Clark Burn Center Nursing Resource Manual

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Introduction

Burn Team

Burn team should be multidisciplinary (MDT) in nature, including but not limited to:

- Pre-hospital: from scene are Fighter Fighters, Paramedics, EMT, air care personnel
- Hospital: Patient, Family members, Physicians, Nurse Practitioner, Nurses, Nursing Assistant, Respiratory Therapy, Occupational Therapy, Physical Therapy, Dietician/Nutritionist, Pharmacist, Surgeons, Social Work, Case Management, Quality & Performance Specialist, Child Life Specialist, Psychiatry, Infection Prevention Specialist, Chaplain, Interpreter, Housekeeping
- Post Hospital: Home Health Care, Social work, Teachers (peds patients), Burn clinic staff, Burn Foundation CNY, burn support groups, out-patient physical/occupational therapy, Phoenix Society: Survivors offering assistance in recovery (SOAR), Phoenix World Burn Congress annual conference, Burn camps, American Burn Association.
- Burn Patients are primarily admitted to 6E (ICU), 5B, 11E, & 12F (ICU)

American Burn Association (ABA) Introduction

What is the ABA?

- The ABA is a professional organization dedicated to improving the lives of everyone affected by burn injury
- The American Burn Association and its more than 2,000 members worldwide dedicate their efforts and resources to promoting and supporting burn-related research, education, care, rehabilitation, and prevention
- Members include physicians, nurses, occupational and physical therapists, researchers, social workers, fire fighters, and hospitals with burn centers
- Multidisciplinary membership enhances the ability to work toward common goals with other organizations on educational programs

Why is ABA Burn Center Verification Such a Big Deal?

- There are just 64 ABA verified burn centers of the approximately 120 burn care facilities across the U.S.
- Clark Burn center is one of just three ABA verified burn centers in New York State
- Verified burn centers are centers that take quality and excellence to the highest level. Becoming verified means that the Clark Burn Center is held to high standards similar to Magnet Status for nursing.
- Verified burn centers have met rigorous standards for organizational structure, personnel qualifications, facilities resources and medical care services.
- Members of the burn center team have specialized training in the care, treatment and rehabilitation of burn injured patients.
- The American Burn Association (ABA) Verified Burn Centers are accredited to ensure optimal care, recovery, rehabilitation, reintegration and support for the burn injury survivor and families of the survivor.
- Recertification happens every 3 years

ABA Referral Criteria

Guidelines for Burn Patient Referral

(Advice on Transfer and Consultation)

- These guidelines are designed to be used to aid in clinical decision making. If you have sustained a burn injury, please seek medical advice from a medical professional.
- Local and regional infrastructure, resources, and relationships may determine the necessity and timeliness of burn center referral.
- These guidelines are not meant to be definitive care recommendations. They may facilitate building the proper referral network within the local healthcare community.

	Immediate Consultation with Consideration for Transfer	Consultation Recommendation
Thermal Burns	• Full thickness burns • Partial thickness ≥10% TBSA* • Any deep partial or full thickness burns involving the face, hands, genitalia, feet, perineum, or over any joints • Patients with burns and other comorbidities • Patients with concomitant traumatic injuries • Poorly controlled pain	• Partial thickness burns <10% TBSA* • All potentially deep burns of any size
Inhalation Injury	• All patients with suspected inhalation injury	• Patients with signs of potential inhalation such as facial flash burns, signed facial hairs, or smoke exposure
Pediatrics (≤14 years, or <30 kg)	• All pediatric burns may benefit from burn center referral due to pain, dressing change needs, rehabilitation, patient/caregiver needs, or non-accidental trauma	
Chemical Injuries	• All chemical injuries	
Electrical Injuries	• All high voltage (≥1,000V) electrical injuries • Lightning injury	• Low voltage (<1,000V) electrical injuries should receive consultation and consideration for follow-up in a burn center to screen for delayed symptom onset and vision problems

Burn Severity Determination

SUPERFICIAL

- Dry, red, easily blanching, sometimes painful
- Example: Sunburn
- NOT counted in calculations of total burn surface area (TBSA)

SUPERFICIAL PARTIAL THICKNESS

- Moist, red, blanching, blisters, very painful
- Counted in calculations of total burn surface area (TBSA)

DEEP PARTIAL THICKNESS

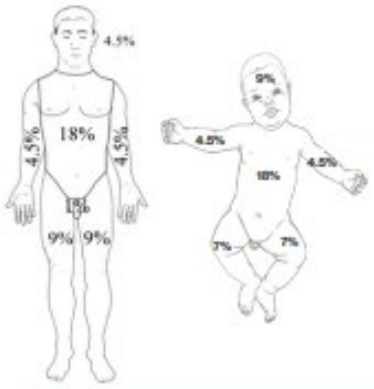
- Drier, more pale, less blanching, less pain
- Counted in calculations of total burn surface area (TBSA)

FULL THICKNESS

- Dry, leathery texture, variable color (white, brown, black), loss of pin prick sensation
- Counted in calculations of total burn surface area (TBSA)

Percentage Total Body Surface Area (TBSA)

"RULE OF NINES"



"PALMAR METHOD"

Patient's entire palmar surface is approximately 1%

For more information visit **ameriburn.org/burnreferral**

https://academic.oup.com/bjs/advance-article-abstract/doi/10.1093/bjs/znac038/6775267?redirectedFrom=fulltext

American Burn Association | 311 S. Wacker Drive, Suite 950 | Chicago, IL 60606 | ameriburn.org

ABA Verification Criteria

Verification Criteria 2021 Dev Update

#	Criterion	Criterion Level
1.1. (1)	The burn center hospital is currently accredited by the Joint Commission or equivalent.	1
1.2. (2)	The burn center has an identifiable medical and administrative commitment to the care of the patient with burns.	1
1.3. (3)	The burn center hospital maintains a specialized unit dedicated to acute burn care.	1
1.4. (4)	The burn center has designated ICU capable beds.	1
1.5. (5)	The burn center maintains an appropriate policy and procedure manual that is easily accessible by the burn team and reviewed regularly with appropriate documentation by the burn center director and the nurse leader.	1
1.6. (6)	Multi-disciplinary patient care conferences are held and documented at least weekly.	1
1.7. (7)	Renal dialysis, radiological services, including computed tomography scanning, and clinical laboratory services are available 24 hours per day.	2
1.8. (10)	The burn center hospital's policies and procedures regarding the use of allograft tissues are in compliance with all federal, state, and The Joint Commission (or equivalent) requirements, and, when feasible and appropriate, with standards of the American Association of Tissue Banks (or equivalent).	1
1.9. (11)	The burn center has liaisons with a designated trauma center to coordinate care of patients with multi-trauma.	1
2.1 (12.)	The burn center must have a sufficient volume of acute burn admissions on an ongoing basis.	1
2.2. (13.)	Majority of admissions to the burn center are burn patients.	1
2.3. (15.)	The burn center maintains and average daily census of 3 or more patients with acute burns.	1
2.4. (16.)	No more than 5% of all patients with a primary diagnosis of a burn injury are admitted to another service per year (e.g. geriatrics, pediatrics, medicine).	1
2.5 (88.)	No more than 5% of hospital admissions are transferred to another acute care facility.	1
3.1 (26.)	The burn center director is a licensed surgeon (MD or DO) with board certification by American Board of Surgery or American Board of Plastic Surgery (or equivalent for international burn centers in which case a surgeon must co-manage the center).	1
3.2 (27.)	The burn center director has completed a one-year fellowship in burn treatment and/or has experience in the care of patients with acute burn injuries for two or more years during the previous five years.	1
3.3 (28.)	The burn center director has ABLS (or equivalent) training.	1
3.4 (29.)	The burn center director is responsible for the direction of burn center administrative functions.	1
3.5 (30.)	The burn center director is responsible for the creation of policies and procedures within the burn center specifying all aspects of care for burned patients.	1
3.6 (31.)	The burn center director is responsible for ensuring that all burn center team members conform to the burn center's locally established policies and procedures.	1
3.7 (33.)	The burn center director is responsible for the approval of privileges for physicians participating in the burn service based on medical staff credentialing process.	1
3.8 (34.)	The burn center director is responsible for the development and active participation in internal and external continuing medical education programs in the care and prevention of burn injuries.	1
3.9 (36.)	The burn center director is responsible for the communications on a regular basis with referring physicians regarding patients who have been transferred.	1
3.10 (37.)	In the event that the burn center director is not available, an accessible burn center staff surgeon is designated for administrative or clinical decisions.	1
3.11	The burn center director regularly participates in regional, national or international burn	1

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#	Criterion	Criterion Level
(38.)	meetings.	
3.12P	The burn center director demonstrates CME or evidence of education in pediatric burn care annually (i.e. Pediatric Advanced Life Support, pediatric topic review, local regional meetings, invited speakers, journal clubs etc.)	2
3.13 (39.)	The burn center director has directed the total burn care of 50 or more acutely burned patients annually over a three-year period.	1
3.14P	The burn center director is involved in at least 25 pediatric cases annually.	2
3.15 (40.)	The burn center director demonstrates ongoing involvement in burn-related research, community education, continuing medical education, prevention efforts and local regional or national burn advocacy.	1
4.1 (41.)	Burn surgeons are licensed surgeons with board certification by American Board of Surgery, American Board of Plastic Surgery or equivalent based on review by Verification Committee.	1
4.2 (42.)	Burn surgeons have demonstrated expertise in burn treatment, by two or more years of mentored experience in the management of patients with acute burn injuries.	1
4.3 (45.)	Each burn surgeon has participated, including primary decision-making, in the care of sufficient acutely burned patients annually.	1
4.4 (43.)	Each burn surgeon must participate in continuing medical education in burn treatment.	1
4.5 (44.)	Burn surgeons have had ABLS (or equivalent) training.	2
4.6 (49.)	Assigned burn center medical staff are promptly available on a 24-hour basis.	1
4.7 (46.)	The burn center maintains an on-call schedule for residents, qualified healthcare professionals and burn surgeons for continuous responsibility of burn patients.	1
4.8 (109)	For centers that have residents involved in care of the burn patients an orientation program is provided for new residents.	2
4.9P	Burn center has physicians who are board certified or eligible for certification in one of the following: · pediatric critical care medicine · pediatric surgery or surgical critical care	2
4.10P	Burn surgeons have pediatric burn fellowship training or mentored clinical experience in pediatric burn surgery.	2
4.11P	All burn surgeons demonstrate CME in pediatric care or equivalent internal burn education in pediatric burn care annually.	2
5.1 (47.)	All advanced practice providers who are routinely responsible for the care of burn patients conform to burn center criteria documenting appropriate training, patient care experience, continuing medical education, and commitment to the care of the burned patient.	1
5.2 (48.)	All advanced practice providers participating in the burn service are credentialed by the hospital medical staff credentialing process and are approved by the burn center director.	1
6.1 (52.)	The burn nurse leader or equivalent is a licensed Registered Nurse (RN) with a minimum of a baccalaureate degree in nursing.	2
6.2 (53.)	There is at least one nurse leader or equivalent who is administratively responsible for the nursing care provided within the burn center.	1
6.3 (54.)	A burn nurse leader or equivalent must have sufficient experience in burns and nursing leadership to lead the staff and manage the nursing program of the burn center.	1
6.4 (55.)	A metric-based staffing system is in place to determine nurse-staffing needs for patients in the burn center.	2
6.5 (56.)	There is a burn-specific competency-based training and continuing educational program for all nurses assigned to the burn center.	1
6.6 (57.)	The burn nurse leader or equivalent routinely participates in multi-disciplinary patient care rounds and there is dissemination to the nursing staff.	1
6.7 (58.)	The burn nurse leader or designee attends burn-specific continuing educational opportunities at least once every two years. These requirements can be addressed by attending regional, national or international burn meetings; being an ABLS Instructor; and being involved in the ABA.	1

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#	Criterion	Criterion Level
6.8 (59.)	There is nurse representation within burn center quality improvement processes.	1
6.9P	Nurses have pediatric certification or participate in pediatric specific continuing education or equivalent internal burn programming in pediatric burn care annually.	2
7.1 (60.)	A comprehensive rehabilitation program is designed for burned patients within 24 hours of admission.	1
7.2 (61.)	Physical and occupational therapists in the burn center are appropriately licensed in their respective disciplines and demonstrate ongoing continuing education in burn rehabilitation.	1
7.3 (62.)	Therapy staffing is based upon burn center inpatient and therapy specific outpatient activity with at least one designated full-time equivalent burn physical therapist and one occupational therapist, but more depending on center volume.	1
7.4 (63.)	Inpatients with an active rehabilitation plan must have care delivered as prescribed in the evaluation which should determine duration and frequency based on acuity, include goals, outcome and plan for follow up.	1
7.5 (64.)	Burn therapy services are provided 7 days per week for care of burn inpatients.	1
7.6 (65.)	Burn therapists participate in multi-disciplinary rounds and quality improvement.	1
7.7 (66.)	Therapists assigned to the burn center must show evidence of ongoing burn specific competency training.	1
7.8 (67.)	Therapists must participate in burn-related CEU activity on a regular basis.	1
7.9P	Therapy staff participates in pediatric specific continuing education.	2
7.10P	Therapy department has pediatric age-appropriate therapeutic equipment.	2
8.1 (68.)	Social service consultation is available to the burn service, as needed.	1
8.2 (69.)	A dietitian with adequate critical care and burn experience is available on a daily basis for consultation.	1
8.3P	A pediatric dietitian with adequate critical care and burn experience is available on a daily basis for consultation.	2
8.4 (70.)	A pharmacist with adequate critical care and burn experience is available on a 24-hour basis.	1
8.5P	A pediatric pharmacist with adequate critical care and burn experience is available on a 24-hour basis.	2
8.6 (71.)	Respiratory therapists are available for the assessment and management of patients on the burn service on a continuous basis.	1
8.7 (73.)	A psychologist or psychiatrist is available to the burn service on an as needed basis.	1
8.8P (72.)	A child life/recreational therapist is available for children cared for in the program.	2
8.9 (106)	Burn team members are provided with a minimum of one regional, national or international burn-related continuing education opportunity annually OR demonstrate annual participation in internal educational process specific to burn care.	1
8.10 (107)	A burn center orientation and ongoing continuing education program documents staff competencies specific to age appropriate care and treatment of burn patients, including critical care, wound care, and rehabilitation.	1
9.1 (102)	The burn center develops ongoing quality improvement projects to create a culture of safety and promote value-based programs.	1
9.2P	The pediatric burn center develops ongoing quality improvement projects to create a culture of safety and promote value-based programs.	2
9.3 (94.)	Sufficient QI documentation is available to verify problems, identify opportunities for improvement, resolve the problem and provide loop-closure.	1
9.4	The burn center director is responsible for direction and active participation in the burn center	1

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#	Criterion	Criterion Level
(35.)	Quality & Process Improvement Programs.	
9.5 (92.)	The burn center director is responsible for the risk adjusted quality improvement program.	1
9.6 (93.)	A multidisciplinary burn center committee participates in the quality improvement program, meets at least quarterly and is integrated into the hospital QI structure.	1
9.7 (97.)	All life-threatening complications and deaths are discussed in a forum that includes specialist peers outside the core burn team, and are classified in a systemic fashion, so as to identify opportunities for improvement	1
9.8 (95.)	The morbidity and mortality conferences are held at least monthly.	1
9.9 (96.)	The morbidity and mortality conferences include specialist peer staff members other than those practicing in the burn center.	1
9.10 (98.)	The morbidity and mortality conferences include documentation of loop closure.	1
9.11 (99.)	Clinical team members involved in the direct care of the burn patients participate in at least 50% of the morbidity and mortality conferences.	1
9.12 (100)	Sentinel events are discussed in a timely manner at multi-disciplinary intensive reviews during which time a non-involved peer leads a discussion with all involved parties and areas for improvement and loop closure are identified.	1
9.13 (101)	The burn program conducts audits of their benchmarked outcomes data (using available resources such as NBR, UHC, NHSN, or CMS) at least quarterly.	1
9.14 (103)	The burn center has policies for infection control with regular monitoring for hospital-acquired infections, multi-drug resistant organisms and compliance.	1
9.15 (104)	The burn center participates in the ABA's National Burn Repository or other equivalent data collection/analysis tool and submits data every year.	1
9.16 (105)	The burn center database includes all patients who are admitted to the burn center hospital for burn care.	1
9.17P	Evidence of at least one on-going QI metric in pediatric specific rehabilitation issues (i.e., garment compliance, splint compliance, rates of contracture, success with release, etc.)	2
10.1 (17.)	The burn center has written guidelines for the triage, treatment, and transfer of burned patients from other facilities.	1
10.2 (32.)	The burn center director is responsible for the coordination with regional EMS authorities regarding triage and transport of burn patients.	1
10.3 (18.)	The burn center maintains access to an EMS system for the transport of patients with burns from referral sources within the service area.	1
10.4 (19.)	The burn center offers input into the quality improvement of pre-hospital care of burn patients.	1
11.1 (20.)	Written protocols developed with input from the burn center guide the care of burn patients in the emergency department.	1
11.2	Emergency department is available 24/7.	2
11.3P	Emergency physicians are board certified or eligible for certification by an appropriate emergency medicine board according to current requirements in pediatric emergency medicine.	2
11.4P	Evidence of collaborative clinical practice and educational activities between the burn program and the emergency services.	2
11.5P	Emergency service representative serves as a liaison to the burn quality care program.	2
12.1 (14.)	Burn centers caring for critically ill patients must demonstrate facilities, protocols and personnel specific to the care of critically ill patients.	1
12.2P	The burn program works collaboratively with the pediatric critical care providers, although all significant therapeutic decisions involving burn patients are approved by the burn program, and the burn program is made aware of all significant clinical changes.	2
12.3P	A PICU representative serves as a liaison to the burn quality improvement program.	2
12.4P	There are protocols for burn specific care in collaboration with the PICU.	2

#	Criterion	Criterion Level
12.5P	PICU works in concert with the Burn Center Director to develop protocols for intensive care.	2
13.1 (8)	The burn center has timely access to operating rooms.	1
13.2 (9)	A dedicated OR team with burn experience is available for the burn operating theatre.	2
13.3 (51.)	A dedicated anesthesia team with burn experience is available for the burn operating theatre.	2
13.4P	For centers admitting patients under 2 years of age and requiring surgery, an anesthesiologist with certification in pediatric anesthesiology is available 24/7.	2
13.5P	A pediatric anesthesiology representative serves as a liaison to burn quality improvement program.	2
14.1 (89.)	Physiatrist consultation is available.	2
14.2 (90.)	The burn center coordinates with local and/or regional rehabilitation centers for inpatient rehabilitation.	1
14.3 (91.)	The burn center coordinates with local and/or regional outpatient facilities for ongoing outpatient therapy needs of patients needing rehabilitation after discharge.	1
15.1 (74.)	The burn center has appropriate outpatient facilities, including adequate facilities for wound care.	1
15.2 (75.)	The outpatient facility must be able to provide for appropriate pain management during wound care.	2
15.3 (80.)	The burn center provides appropriate multi-disciplinary follow-up.	1
15.4 (76.)	For continuity of care, staffing of the outpatient area should be by multi-disciplinary experienced burn team members, approved by the burn center director and nurse leader.	2
15.5 (86.)	The burn center provides access to outpatient social service, pharmacist and dietary consultations, as needed.	2
15.6 (77.)	A representative of the outpatient staff participates in weekly multi-disciplinary burn conferences and the burn center QI program.	1
16.1 (79.)	The burn center provides coordinated transition of care to the outpatient status.	1
16.2 (78.)	The burn center follows >75% of all patients who transition to the outpatient setting.	1
16.3 (83.)	A burn therapist is available in the outpatient clinic to provide services, including follow up, as needed.	1
16.4 (81.)	The burn center provides brief psychological screening/intervention.	1
16.5P (82.)	The burn center provides evaluation of patient developmental status (for children).	2
16.6 (84.)	The burn center provides timely access to reconstructive surgery.	2
16.7 (85.)	The burn center facilitates access to peer-to peer and burn survivor resources for patient and family support. Provides access to peer support (such as but not exclusively a Phoenix Society SOAR program).	1
16.8 (87.)	The burn center provides access to vocational counseling.	2
16.9 P	Burn center has established relationship with one of the many camps and demonstrated active attempts at recruitment for children to attend.	2
17.1 (111)	Burn program is involved in local, regional, national, or international prevention outreach efforts.	1
17.2 (108)	The burn program regularly participates in regional education related to burn care.	1
17.3	The burn center participates regularly in community burn outreach programs.	2

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#	Criterion	Criterion Level
(110)		
18.1 (112)	Burn Center multi-disciplinary staff, under the leadership of the burn center director, work locally, regionally, or nationally to advocate for burn related health care issues.	2
18.2 (113)	The burn center multi-disciplinary staff is involved in research (including basic science, clinical, industry-sponsored, QI, multi-center) and presents posters or oral presentations at hospital based, regional national or international meetings.	2
19.1 (21.)	The burn center interfaces with regional trauma centers to coordinate care of patients with multiple injuries and to develop regional educational programs, disaster planning and advocacy efforts.	2
19.2 (22.)	The burn center has a written Mass Casualty Disaster Plan for the triage and treatment of those patients burned in a mass casualty incident occurring within its service area.	1
19.3 (23.)	The Mass Casualty Disaster Plan is reviewed and updated as needed and on an annual basis by EMS representatives and the burn center director.	2
19.4 (24.)	There are current (within the past 3 years) written memoranda of understanding with other burn centers regarding secondary triage.	1
19.5 (25.)	The burn center must maintain accurate and up to date contact information for burn surgeons and managers on the ABA website.	2

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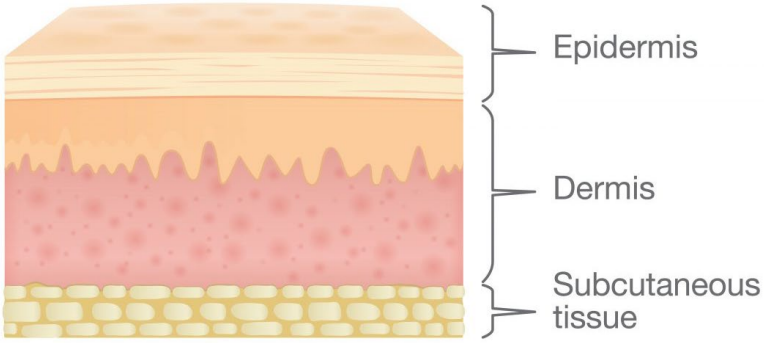
Understanding Your Skin

Skin is the largest organ in the body

Skin protects our body, helps keep our body at the right temperature, and allows us to have the sense of touch

Layers of the Skin



Epidermis: This is the layer you can see with your eyes. This layer is made up of many small cells that keep your body protected. You also have skin cells called Melanin. Melanin gives your skin its special color. The darker your skin is, the more melanin you have. The thickness of this layer depends on where it is located on the body. For example, it's thinnest on the eyelids (half a millimeter). It's thickest on the palms of the hands and soles of the feet (1.5 millimeters).

Dermis: This layer you cannot see, it is under the epidermis. This is where your nerve endings, blood vessels, oil glands, and sweat glands are. The nerve endings in the dermis tell you how things feel when you touch them. The nerve endings send messages to your brain and nervous system. This is how you know that a dog's fur is soft and ice is cold. The dermis is also filled with many blood vessels. Your blood vessels keep your skin healthy by bringing oxygen and nutrients.

Subcutaneous tissue: This is the deepest layer of the three layers of skin. This layer is made up of fat that helps your body stay warm. In this layer there are hair follicles, which is where each tiny piece of hair starts to grow.

Functions of The Skin

- Provides a protective barrier against mechanical, thermal, chemical, and physical injuries
- Prevents loss of moisture
- Reduces harmful effects of UV radiation
- Acts as a sensory organ (touch, detects temperature)
- Helps regulate temperature
- An immune organ to detect infections
- Production of vitamin D

Understanding Burn Injuries

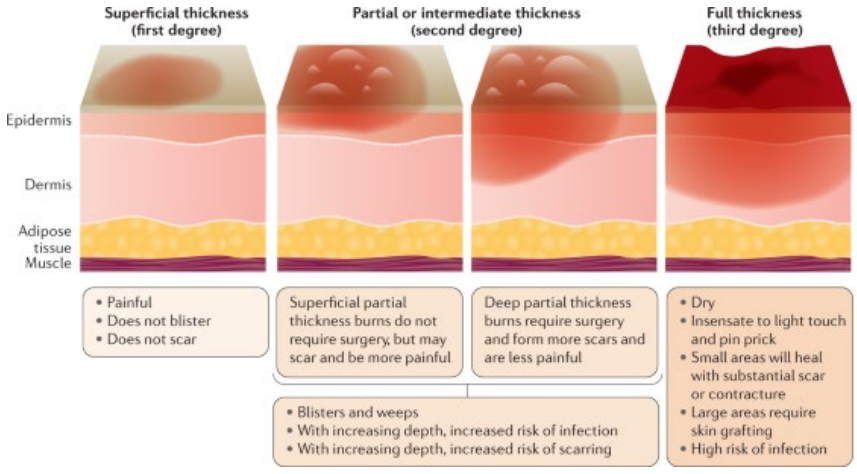
When the skin gets burned by something hot like water or oil, or by a chemical, some of the skin layers get injured. Injured layers of the skin cannot carry out their functions like normal, which puts burn patients at an increased risk of low body temperature (hypothermia), infection, and dehydration. The doctors will talk to you about which layers of your skin were injured.

Depending on what layers of your skin were injured, depends on what type of management the skin will need to help it heal. In general, the more layers of skin injured the longer time it will take to heal. The burn team will also use different types of bandages (dressings) depending on which layers of skin were injured.

The skin may take time to heal, and that's okay! Every body is different. At first the skin may look pink, this is the new skin starting to grow. Over time the skin will continue to heal. The final healed skin may always look a little different than the way the skin looked before the burn injury.

Depth of Burn

Figure 1 below shows different burn depths. You can see in first degree burns; the injury is only in the epidermal layer. There are two types of second-degree burns. In superficial second-degree burns, the injury goes through the epidermis (top layer) and partially through the dermis below. In deep second-degree burns, the injury goes through the epidermis and deeper into the dermis below. In third degree burns, the injury goes through the epidermis, and fully through the dermis, to the adipose tissue below.



Burn Depth with Photo Examples

- Superficial Burns (First Degree)
  - Think sunburn
  - Not used in TBSA calculation (skin is technically intact)
  - No blisters
  - Often very painful



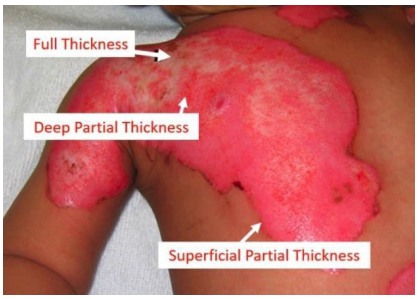
- Superficial Partial Thickness (Second Degree)
  - Blisters present
  - Very painful
  - Capillary refill is intact (blanchable)
  - Wound bed is pink

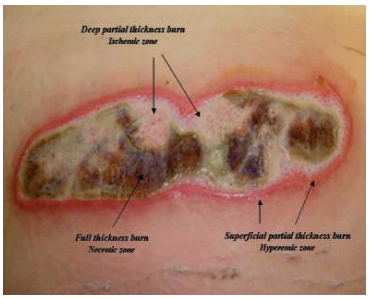



- Deep Partial Thickness (Second Degree)
  - Same as superficial second degree with following differences:
    - Sensation may be decreased in deepest areas
    - Capillary refill is intact but sluggish
    - In general, wound bed is more red/red-white appearing than superficial partial thickness
    - Skin feels tight


- Full Thickness (Third Degree)
  - Dry (no blisters)
  - Insensate
  - Body hair will readily fall off as hair follicles deep in the dermal layer have been damaged
  - Not blanchable


- Mixed Thickness
  - Most patients will present with a mix of different burn depths





Types of Burns: Etiology/Mechanism of Injury

Thermal

- Flame —Flame burns comprise 50% of adult burns. They are often associated with inhalational injury and other concomitant trauma. Flame burns tend to be deep dermal or full thickness

- Scald —About 70% of burns in children are caused by scalds. They also often occur in elderly people. The common mechanisms are spilling hot drinks or liquids or being exposed to hot bathing water. Scalds tend to cause superficial to superficial dermal burns (see later for burn depth)

- Contact —In order to get a burn from direct contact, the object touched must either have been extremely hot or the contact was abnormally long. The latter is a more common reason, and these types of burns are commonly seen in people with epilepsy or those who misuse alcohol or drugs. They are also seen in elderly people after a loss of consciousness; such a presentation requires a full investigation as to the cause of the blackout. Burns from brief contact with very hot substances are usually due to industrial accidents. Contact burns tend to be deep dermal or full thickness.

Electrical

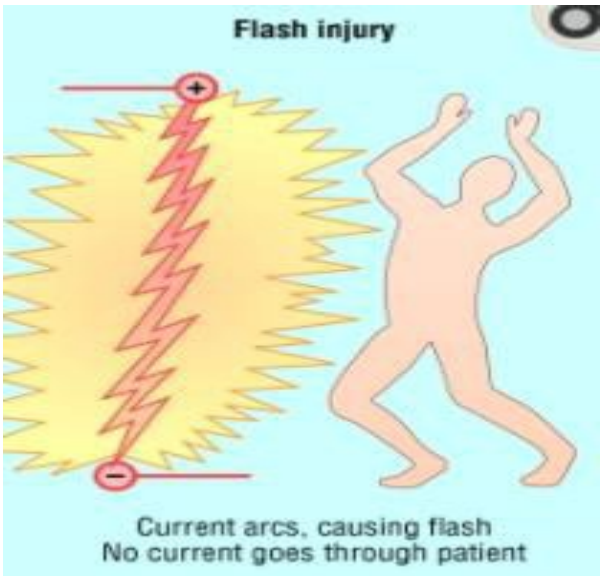
- 3-4% of burn unit admissions are caused by electrocution injuries. An electric current will travel through the body from one point to another, creating “entry” and “exit” points. The tissue between these two points can be damaged by the current. The amount of heat generated, and hence the level of tissue damage, is equal to $0.24 \times (\text{voltage})^2 \times \text{resistance}$. The voltage is therefore the main determinant of the degree of tissue damage, and it is logical to divide electrocution injuries into those caused by low voltage, domestic current, and those due to high voltage currents.

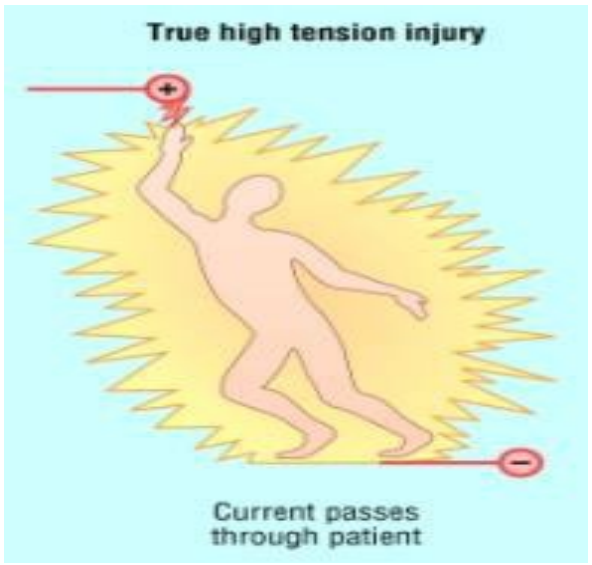
- **High voltage** injuries can be further divided into “true” high tension injuries, caused by high voltage current passing through the body, and “flash” injuries, caused by tangential exposure to a high voltage current arc where no current actually flows through the body. A particular concern after an electrical injury is the need for cardiac monitoring. There is good evidence that if the patient's electrocardiogram on admission is normal and there is no history of loss of consciousness, then cardiac monitoring is not required. If there are electrocardiographic abnormalities or a loss of consciousness, 24 hours of monitoring is advised.

- **Flash injury** can occur when there has been an arc of current from a high-tension voltage source. The heat from this arc can cause superficial flash burns to exposed body parts, typically the face and hands. However, clothing can also be set alight, giving rise to deeper burns. No current actually passes through the victim's body.

- **Domestic electricity**: Low voltages tend to cause small, deep contact burns at the exit and entry sites. The alternating nature of domestic current can interfere with the cardiac cycle, giving rise to arrhythmias.

- **“True” high tension injuries** occur when the voltage is 1000 V or greater. There is extensive tissue damage and often limb loss. There is usually a large amount of soft and bony tissue necrosis. Muscle damage gives rise to rhabdomyolysis, and renal failure may occur with these injuries. This injury pattern needs more aggressive resuscitation and debridement than other burns. Contact with voltage greater than 70 000 V is invariably fatal.

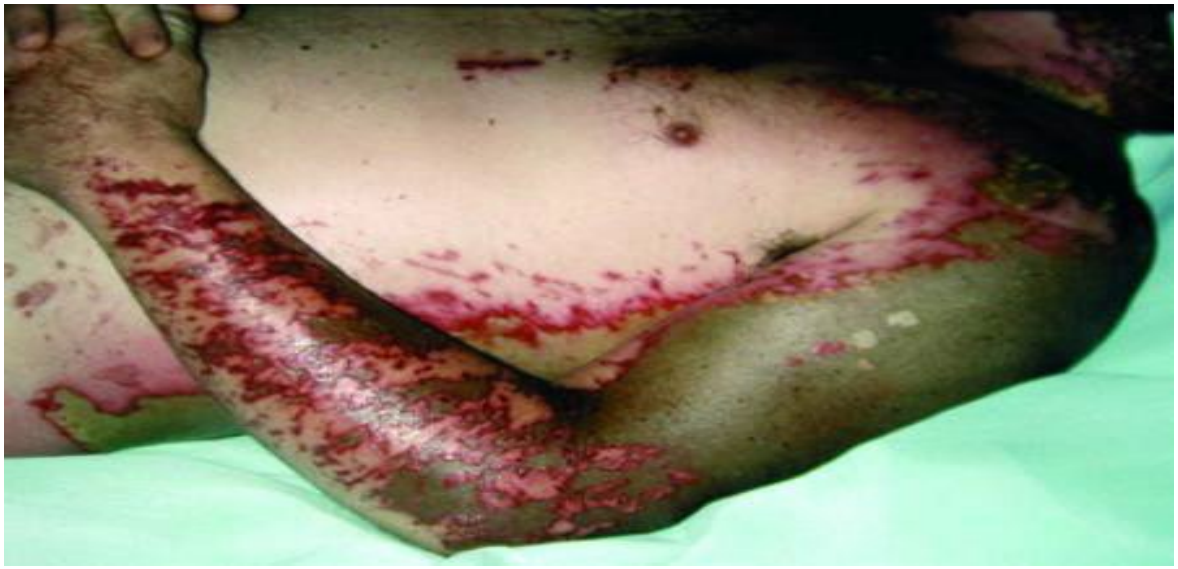




Chemical

- The initial management of all chemical burns is the same irrespective of the agent. All contaminated clothing must be removed, and the area thoroughly irrigated. This is often best achieved by showering the patient. This has been shown to limit the depth of the burn. Litmus paper can be used to confirm removal of alkali or acid. Eye injuries should be irrigated copiously and referred to an ophthalmologist

- Certain industrial agents may require specific treatments in addition to standard first aid. Hydrofluoric acid, widely used for glass etching and in the manufacture of circuit boards, is one of the more common culprits. It causes a continuing, penetrating injury and must be neutralized with calcium gluconate, either applied topically in a gel or injected into the affected tissues.



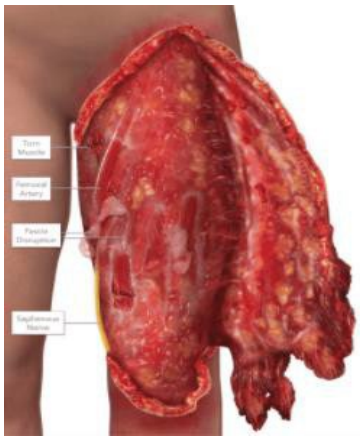
Frostbite/Cold Injuries

Friction Burns (Road Rash)



Degloving

- Degloving, also called avulsion, is a type of severe injury that happens when the top layers of your skin and tissue are ripped from the underlying muscle, connective tissue, or bone. It can affect any body part, but it's more common in the legs. Degloving injuries are often life-threatening. This is because they involve large amounts of blood loss and tissue death.
- There are two main types of degloving. They're known as open degloving and closed degloving.
- Closed degloving injuries aren't always visible. This makes them harder for doctors to diagnose. In some cases, they can cause a bruise, but this is usually the only visible symptom. A 2017 review Trusted Source estimated that up to one-third of people with closed degloving injuries may have a delayed diagnosis.
- Many closed degloving injuries involve a force that separates the top layer of skin and tissue from deeper tissues, leaving a space under the skin. These spaces are known as Morel-Lavallée lesions. The lesions can fill with lymph fluid, blood, and fat.
- Despite their different appearance, closed degloving injuries are caused by the same types of accidents that lead to open degloving injuries




Stages of Wound Healing

- **Hemostasis**: Immediately after injury to the skin, small vessels within the wound constrict to provide hemostasis for 5-10 minutes
    - Platelet aggregation in the damaged vessels trigger the clotting cascade and the release of cytokines
    - The resulting fibrin matrix stabilizes the wound and provides a provisional scaffold for the wound healing process

- **Inflammation**: Begins shortly after injury occurs for approximately 3 days post injury (except in the presence of infection or other factors associated with impaired wound healing)
    - Key aspects of this phase are **increased vascular permeability** and **cellular recruitment**
        - Mast cells degranulate which releases vasoactive substances
        - Vasoactive substances make small vessels more permeable to molecular and cellular mediators of the inflammatory response
        - The increased vessel permeability results in accumulation of plasma and cellular elements extravascularly. We see this clinically, as edema or swelling.

- **Epithelialization**: refers to basal cell proliferation and epithelial cell migration occurring in the fibrin bridgework inside a clot
    - Proliferation continues until individual cells are surrounded by cells of a similar type
    - In a clean surgical wound, the epithelial cells migrate downward to meet deep in the dermis
        - Migration ceases when this layer is repaired
    - This process is usually completed within 48 hours following surgery
        - This superficial layer of epithelium creates a barrier to bacteria and foreign bodies, however it is a very thin, easily traumatized, and has little tensile strength
    - The process of epithelialization is challenged in wounds that are not primarily closed or require healing by secondary intention.
    - Epithelialization can be further impaired by the presence of biofilm (peel) and dead cells on the wound edge or base
        - Biofilm is an extracellular matrix that is produced by bacteria that irreversibly binds to the wound base, promoting inflammation and impairing epithelialization

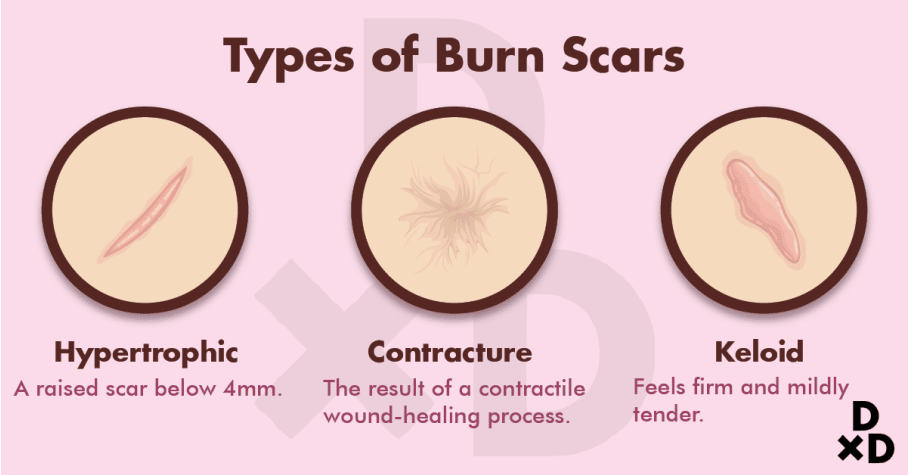
Burn wound with biofilm (aka: peel)

- **Fibroplasia**: fibroblast proliferation, accumulation of ground substance, and collagen production occur
    - Fibroblasts are present in the wound within 24 hours of injury and predominate by the 10th post-operative day
        - They attach to the fibrin matrix of the clot, multiply, and produce the materials needed to make up ground substance
        - Fibroblasts also produce contractile proteins which have the ability to contract the wound by the 5th day post-operative
    - Fibroblasts also synthesize collagen, which is the primary structural protein of the body
        - Collagen production begins on the 2nd post-operative day but it is secreted in the form of a gel

devoid of strength
        - Maximum collagen production does not begin until post op day 5 and continues for at least 6 weeks
        - The developing collagen matrix stimulates the production of new blood vessels
    - Granulation tissue begins to form as the result of the combined production of collagen and growth of capillaries

- **Maturation**: Key elements of the maturation stage include collagen cross linking, collagen remodeling, wound contraction, and repigmentation
    - The tensile strength of any wound is directly proportional to the amount of collagen present
        - Collagen types I and III predominate in the skin layers
    - The maximum strength of the healed wound depends on the interconnection of collagen subunits
    - Approximately 80 percent of the original strength of the tissue is obtained by 6 weeks post op
    - The diameter and morphology of collagen fibers do not have the appearance of normal skin until approximately 180 days
    - Wounds slowly continue to get stronger, but may never actually achieve 100 percent of their previous strength

Scarring



A **hypertrophic scar** is a thickened, wide, often raised scar that develops where skin is injured. Scars are common during the wound healing process, but a hypertrophic scar is a result of an abnormal response to a trauma or injury.

In certain people, body cells called myofibroblasts produce too much collagen during healing. This can happen simply as a result of a person's skin type and healing tendencies. More commonly, overproduction of collagen occurs when a wound is infected or inflamed, under a great deal of tension or motion (such as in injuries over a joint) or left to heal without stitches.

The scars are a frequent complication of burn injuries, but can also form after piercings, cuts, or even acne. Hypertrophic scars are similar to keloid scars but tend to be milder and don't grow beyond the boundaries of the original skin injury.

The scars aren't dangerous or life-threatening. They can be itchy and painful, but more often are simply a cosmetic issue. Some people seek treatment to minimize the appearance of the scar. There isn't an officially established treatment regimen for hypertrophic scars, but a variety of treatments can help get rid of the scar more quickly

Before treating a hypertrophic scar, it's important to differentiate it from a similar type of scar called a keloid.

A keloid (say "KEE-loyd") is a scar that grows bigger and wider than the original injury. Keloids most commonly grow on the breastbone, shoulder, upper chest and back, earlobes, and face. Keloids do not become cancer. But they can be bothersome or painful enough that you seek treatment. Keloids often grow back after treatment.
It's possible to prevent a keloid from forming if you take steps to protect the skin after it is damaged.

What causes a keloid?

- Keloids can form where the skin is damaged, such as by a surgery cut, a piercing, a burn, chickenpox, or acne. Thick tissue grows up and out from the healing area, making the scar bigger than the original injury. For some people, even a scratch can lead to keloids.
- Keloids do run in families, and they rarely grow in light-colored skin. Experts think that keloids may be linked to a gene that is linked to dark skin pigment.

What are the symptoms?

- Keloids look like firm, raised, hard scars. They grow larger over time. Their colors vary from slightly pink to very dark.
- Keloids can rub against your clothes and become irritated, itchy, or painful. When exposed to the sun, they may turn darker than the rest of your skin. The dark color may stay.

How is it treated?

- There is no sure cure for keloids, but treatment sometimes improves how they look and feel. It is common for keloids to grow back after treatment.
- When trying to treat a keloid, your doctor may need to use more than one type of treatment.
- Based on a keloid's size and location, and how soon it is treated, your doctor may:
    - Freeze it. This is called cryotherapy. It is best used for small keloids, such as from acne. Cryotherapy can lighten the skin.
    - Inject it with medicine. A corticosteroid is the most commonly used medicine for reducing keloids. It is most likely to work well with cryotherapy or right after surgery.
    - Other medicines may improve keloids. These include verapamil, fluorouracil, bleomycin, and interferon alfa-2b shots. They are not as well studied as corticosteroid shots, but your doctor may recommend trying one. They are most likely to work when used with another treatment.
    - Cut it away. Surgery is sometimes used to remove larger keloids. But removing keloids can lead to more keloids. So, it's important to treat the area after surgery. Treatment may include laser or medicine injections.
    - Cover the area with a silicone gel bandage after surgery. You can buy these at most drugstores. Keep the silicone bandage on the skin for 12 to 24 hours a day for 2 to 6 months. Your doctor will tell you when you can stop treatment.
    - Keep pressure on it with a wrap or bandage.
    - Radiation tends to be reserved as a last option for treating keloids. There is a chance that it can cause cancer.

How can you prevent keloids?

- If you tend to get keloids, it's best to avoid body piercings, tattoos, or any surgery you do

not need. Keloids can grow after these procedures.

- To prevent keloids after a minor skin injury, start treating it right away. This may help it heal faster and with less scarring. Using the following tips to treat the area may help prevent keloid growth.
    - Cover a new wound with a thin layer of petroleum jelly, such as Vaseline, and a nonstick bandage.
    - Hold the bandage in place with tape so that there is even pressure on the wound.
    - Wash the area with soap and water every day.

After a wound is healed over, use a silicone gel bandage. Keep even pressure on the area. This may prevent keloid growth. Keep the bandage on the skin for 12 to 24 hours a day for 2 to 3 months. (It takes 3 months for a keloid to grow).

Keloid scars are smooth, hard, benign growths that also form when scar tissue grows excessively. Even your doctor may have difficulty telling the difference between a hypertrophic scar and a keloid, but it's important to distinguish them because the treatment may be different.

In general, **hypertrophic scars**:

- are raised, but rarely more than 4 millimeters above the skin
- are red or pink in color
- can develop anywhere on the body

On the other hand, **keloids** usually:

- are raised more than 4 millimeters from the skin
- grow beyond the boundaries of the original incision or wound
- are pink to purple in color
- evolve and grow over time
- form on the earlobes, shoulders, cheeks, and chest above the sternum

**** Both scars tend to occur more commonly in darker skin types. Hypertrophic scars tend to be easier to treat than keloids, which have a high recurrence rate despite treatment.

Burn **scar contracture** is the tightening of the skin after a second- or third-degree burn. When skin is burned, the surrounding skin begins to pull together, resulting in a contracture. It needs to be treated as soon as possible because the scar can result in restriction of movement around the injured area.

Primary Survey

- The initial assessment of the burn patient is identical to other trauma: recognize and treat life/limb-threatening injuries first. Many patients with burns also have associated trauma.

- First responders should not let the burn overwhelm them. Immediate priorities are outlined by the American College of Surgeons Committee on Trauma and promulgated in the Advanced Trauma Life Support Course.

- The Primary survey consists of the following:
    - **A**irway maintenance with cervical spine protection
    - **B**reathing and ventilation
    - **C**irculation and Cardiac Status with hemorrhage control
    - **D**isability, Neurological Deficit and Gross Deformity assessment
    - **E**xposure and Environmental Control (Completely undress the patient, Examine for associated injuries and maintain a warm Environment.)

Airway

- Is airway patent (Yes or No)
- Can patient protect their airway (Yes or No)
- Is inhalation injury suspected (Yes or No)
- Does the patient have facial burns and edema (Yes or No)
- Is the burn > 20% TBSA (Yes or No)

**** If the above criteria are met it's strongly recommended the patient is intubated, even if the GCS is 15**

Breathing & Ventilation

- Breath sounds
- Assess chest wall for burns and other injuries as well as compliance
- Circumferential full-thickness burns of the trunk and neck may impair ventilation and must be closely monitored.
- Start 100% O2 on NRB
- Carbon Monoxide (CO) poising, think enclosed space (house, automobile)
    - Check ABG & carboxyhemoglobin levels
    - Start on 100% NRB mask for at least 3 hours
- Upper airway = Above the glottis
- Lower airway = below the glottis
- **Presence of singed nasal hair or facial burns are not an automatic intubation**
- Inhalation injury may be from extreme heat or related to toxins from smoke (cyanide poisoning)
- Evaluate with bronchoscopy
- It is important to recognize that respiratory distress may be due to a non-burn condition such as a pre-existing medical condition or a pneumothorax from an associated injury

Circulation & Cardiac Status

- Assess circulation by blood pressure, pulse rate, and skin color (of unburned skin).
- A continuous cardiac monitor and pulse oximeter on an unburned extremity or ear will allow for continued monitoring.
- Increased circulating catecholamines after burns often elevate the adult heart rate to 100-120 bpm. Heart rates above this level may indicate hypovolemia from an associated trauma, inadequate oxygenation, unrelieved pain or anxiety.
- Abnormal cardiac rhythms may be due to electrical injuries, underlying cardiac abnormalities or electrolyte imbalances.
- Insert a large bore intravenous catheter (through unburned skin, if possible).
- Burns greater than 20% should have 2 large bore, indwelling venous catheters, especially during transport.
- In the pre-hospital and early hospital settings, prior to calculating the Total Body Surface Area (TBSA) burned, the initial fluid rates for patients with visibly large burns are based on patient age:
  - 5 years old and younger: 125 ml Lactated Ringers (LR) per hour
  - 6-13 years old: 250 ml LR per hour
  - 14 years and older: 500 ml LR per hour
- Definitive calculation of hourly fluid rates (termed “adjusted fluid rates”) occurs during the secondary survey.
- Circulation in a limb with a circumferential or nearly circumferential full-thickness burn may become impaired by edema formation.
- Typical indicators of compromised circulation, (pain, pallor, paresthesia) may not be reliable in a burned extremity. On the other hand, the absence of a radial pulse below (distal to) a full-thickness circumferential burn of the arm suggests impaired circulation. Doppler examination can also be used to confirm the circulation deficit.
- Acute burns do not bleed. If there is bleeding, there is an associated injury—find and treat the cause. Associated trauma may also cause internal bleeding, resulting in tachycardia and hypotension. Maintain a high index of suspicion if the injury mechanism suggests possible non-burn trauma (i.e. fall, motor vehicle crash).

***** If there are any rings/necklace/watches/bracelets/piercings remove them as soon as possible. As the swelling increases these can become tourniquets**.

Disability, Neurologic Deficit, and Gross Deformity

- Typically, the patient with burns is initially alert and oriented. If not, consider associated injury, carbon monoxide poisoning, substance abuse, hypoxia, or pre-existing medical conditions.
- Begin the assessment by determining the patient’s level of consciousness using the AVPU method:
  - A – Alert
  - V – Responds to verbal stimuli
  - P – Respond only to painful stimuli
  - U – Unresponsive
- The Glasgow Coma Scale (GCS) is a more definitive tool used to assess the depth and duration of coma and should be used to follow the patient’s level of consciousness.

Exposure & Environmental Control

- Expose and completely undress the patient, examine for major associated injuries and maintain a warm environment.
- Stop the burning process. Again, make sure you remove all jewelry/body piercing, clothing, shoes, and diapers. If any material is adherent to the skin, stop the burning process by cooling the adherent material, cutting around it and removing as much as possible.
- Contact lenses, with or without facial burns, should be removed before facial and periorbital edema develops.
- Chemicals may also adhere to the lenses and present further problems. Corneal abrasions are common and can easily be assessed using the woods lamp in addition to an ophthalmology consult.
- Anyone with facial burns or injury should consider an ophthalmology consult.
- For smaller size injuries (i.e., ≤5% TBSA) cool the burn briefly (3-5 minutes) with water. Never use ice or cold water. Prolonged application of cold compresses pose the risk of wound and body hypothermia.
- Wound hypothermia reduces blood flow to the damaged area and may deepen the injury. Systemic hypothermia (core temperature less than 95o F / 35.0 C) may also increase the depth of the burn injury by vasoconstriction, decrease enzymatic activity, depress muscle reflexes, interfere with clotting mechanisms and respiration, and may cause cardiac arrhythmias and death.
- This is especially true in a pediatric patient who has limited ability to maintain core body temperature.
- Maintaining the patient's core body temperature is a priority. The EMS transport vehicles and treatment room should be warmed and, as soon as the primary survey is complete, the patient should be covered with dry sheets and blankets to prevent hypothermia.
- Warmed intravenous fluid (37–40℃) may also be used for resuscitation. If the burn has already been cooled, remove all wet dressings and replace with a clean, dry covering.
- Apply blankets to re-warm the patient.
- Tar and asphalt burns are an exception to brief cooling. These products must be thoroughly cooled with copious amounts of cool water (Burn Wound Management).
- For chemical burns, brush dry chemicals off the patient and then irrigate with copious running water. Immediate irrigation is essential in chemical injuries (see Chemical Burns).

****** For females check and remove any tampon present.**

Secondary Survey

The secondary survey does not begin until the primary survey is completed and after initial fluids are started. A secondary survey includes the following elements:

- History (injury circumstances and medical history)
- Accurate pre-injury patient weight & height
- Complete head-to-toe evaluation of the patient
- Determination of percent Total Body Surface Area burned
- Apply adjusted fluid rates after TBSA determination
- Obtain indicated labs and X-rays
- Monitor fluid resuscitation
- Pain and anxiety management
- Psychosocial support
- Wound care

The burn is often the most obvious injury, but other serious and even life-threatening injuries may be present. Thorough history and physical examination are necessary to ensure that all injuries and preexisting diseases are identified.

A. History

The circumstances surrounding the injury can be very important to the initial and ongoing care of the patient. Family members, co-workers and Emergency Medical Services personnel can all provide information regarding the scene of the incident and the circumstances surrounding the injury. Document as much detail as possible.

Every attempt should be made to obtain as much information from the patient as possible prior to endotracheal intubation. The following list includes important details to consider:

- Flame Injuries
    - Did the fire occur inside or outside?
    - Was the patient found inside a smoke-filled room?
    - How did the patient escape?
    - If the patient jumped out of a window, from what floor did he/she jump?
    - Were others killed at the scene?
    - Did the clothes catch on fire? How long did it take to extinguish the flames?
    - How were the flames extinguished? Was gasoline or another fuel involved? Was there an explosion?
    - Was there a blastinjury?
    - Was the patient unconscious at the scene?
    - Was there a motor vehicle crash? What was the mechanism of injury (T- bone, head-on, roll- over, other)
        - How badly was the car damaged?
        - Was there a car fire?
        - Was the patient trapped in the burning vehicle?
        - How long was he/she trapped?
    - Are there other injuries?
    - Is there any evidence of a fuel or chemical spill that could result in a chemical burn as well as thermal injury?
    - Are the purported circumstances of the injury consistent with the burn characteristics (i.e., is abuse a possibility)?

- Scald Injuries
  - How did the burn occur?
  - What was the temperature of the liquid?
  - What was the liquid?
  - How much liquid was involved?
  - What was the thermostat setting of the water heater?
  - Was the patient wearing clothes?
  - How quickly were the patient's clothes removed?
  - Was the burned area cooled? With what? How long?
  - Who was with the patient when the burn took place?
  - How quickly was care sought?
  - Where did the burn occur (e.g., bathtub, sink)?
  - Are the purported circumstances of the injury consistent with the burn characteristics (i.e., is abuse a possibility)?
    - Pediatric scalds are sometimes due to child abuse. In addition to obtaining the patient history, it is helpful to ask EMS or other pre-hospital providers what they observed at the scene.

History of non-accidental burns

- Evasive or changing history
- Delayed presentation
- No explanation or an implausible mechanism given for the burn
- Inconsistency between age of the burn and age given by the history
- Inadequate supervision, such as child left in the care of inappropriate person (older sibling)
- Lack of guilt about the incident
- Lack of concern about treatment or prognosis

"Doughnut sign" in a child with immersion scalds. An area of spared skin is surrounded by burnt tissue. The tissue has been spared as it was in direct contact with the bath and protected from the water. This burn pattern suggests non-accidental injury

- Chemical Injuries
  - What was the agent(s)?
  - How did the exposure occur?
  - What was the duration of contact?
  - What decontamination occurred?
  - Is there a Material Safety Data Sheet (MSDS) available?
  - Is there any evidence of ocular involvement?
  - Is there any evidence of illegal activity?

- Electrical Injuries
  - What kind of electricity was involved – high voltage/low voltage, AC/DC (alternating current)?

- What was the duration of contact?
- Was the patient thrown or did he or she fall?
- Was there loss of consciousness?
- Was CPR administered at the scene?

Medical History

The "**AMPLET**" mnemonic is useful for key history elements:

- **A** – Allergies. Drug and/or environmental
- **M** – Medications. Prescription, over-the-counter, herbal, illicit, alcohol.
- **P** – Previous illness (diabetes, hypertension, cardiac or renal disease, seizure disorder, mental illness) or injury, past medical history, pregnancy
- **L** – Last meal or drink
- **E** – Events/environment related to the injury
- **T** – Tetanus and childhood immunizations Tetanus is current if given within five years for patients with burns. More information on recommendations for administration of tetanus is provided in Appendix II Tetanus Prophylaxis

Pre-Burn Weight

Adjusted fluid rates are based on the patient's pre-burn weight. If the patient has received a large volume of fluid prior to calculating the hourly fluids, obtain an estimated of the patient's pre-injury weight from the patient or family member if possible.

Head to Toe Examination

- Head/maxillo-facial/mouth/ears
- Cervical spine and neck
- Chest
- Abdomen
- Perineum, genitalia
- Back and buttocks
- Musculoskeletal
- Vascular
- Neurological

Determining the Severity of a Burn

Burn severity depends primarily on the depth of injury and body surface area involved. However, other factors such as age, the presence of concurrent medical or surgical problems, and complications that accompany burns of functional and cosmetic areas such as the face, hands, feet, major joints, and genitalia must be considered. Pre-existing health and/or associated injuries also impact morbidity and mortality.

Even a small burn can have a major impact on the quality of life of a burn survivor. For example, a 1% TBSA hand burn can have a devastating effect on future hand function. Individual emotional and physiological responses to a burn vary and should be taken into consideration when determining the severity of injury in relation to the survivor's perception of their own quality of life post-burn.

Depth of Burn

Burns are classified by degrees, or as partial vs. full-thickness injuries. The depth of tissue damage due to a burn is largely dependent on four factors:

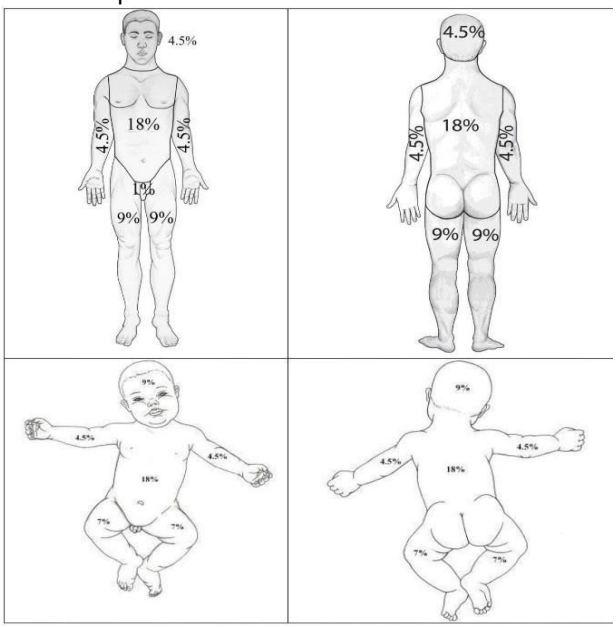
- Temperature of the offending agent
- Duration of contact with the burning substance
- Thickness of the epidermis and dermis
- Blood supply to the area

Burn depth is classified into partial (some, but not all layers of the skin are injured) vs. full thickness (all layers of the skin are injured). Another complementary classification is by first-, second, and third-degree, as described below. Remember that it is sometimes difficult to determine the depth of injury during the first several days as the wound evolves.

Certain areas of the body such as the palm of the hands, soles of feet, and back can tolerate a higher temperature for a longer period of time without sustaining a full thickness injury. Other areas such as the eyelids have very thin skin and burn deeply very quickly. People with circulatory problems may sustain deeper burns more easily.

Young children and elderly patients have thinner skin. Their burns may be deeper and more severe than they initially appear. It is sometimes difficult to determine the depth of injury for 48 to 72 hours.

Extent of Burn



The most commonly used guide to estimate second and deeper degrees of burn is the “Rule of Nines.” In adults, distinct anatomic regions represent approximately 9% - or a multiple thereof – of the Total Body Surface Area (TBSA). In the infant or child, the “Rule” deviates because of the large surface area of the child’s head and the smaller surface area of the lower extremities. (Burn diagrams take these factors into account.)

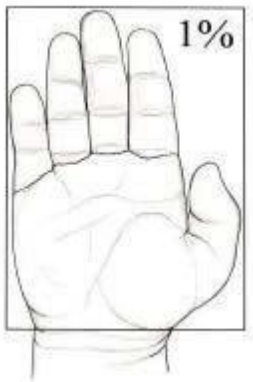
Note that first degree (superficial burn without blister formation) areas are not included in the TBSA burn calculation.

If only part of the anatomical area is burned, calculate the percent TBSA burned based on the percentage of that site injured and not the value of the whole (i.e., if the arm is circumferentially burned from the hand to the elbow, only half the arm is burned for a total of approximately 4.5%).

Burn centers typically use the **Lund-Browder Chart** for a more accurate determination of percent TBSA burn. A copy of this chart is included at the end of this chapter for your reference.

Estimating Size in Scattered Burns

The size of the patient’s hand—including the fingers—represents approximately one percent of his/her total body surface area. Therefore, using the patient’s hand- size as a guideline, the extent of irregularly scattered burns can be estimated.



Burn Management and Adjuncts

1. Fluid Resuscitation: The adjusted fluid rates are calculated according to the Fluid Resuscitation of Adult Burn Patients (**PROC CM F-15A**)

    a. Starting rate is calculated using the Modified Brooke Formula:

        i. 2 mL x Dry Weight (kg) x % TBSA=total fluid projected for 1st 24 hours

    b. For electrical injuries,

        i. 4mL x Dry weight (kg) x % TBSA = total fluid projected for 1st 24 hours

2. Check the patient's urinary output (at least hourly) and physiological response to decide further fluid titration. It is better to increase fluids based on response than to attempt to remove excess fluids once given

    a. Some patients, including those with a delayed start of fluid resuscitation, prior dehydration, chronic or acute alcohol use or abuse, methamphetamine lab injuries, high voltage electrical injuries, or inhalation injuries may require more than the estimated fluids. Again, the adjustments to fluid rates are based on patient response.

3. Vital Signs: Monitor vital signs *at least hourly* in burns ≥20% TBSA.

4. Nasogastric Tube: Insert a nasogastric tube for intubated patients and burns 20% or greater. Monitor all other patients for signs of nausea and vomiting.

5. Urinary Catheter A urinary catheter is important because urine output is the best monitor of adequate fluid resuscitation. In general, all patients with burns ≥20% TBSA should have a urinary catheter.

6. Monitoring Extremity Perfusion: In constricting, circumferential extremity burns, edema developing in the tissue under the burn eschar may gradually impair venous return. If this progresses to the point where capillary and arterial flows are markedly reduced, ischemia and necrosis may result. Elevate the affected extremity to minimize swelling.

    a. An escharotomy is sometimes indicated to restore adequate circulation. An escharotomy is a releasing incision made in a longitudinal fashion through the burned skin (eschar) to allow the subcutaneous tissue expand.

7. Monitoring Ventilation Circumferential chest and/or abdominal burns may restrict ventilatory ventilation and chest/abdominal escharotomy may be necessary in adults and children. A child has a more pliable rib cage (making it more difficult to work against constriction resulting from a circumferential chest burn) and may need an escharotomy earlier than an adult burn patient.

8. Pain and Anxiety Management Burn pain may be severe. Assess whether pain is due to the burn injury or caused by associated trauma.

    a. PO Morphine (7.5 mg/15mg) are indicated for control of pain associated with burns in patients

with good kidney function. This drug may be particularly useful in patients with a history of ETOH or substance use issues.

b. PO Oxycodone (5mg/10 mg) can be used in patients with impaired renal function, but this drug carries the highest abuse liability

c. Pain should be differentiated from anxiety. Benzodiazepines may also be indicated to relieve the anxiety associated with the burn injury. Titrate for effect by administering small frequent doses IV (*never IM*).

d. **It is not unusual for the opioid dose to exceed the standard weight-based recommendations**. Respiratory status should be constantly evaluated as large dosages may be required to alleviate pain and anxiety.

e. Changes in fluid volume and tissue blood flow make absorption of any drug given intramuscularly or subcutaneously unpredictable. The intra-muscular or subcutaneous routes should not be used, and opioids should only be given intravenously and in doses no larger than those needed to control pain.

f. Tetanus immunization is the only medication given IM to a patient with burns.

9. Elevate the patient's head and affected extremities Unless contraindicated by spine immobilization, elevate the patient's head to 45 degrees. This will help minimize facial and airway edema and prevent aspiration. Similarly, elevating the affected extremities reduces edema. **Please do not use pillows behind the head if the ears are burned.** This can cause the ears to heal in a folded or curled shape.

10. Psychosocial Assessment and Support Patients with burns should initially be alert and oriented. As such, even patients with major burns can remember the first several hours post injury. Health care providers must be sensitive to the variable emotions experienced by burn patients and their families. Feelings of guilt, fear, anger, and depression must be recognized and addressed.

    a. In cases where intentional burning is suspected, either from self- immolation or from abuse, efforts should be instituted to protect the patient from further harm.

    b. In order for a burn survivor to reach optimal recovery and reintegration into family life, school, work, social and recreational activities, the psychosocial needs of the survivor and family must be met during and following hospitalization and rehabilitation to minimize post-traumatic stress disorder (PTSD), acute and chronic.

Initial Labs

Skin burns can cause dysfunction of other organ systems. Thus, baseline screening tests are often performed and can be helpful in evaluating the patient's subsequent course:

- Complete Blood Count (CBC)
- Serum chemistries/electrolytes (e.g., Na+, K+, Cl-)
- Prealbumin
- Blood urea nitrogen
- Glucose levels, especially in children and diabetics
- Urinalysis for pregnancy, toxicology, and in diabetics
- Chest roentgenogram (X-Rays) in intubated patients
- COVID
- MRSA/MSSA
- Under specific circumstances, additional specialized tests are appropriate:
    - Arterial blood gases with Carboxyhemoglobin level (Carbon Monoxide) if injury was sustained in an enclosed space (automobile, house, garage) inhalation injury is suspected
    - ECG – With *all* electrical burns or pre-existing cardiac problems
    - Type and screen (or cross) for associated trauma

Monitoring for Complications

- **Heart failure:** Assess for fluid overload, decreased cardiac output, oliguria, jugular vein distention, edema, or onset of S3 or S4 heart sounds.

- **Pulmonary edema:** Assess for increasing CVP, pulmonary artery and wedge pressures, and crackles; report promptly. Position comfortably with head elevated unless contraindicated. Administer medications and oxygen as prescribed and assess response.

- **Compartment Syndrome:** Compartment syndrome can develop when there's bleeding or swelling within a compartment. This can cause pressure to build up inside the compartment, which can prevent blood flow. It can cause permanent damage if left untreated, as the muscles and nerves won't get the nutrients and oxygen they need.
    - The "5 P's" are oftentimes associated with compartment syndrome:
        - pain
        - pallor (pale skin tone)
        - paresthesia (numbness feeling)
        - pulselessness (faint pulse)
        - paralysis (weakness with movements).
    - Compartment pressures are often measured with a manometer, a device that detects intra-compartmental pressure by measuring the resistance that is present when a saline solution is injected into the compartment.

- **Sepsis:** Assess for increased temperature, hypothermia, increased pulse, widened pulse pressure, confusion or disorientation, hyperventilation, warm orclammy/sweaty skin, or flushed, dry skin in unburned areas (early signs), *and **note trends** in the data*. Perform wound and blood cultures as prescribed. Give sepsis fluids per protocol and scheduled antibiotics on time.

- **Acute respiratory failure (ARF) and acute respiratory distress syndrome (ARDS):** Monitor respiratory status for dyspnea, change in respiratory pattern, and onset of adventitious sounds. Assess for decrease in tidal volume and lung compliance in patients on mechanical ventilation. The hallmark of onset of ARDS is hypoxemia on 100% oxygen, decreased lung compliance, and significant shunting; notify physician of deteriorating respiratory status.

- **Visceral damage (from electrical burns):** Monitor electrocardiogram (ECG) and report dysrhythmias; pay attention to pain related to deep muscle ischemia and report. Early detection may minimize severity of this complication. Fasciotomies may be necessary to relieve swelling and ischemia in the muscles and fascia, monitor patient for excessive blood loss and hypovolemia after fasciotomy.

- **Contractures:** Provide early and daily aggressive physical and occupational therapy; support patient if surgery is needed to achieve full range of motion.

- **PTSD:** Impaired psychological adaptation to the burn injury. Obtain psychological or physciatric referral as evidence of major coping problems appear.

Surgical Interventions

Escharotomy:

With deep partial thickness and full thickness burns, the dermis can become stiff and unyielding (similar to leather). This stiff leathery tissue is referred to as an eschar. Incision of an eschar (i.e. escharotomy) may be necessary to release the tight tissue to allow the patient to ventilate correctly or to prevent ischemia. Circumferential eschar over the torso can lead to significant compromise of chest wall expansion and can hinder ventilation. Abdominal compartment syndrome with visceral hypoperfusion is associated with severe burns of the abdomen and torso. Decompressive escharotomy of an extremity may be required for circumferential full thickness burns, if eschar and underlying edema cause distal ischemia. Escharotomy incisions should extend through the eschar to the fatty tissue just beneath, but no further. The fascia should be left intact.

Ideally, escharotomy is performed by a physician experienced with the procedure to avoid damage to underlying structures. Most often the decision to perform an escharotomy is made clinically based on the presence of constrictive wounds and compromised distal perfusion. For ventilated patients, increasing peak inspiratory pressures (PIPs) and decreasing tidal volume (Vt) may indicate the need for escharotomy in circumferential torso burns.

Fasciotomy:

Fasciotomy, is an emergency procedure in which the fascia is cut to relieve pressure in the muscle compartment, is used to treat people with acute or chronic compartment syndrome.

Grafts:

Larger areas of third degree (full thickness) burns are treated with split thickness skin grafts. This surgery removes dead skin and replaces it with healthy skin from another part of the body. Once the skin has been grafted it is often treated with an antibiotic ointment and a nonstick dressing.

Split thickness skin grafts (STSG) can be meshed to increase the overall size of the graft, which is useful in cases where the wound size is greater than the available donor site. In a meshed graft, the bridges of meshed skin follow the below stages of skin graft take—the spaces between the skin heal via epithelialization from the skin bridges. Meshing can occur in various ratios such as 1:1, 2:1, 3:1, and even 6:1. The greater the ratio, the larger spaces between the skin bridges and the more epithelialization necessary to heal the space in-between. Meshing a skin graft effectively expands the skin graft to increase the area that can be covered. Additionally, the holes between skin bridges act as drainage holes to prevent blood, fluid, or seroma build up between the recipient wound bed and the skin graft, which would cause graft failure

Clinically, skin grafts are secured into place and often bolstered for 5 to 7 days postoperative to allow the skin graft to go through the steps below, ensuring the best skin graft take.

- Imbibition: The skin graft passively absorbs oxygen and nutrients from the wound bed.
    - During this stage the skin graft is ischemic and survives on diffusion alone until

reestablishing graft vasculature
    - The graft is pale/white during this time
    - Split thickness skin grafts (STSG) can tolerate up to 4 days of ischemia

- Inosculation: A vascular network is established between the cut vessels on the underside of the skin graft and the capillary beds in the wound bed, establishing a vascular connection.
    - The graft becomes pink at this point
    - Inosculation typically occurs at around 48 hours after graft placement

- Revascularization: Several hypotheses regarding the exact mechanism exist
    - Neovascularization Theory: new vessel ingrowth into the graft from the recipient wound bed
    - Endothelial cell ingrowth theory: endothelial cells proliferate and slide from the recipient side via a pre-existing vascular basal lamina as structure, with graft endothelial cells eventually degrading

- Maturation: Once the graft has integrated into the wound bed, it undergoes a maturation process that takes over a year to complete.
    - Skin maturation can last up to several years in burn patients
    - The process includes changes in pigmentation, flattening, and softening
    - Even after maturation, meshed split thickness skin grafts may maintain a cobblestone appearance

<u>Graft Complications:</u>

- Hematoma (most common)
- Infection
- Mechanical shearing forces
- Inadequate recipient bed vascularity
- Seroma
- Poor selection of skin graft location
- Technical error

<u>Types of Grafts:</u>

- **Sheet Grafts** are usually applied to the face or hands for a better cosmetic effect
    - Sheet graft uses the whole piece of skin (not meshed with the holes in it)
    - It gives a better cosmetic appearance, but requires much more skin to cover a specific area
    - Newly healed sheet grafts are *very* fragile. Special care should be taken to protect them

- **Meshed Grafts** are used for larger wounds.
    - For permanent wound coverage, a piece of skin is taken from another part of the body (donor skin) to close the open area.
    - When the donor skin is taken off the body, it shrinks. To cover more surface area, the skin is put through a machine that meshes the donor skin.
    - The meshed skin covers a larger area than an unmeshed sheet graft, but leaves a permanent mesh pattern similar to fish net stockings
    - The wound heals as the areas between the mesh fill in with new skin.

- Once the mesh sheet sticks to the skin and drainage stops, the wound is considered healed and can be left open to air
- Lotion or mineral oil can be used to keep it moist

- **Autografts** are permanent skin grafts that replace burned skin. Surgeons remove skin from one place on the patient's body and place it on the burned are of the body.
  - There are two types of autografts:
    - Split thickness skin graft: removes the epidermis and a shallow layer of the dermis.
      - Does not have its own blood supply, so must rely on the underlying wound bed for nutrients and blood supply
    - Full thickness skin grafts: used for reconstruction of small areas that are prone to contracture
      - Consists of the full thickness of the skin (epidermis and full dermis including hair follicle)
      - Shrinks the least compared to other grafts
- **Autologous Skin Cell Suspension (ASCS)** is a newer FDA approved product that is approved to treat burns.
  - ASCS is generated from immediate point of care processing of a small split-thickness skin sample (postage stamp size)
  - The STSG sample is "cooked" in an enzyme solution that separates the epidermal cells from the dermis
  - The patient's own epidermal cells are then drawn up into a solution and sprayed onto the wound bed
  - This method achieves 1:80 expansion (1 cm2 of donor can cover up to 80 cm2 of burn)
  - Coupled with STSG, this method achieves more rapid burn wound closure with acceptable long-term scar satisfaction outcomes
  - The ASCS product used at SUNY Upstate is **Recell**
- **Allografts** are temporary skin grafts to cover the wound. Donor skin comes from another human (usually a cadaver)
- **Fish Accelerated Skin Treatment** (FAST) are temporary grafts to cover the wound. Donor skin comes from fish that is rich in omega 3 fatty acids, have natural anti-inflammatory effects, and speed healing. The most commonly used FAST at SUNY Upstate is **Kerecis**

Donor Sites are areas of the dermis or epidermis that have been separated from one part of the body and reaffixed to a site where the skin has been removed or damaged

- The donor site should be chosen based on the amount of skin needed, surgical positioning of the patient, ease of donor site harvest, and aesthetics
- Broad, flat regions like the anterolateral thighs, back, truck, lateral arm/forearm, lateral lower leg serve as the easiest donor sites when using a mechanical dermatome because they are firm surfaces against which the dermatome operator can push
- Aesthetically, donor sites that will be routinely covered by clothing are typically chosen
- The donor area usually takes about 2 weeks to heal for STSG
- Full thickness skin graft donor area only takes about 5-10 days to heal because it is normally small and closed with sutures
- At first the healed donor site will appear reddish purple, but will fade over time

Nutrition

Nutrition support is the provision of nutrients and adjunctive agents to improve or maintain nutritional status and is fundamental in the management of patients with a moderate-to-severe burn injury. The primary goal of nutrition support is to meet the distinctive demands placed upon the body by hypermetabolism. While all critically ill surgery patients may experience a hypermetabolic state, the severity, magnitude, and duration of the hypermetabolic response for the severe burn patient is far greater.

Metabolic rates of burn patients can surpass twice that of normal metabolic states. Failure to fulfill these increased energy requirements will result in impaired wound healing, organ dysfunction, and increased susceptibility to infection. A prolonged hypermetabolic state can result in muscle wasting and cachexia.

Adequate assessment and monitoring of nutritional needs are imperative to care for this patient population. There is no consensus regarding the optimal timing, route, amount, and composition of nutritional support for burn patients, but most clinicians advocate for early enteral nutrition with high-carbohydrate formulas.

Rehabilitation

Exercise following a burn injury is an extremely important part of treatment. The goal of exercise is to return to a person's prior level of independence. Occupational and Physical Therapists work with patients to design individualized exercise programs. The exercises and activities include cardiovascular and strengthening exercises, stretching to prevent contractures of the joints, and play or leisure activities. It is important to begin regaining independence in all daily activities such as: eating, getting dressed, grooming, bathing and toileting, getting onto a chair, bed, toilet, bathtub/shower or into a car, and walking up and down stairs. Therapists help people practice these tasks so they can become independent.

One of the most common complaints after a burn injury is that it seems like the skin feels tight and doesn't want to move. This feeling is real and normal. This is because as the burned skin heals, it shrinks and becomes tight and harder to move. This is very frustrating! The burned skin is tightest and stiffest in the morning right after waking up. This is because when we sleep, we are not exercising or moving and the burned or grafted skin has a chance to shrink and tighten. It is very important to work on exercises every day and especially every morning after getting up. This will help stretch out the tight skin so that moving the rest of the day will be easier.

Child Life

Certified Child Life Specialists are educated and clinically trained in the developmental impact of illness and injury. Certified Child Life Specialists help infants, children, youth and families cope with the stress and uncertainty of acute and chronic illness, injury, trauma, disability, loss and bereavement. They provide evidence-based, developmentally and psychologically appropriate interventions including therapeutic play, preparation for procedures, and education to reduce fear, anxiety, and pain.

Discharge Teaching

- Wound care. The patient and the family are instructed to wash small clean, open wounds daily with mild soap and water and to apply the prescribed topical agent or dressing.

- Education. The patient and the family require careful written and verbal instructions about pain management, nutrition, prevention of complications, specific exercises, and the use of pressure garments and splints.

- Follow up care. Patients who receive care in a burn center usually return to the burn clinic periodically for evaluation, modification of burn care instructions, and planning for reconstructive surgery.

- Referral. Patients who return home after a severe burn injury, those who cannot manage their own burn care, and those with inadequate support systems need referral for home care

Team Approach

Nurses make up the largest part of the multidisciplinary of burn teams. Patients with burns are unique, representing one of the most severe models of trauma. The management of the burn patient requires highly skilled interprofessional teams including: nurses, surgeons, intensivists, burn specialists, dietitians, physician therapy, occupational therapy, pulmonologist, plastic surgeon, wound care specialist, pharmacy, psychiatry, social work, case management, child life specialist, pastoral care, and possibly palliative care

Resources for Patients & Families

Burn Institute: https://burninstitute.org/about/
Phoenix Society for Burn Survivors: https://www.phoenix-society.org/resources?
Arizona Burn Foundation: https://azburn.org/
American Burn Association: https://ameriburn.org/public-resources/burn-survivor-resources/
NIH National Institute of General Medicine Sciences: https://www.nigms.nih.gov/education/fact-sheets/Pages/burns.aspx

Helpful Links

Helpful Up-To-Date Links

- Emergency Care of Moderate and Severe Thermal Burns in Adults
- Hypermetabolic Response to Moderate-to-Severe Burn Injury and Management
- Overview of Nutrition Support in Burn Patients

Burn Policies

- Burn Service Responsibilities
- Burn Dressing Application Recommendations for Varying Burn Depths
- Consults for Adults with Burn Injuries
- Daily Expectations of Burn Resident
- Fast Track of Burn Patients
- Infection Control Policy for Burn Patients
- Management and Prevention of Delirium in Burn Patients
- Photography of Burn Injuries
- Upstate Burn Transfer Policy

Adult Burn Policies

- Adult Burn Nutrition Protocol
- Adult Fluid Resuscitation Policy
- Adult Fluid Resuscitation Procedure
- Consults for Adults with Burn Injuries

Pediatric Burn Policies

- Pain Management for Pediatric Patients with a Burn Injury
- Consults for Pediatric Patients with Burn Injuries
- Pediatric Burn Nutrition Protocol

Helpful Forms

- Surgeon Pick List
- Lund and Browder Chart
- Burn Dictionary
- General Care of Burn Patient
- Resident Welcome Letter

Specialty Policies

- Care of the Amish Patient with Burn Injuries
- Steven Johnson Syndrome/Toxic Epidermal Necrolysis (SJS/TENS) for Adults and Pediatrics
- Frostbite Policy
- Frostbite Procedure