremia, hypocalcemia	Keep dressings wet, check daily electrolytes
Sulfamylon Mafenide Acetate	Water based bacteriostatic crem	Effective against gram +/- organisms	Effective against pseudomonas, penetrates thick eschar	May cause metabolic acidosis and rash, can be painful, delays eschar separation	Monitor blood gases and electrolytes

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AGENT	DESCRIPTION	ACTION	ADVANTAGES	DISADVANTAGES	CONSIDERATIONS
Transcyte Dermagraft-TC	Bi-layer, temporary skin substitute	Contains active human wound healing factors	Controls pain, retains heat and moisture, stimulates wound re-epitheliazation	Wound must be debrided prior to placement. Has no antibacterial effects	Monitor for adhesion and infection
Triple antibiotic ointment	Mixture of neomycin, polymixin, bacitracin	Bactericidal for gram +/- organisms for partial thickness burns	No pain on applications	Cannot be used for full thickness burns	Monitor for infection
Vitamin A&D	Petroleum based ointment	Fat soluble vitamins assist with healing	Moisturized newly healed tissue	No antibacterial effects	
Xeroform bismuth tribromphenate	Yellow substance on Vaseline impregnated gauze	Debrides and protects wounds, donor sites and grafts	Conforms to wound, nontoxic	Can stick to wounds, no antibacterial	Careful removal from new grafts essential

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