# Burns in Rehabilitation: From Acute Care to Functional Recovery

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## Objectives:

- Identify burn depth (partial vs full thickness)
- Review burn wound operative wound management
- Discuss types of burn grafts
- Review nutritional needs of burn patient
- Understand burn scar management and importance for mobility
- Review positioning and splinting of burn patient
- Discuss pain and other discomforts burned patients experience
- Review psychosocial recovery in burn rehabilitative phase

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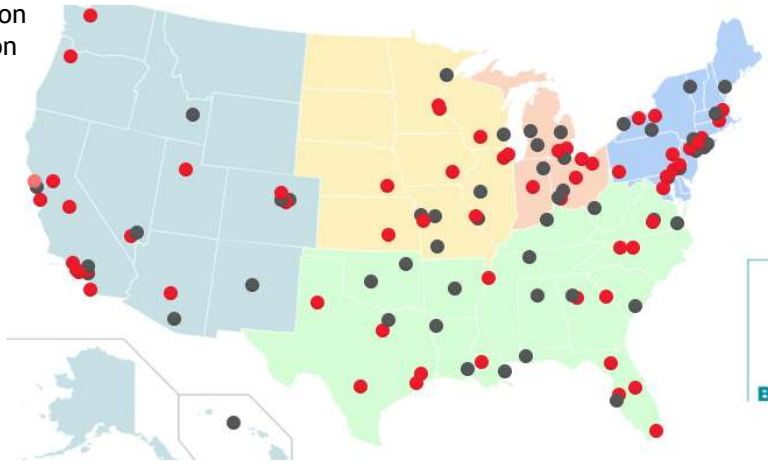
The Burn Disaster Regions are:

- Northeast Region
- Midwest Region Great Lakes Region
- Southern Region
- Western Region

77 verified Burn Centers



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# Specialized Burn Team

- EMS & referring hospitals and rehabilitative facilities
- Burn Surgeons & Specialty Surgeons ~ Trauma Plastics, Hand,
- Pediatric Intensive Care Physicians
- Nursing Staff & Educators
- 19 Physical / Occupational Therapist
- Dietician
- Respiratory Therapists
- Psychologist
- Child Life Specialist
- 2 Pharmacist, Toxicologist
- Ophthalmologist
- Disaster Management
- Research Nurses and Coordinators
- Burn Care Coordinator/Social Worker
- Law enforcement, fire investigators
- Arizona Burn Foundation
- Valleywise Health Foundation

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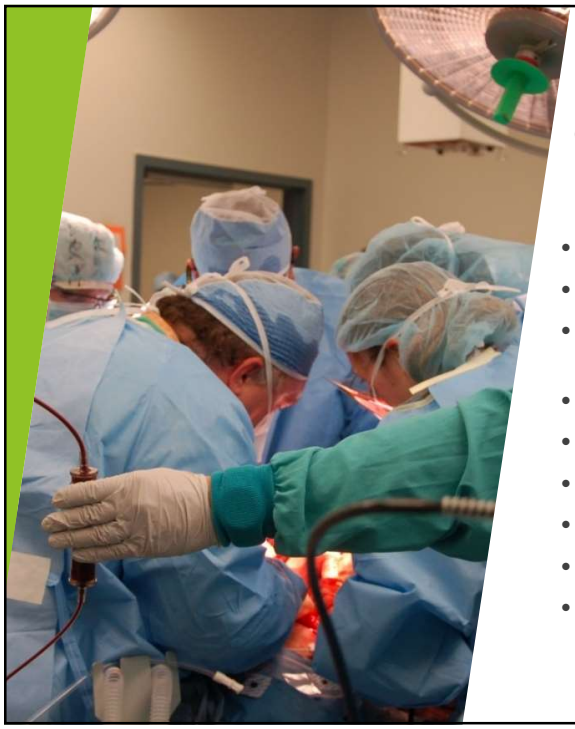

## Reduction in Mortality over last decade r/t:

- Specialized Burn Centers
- Advances in fluid resuscitation
- Better understanding of burn shock
- Early surgical excision & grafting
- Advances in wound closure
- Infection control
- Treatment of inhalation injury
- Nutritional support
- Support of hypermetabolic response to injury

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Burn injury is a leading cause of severe morbidity, and long-term disability, with significant health and economic burden.

Recovery of physical function following burn injury requires significant engagement by patients and their care team.

Injuries that affect joint function and activity pose a special challenge. What begins as a decreased range of motion can rapidly progress to fixed contractures, particular without optimal exercise, positioning, and splinting or serial casting regimens.

Skin grafts and scars contract increasing stiffness

Joint contractures are difficult to mitigate and remain one of the major unresolved problems in modern burn care.

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## How Long Does it Take to Cause a 3rd Degree Burn with Water?

| | In an Adult | In a Child/Elderly |
|---|---|---|
| 150° | 1 – 1½ seconds | Less than 1 second |
| 140° | Less than 5 seconds | Less than 1¼ to 2½ seconds |
| 133° | 5 seconds | 1¼ to 2½ seconds |
| 130° | About 30 seconds | 7½ to 15 seconds |
| 127° | 1 minute | 15 to 30 seconds |
| 125° | About 2 minutes | 30 seconds to 1 minute |
| 120° | More than 5 minutes | 1¼ to 2½ minutes |

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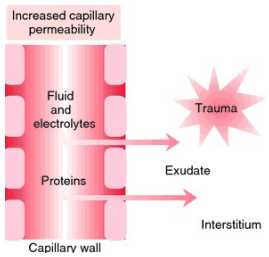
## Pathophysiology of Burn Shock




- Alteration in capillary integrity
  - vascular bed leakage
  - fluid leaks out of burn wounds and circulating volume leading to hypovolemic shock
    - If not treated immediately can lead to irreversible shock and death within a few hours
  - smoke inhalation aggravates the capillary leak in the lungs, which will significantly increase fluid requirements during resuscitation
- ↑ Magnitude and duration is related to extent of injury (TBSA) and the depth of cutaneous injury
- All burns over 20% TBSA shift fluid

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A massive surge of catecholamines 10 to 50 times greater than non-burned plasma levels, drives the hypermetabolic response causing increased myocardial oxygen consumption & cardiac work

Persistent tachycardia (HR 120-130), systemic hypertension, increased muscle protein degradation, insulin resistance, elevated core temperature, & liver dysfunction are characteristic of this hyperdynamic phase

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## In 1953 Dr. Jackson described the three Zones of Burn Injury

- Zone of coagulation
  - Initial most intimate contact suffers most damage as evident by thrombosed blood vessels and nonviable cells
- Zone of stasis "at risk" zone
  - Mix of viable and nonviable cells
  - Cells are ischemic related to clotting & vasoconstriction
  - Ischemia to this zone is devastating
  - Improper fluid management/hypoperfusion may extend this zone
  - Under Ideal circumstances this zone will survive
- Zone of hyperemia
  - Sustained minimal cellular injury
  - Has increased blood flow as result of normal inflammatory response
  - Recovery prevails

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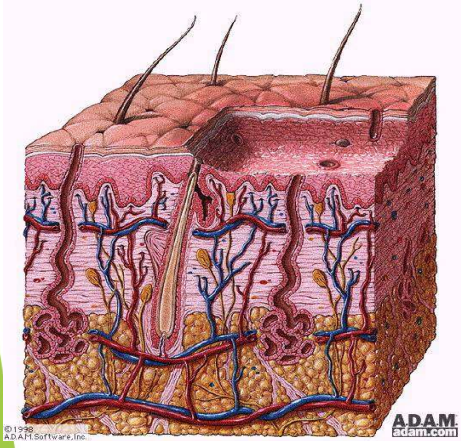
# Burn Depth




- **Superficial Burn: 1st degree**
- Epidermis, no blisters
- Signs & Symptoms
  - Reddened skin
  - Pain at burn site
  - Involves only epidermis
- Heals in 3-7 days
  - Outer injured epithelial cells peel away
  - Seldom clinically significant
- **DO NOT INCLUDE IN TBSA**

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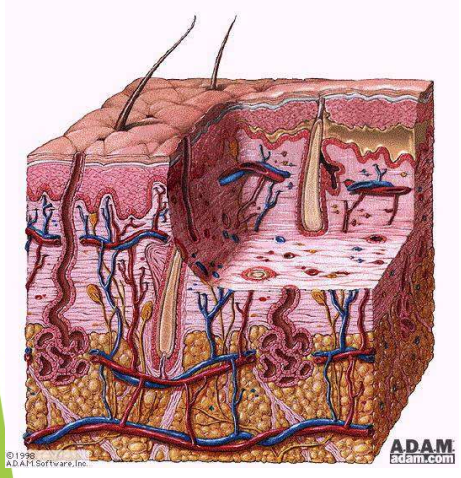
# Burn Depth




- Partial-Thickness Burn: 2nd Degree Burn
- Epidermis and superficial dermis
  - Signs & Symptoms
    - Blisters
    - Moist, Weepy & Shiny
    - Intense pain
    - Red skin
    - Healing time 14-21 days, no scar
  - Deep partial thickness (deep 2nd degree)
    - Epidermis and deep dermis, sweat glands, & hair follicles
    - Blisters and very painful
    - Pink to pale pink
    - Fairly dry
    - Healing time 3 to 8 weeks, permanent scar

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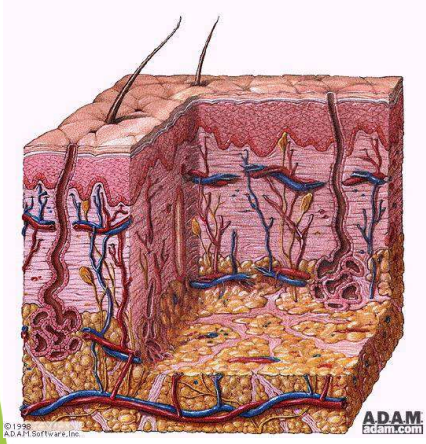
## Full Thickness




- Entire thickness of epidermis & dermis including epidermal appendages
- White, charred, yellow, brown appearing
- Dry, tough and leathery
- May require escharotomy or fasciotomy
- No pain (sensory nerve ending is dead)
- Hair follicle removes easily
- Heals by contracture & epithelial ingrowth from edges, or skin graft
- Healing time months, severe scaring, surgery & skin grafts necessary

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## Wound Grafts

- **Autograft** - healthy tissue harvested from a non-burned portion of patient's body to be transplanted over burn wound
- **Allograft**- tissue taken from same species (usually cadavers)
- **Xenograft**-tissue take from a different species than recipients

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# Types of Autografts

- Split thickness skin graft (STSG)
  - Most common form of autograft
  - Contains epidermal layer and portions of underlying dermis
    - more visible scaring
    - better graft take
    - prolonged healing in donor sight
- Full thickness skin graft (FTSG)
  - Contained epidermal layer and entire dermis
  - Associated with
    - Reduced scarring
    - Higher risk of graft failure
    - Prolonged healing time

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# Autografts

- Sheet graft
  - Involves direct application of skin to a graft site with out meshing or stretching
  - Superior aesthetic result with minimal scaring
  - Primarily used over face, neck, and hands
  - Risk of hematoma/seroma building beneath graft
  - Sheets are placed perpendicular to joints and large muscles to reduce implications of contractures

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## Autografts

- Meshed graft
  - Spit-thickness skin grafts can be meshed to expand their surface area and increased wound coverage
    - Skin bridges adhere and heal into wound bed
    - Interstices heal inward from skin bridges through epithelization
    - More appropriate for large burns
    - Interstices allow for drainage of serous fluid and blood, minimizing hematoma/seroma formation and graft failure
  - Meshing patterns
    - Wider mesh larger surface area can be covered
    - Wider mesh, larger interstices slower to heal more visible scar

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## Nutrition

- Consequences of inadequate nutrition
  - Loss of lean body mass
  - Graft failure, inability to close wounds
  - Loss of mucosal integrity-increased risk of infection
  - Failure of immune defense-increased risk of infection
  - Blunts catabolic response associated with burn pathology
- Nutritionist is essential team member
- High glucose/high protein/low fat diet is recommended

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## ROM & Positioning

- The main goal in burn therapy management is obtaining and preserving ROM of all involved joints so that patient's have the best functional outcomes
  - Active & Passive ROM
    - Stretch to point of blanching
    - Holding stretch at end range for 30 seconds minimum at a time
  - ROM measurements using scar goniometry app
    - *especially important in digits, hands, wrists, and shoulders

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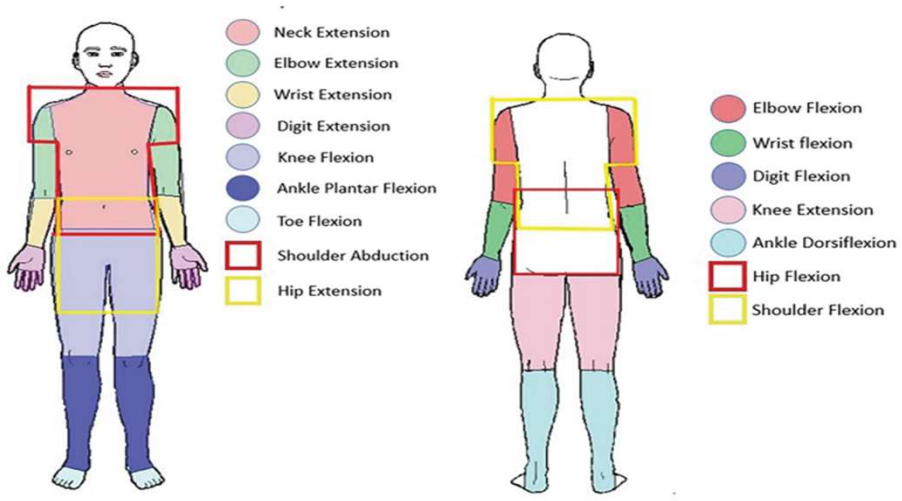
## Cutaneous Functional Units

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## Common Burn Scar Contractures:

Elbow flexion
Knee flexion
Hand/fingers,
Anterior neck, hip
ankle and toe extension

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## Splints

- Common splints we send our patients out with:
  - Knee immobilizers
  - PRAFO's
  - Resting Hand Orthosis
  - Palmar extension splint
  - Custom hand/wrist splints

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# Burn Scar Management

Scars are metabolically active for up to 3 years so scar management is very important

- Massage-
  - promotes blood flow to soften and remodel scars
  - frees and releases adhesions and fibrous bands
  - maintains joint mobility
  - reduces itching
- Compression - increased pressure on scars minimizes height of scars
  - Garments
    - Barriers – discomfort, blistering, swelling to distal extremity
  - Tubi grip
- Silicone/gel (duoderm) – worn for 12 hours a day for months
  - improves textures, color, and overall appearance of scars
  - increases temperature and softens scars
  - DO NOT throw away

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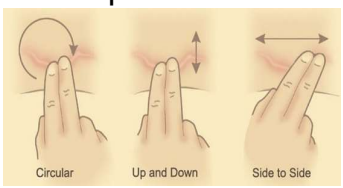
# De-Sensitization

- Burn scars are often very sensitive during the healing phase due to damaged nerve endings that send abnormal signals to the brain.
- Common signs of sensitivity:
  - Itching, sensitive to temperature, numbness, tingling, and increased pain to both painful and non-painful stimuli
- De-sensitization techniques:
  - Scar massage
  - Texture stimulation
  - Percussion
  - Vibration

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## Recommended Therapy Minutes for Burn Patients

8.5 minutes/day per percent burn

22% TBSA burn = 187 minutes (3 hours, 7 minutes)
80% TBSA burn = 680 minutes (11 hours, 20 minutes)

Aerobic training:
- 3-5 days/week
- 70-85% peak HR
- 20-40 minutes
- >150 minutes of aerobic exercise/week

Resistance training:
- 2-3 days a week
- Start with larger muscles first then move to smaller muscles

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## Things You Could Encounter

- Heat intolerance- Deep burns cause destruction of sweat glands and loss of ability to sweat
- Cold intolerance-due to loss of muscle mass and fat stores
- Pruritis
- Auto-release: a portion of the contracture/soft tissue adhesion breaks apart. It could happen from the patient moving or clinician moving the patient. This is normal and will likely happen at some point
- Heterotrophic ossification: Abnormal growth of bone outside of skeletal tissues including muscle, tendons, or other tissues. HO is very painful for patients and significantly limits ROM. It will have a hard-end feel during PROM.
  Do not range into/past pain


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- Providing optimal care to burn patients is challenging yet rewarding, as it facilitates recovery from some of the most devastating injuries seen in medicine
- Hopefully, these key concepts discussed will increase your knowledge and confidence in caring for the  burn patient

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## Thank You

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