Burns

By: Justine Ramos, OT/S
Janet Brooks, EdD, OTR/L

SPRING 2024

TABLE OF CONTENTS

Note: These resources are meant to be a guide to your learning that can better facilitate your knowledge of the Hand and UE and should always be used alongside your lectures and readings.

Burn Injuries

Lecture by: Amy Orroth OTR/L, CHT
Outline and Study Materials by: Justine Ramos, OT/s and Janet Brooks, EdD, OTR/L

I. Goal of Rehabilitation of Burn Injuries
II. Statistics
III. Demographics
IV. Skin Function
    A. Temperature Regulation
    B. Excretion
    C. Sensation
    D. Vitamin D Synthesis
    E. Barrier against infection and dehydration
V. Mechanisms of Injury
    A. Fire
    B. Contact with hot object/liquid
    C. Radiation
    D. Chemicals
    E. Electricity
VI. Burn Classification Systems
    A. Depth of Injury
        1. Superficial
        2. Superficial partial thickness
        3. Deep partial thickness
        4. Full thickness
    B. Size of Injury
        1. Rule of Nines
VII. Response to thermal injury (5 points)
VIII. Fluid Resuscitation (3 points)
IX. Response to thermal injury after successful resuscitation (hypermetabolic response) (3 points)
X. Fluid Resuscitation Phase
XI. Depth of Injury (4 points)
    A. Superficial Burn (First Degree)
    B. Superficial Partial Thickness (Second Degree)
    C. Deep Partial Thickness (Second Degree)
    D. Full Thickness (Third Degree)
XII. Electrical Burns
XIII. Size of Injury
    A. Rule of 9s

B. Burn area percentages
C. Burn Size

XIV. Inhalation Injuries

XV. Emergent Phase: Initial Injury to 72 hours post burn

A. OT Role
B. Medical Team Goals
C. Dressings (4 points)

XVI. Pre-Op Phase

A. Goals (3 points)

XVII. Contracture formation

XVIII. Splinting

A. Purpose (4 points)

XIX. Antideformity Position

A. Location of Burn + Position
    1. Neck → Extension
    2. Axilla → Abduction
    3. Elbow → Extension
    4. Wrist → Extension
    5. Hip → Extension
    6. Knee → Extension
    7. Foot → Dorsiflexion
B. Correct Positioning of the Hand
    1. Wrist 20-30 degrees of extension
    2. Maximum MP joint flexion
    3. PIP and DIP joint extension
    4. Thumb palmar abduction
C. Edema Management
    1. Upper extremities PROM vs AROM
    2. Arms are positioned at 20-40 degrees of shoulder flexion
D. Range of Motion
    1. Prevent muscle atrophy
    2. Prevent tendon adhesion/joint stiffness
    3. Control edema
    4. Prevent capsular shortening
E. Limiting factors of ROM
    1. Excessive edema
    2. Eschar with decreased elasticity
    3. Tension from newly deposited collagen

XX. Escharotomy vs Fasciotomy

A. ROM not contraindicated

XXI. Types of skin grafts
- A. Temporary grafts
  1. Xenografts (bovine)
  2. Allograft (cadaver)
  3. Biological dressings (biobrane)
  4. Autografts
     a) Full thickness
     b) Split thickness
     c) Sheet grafts vs meshed grafts

XXII. Post-Op Phase
- A. Goals
  1. Promote function
  2. Maximize Motion
  3. Minimize Contracture
- B. Post-Op ROM
  1. Xenograft
  2. Autograft
  3. Integra

XXIII. Rehabilitation Phase
- A. OT Goal
- B. Interventions
  1. Functional activity tolerance
  2. Sensation
  3. Scar management
  4. Strength
  5. ROM
  6. Coordination

XXIV. Factors Limiting Motion
- A. Intrinsic muscle tightness
- B. Extrinsic muscle tightness
- C. Joint tightness
- D. Skin tightness

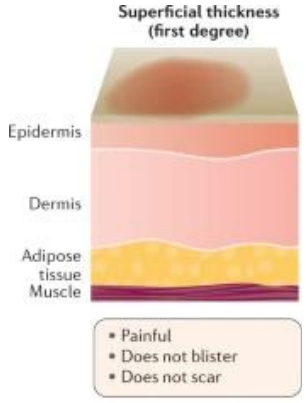
XXV. Scar Formation
- A. Maturation Timeline
- B. ECM
- C. Phases of Wound Healing/Scar Formation
  1. Inflammation
  2. Proliferation
  3. Remodeling/Maturation

XXVI. Keloids and Hypertrophic Scars

XXVII. Scar formation and surgery
XXVIII. Cutaneous Functional Units
XXIX. Axillary Contracture
XXX. Surface Area Graphic Evaluation (SAGE)
XXXI. Splints
    A. Static vs Dynamic
        1. LMB
        2. Dynamic Flexion
        3. Dynamic Extension
        4. Increase PROM, important to follow up with exercise and functional activity
XXXII. Things that can limit hypertrophic scarring/ keloids
    A. Massage
    B. Adhesive tapes
    C. Silicon products
    D. Conformers
    E. Pressure
        1. Tubi Grip sleeve
        2. Coban
        3. Isotoner Glove
        4. Jobst Garments
        5. Conformers
        6. Corticosteroid injections
        7. Laser and light based therapy
        8. Cryotherapy
        9. Radiotherapy
        10. Botulinum toxin
XXXIII. Potential Complications in Burns
    A. Pruritus
    B. Microstomia
    C. Heterotrophic Ossification
XXXIV. Psychosocial Roles in Burn Injuries

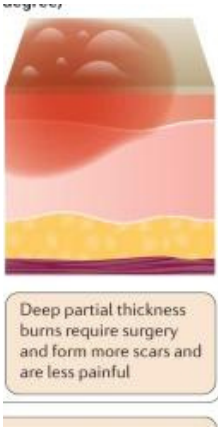
Depth of Injury [For best viewing, please use this link]

Type of Burn/ Depth of Injury	Description	Image

Superficial	• **Layers Affected:**
	  ○ Epidermis
	• **Characterization:**
	  ○ Painful, dry
	  ○ local pain and erythema
	  ○ no blisters
	  ○ minimal systemic response
	• **Color:**
	  ○ Red, bright pink
	• NOT included in TBSA %
	
	<u>Healing</u>
	
	• Heals spontaneously, no scarring
	• 3-7 days with peeling, does not scar
		
		 

Superficial Partial Thickness	• **Layers Affected:**
	  ○ Damages cells in the epidermis and the upper portion of the dermis
	• **Characterization:**
	  ○ Blistered
	  ○ blanchable
	  ○ moist/weeping
	  ○ Painful- irritation of nerve endings
	• **Color:**
	  ○ Bright red
	
	<u>Healing</u>
	
	• Heals spontaneously 7-10 days
	• minimal to no scarring , may have pigment changes.
	• Does not require surgical intervention
		
		 

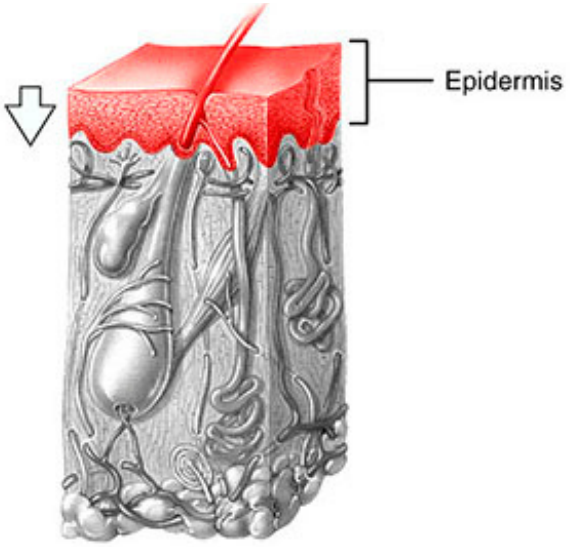
Deep Partial Thickness (Second Degree)	• **Layers affected:** ○ Severe damage to dermal and epidermal layer	

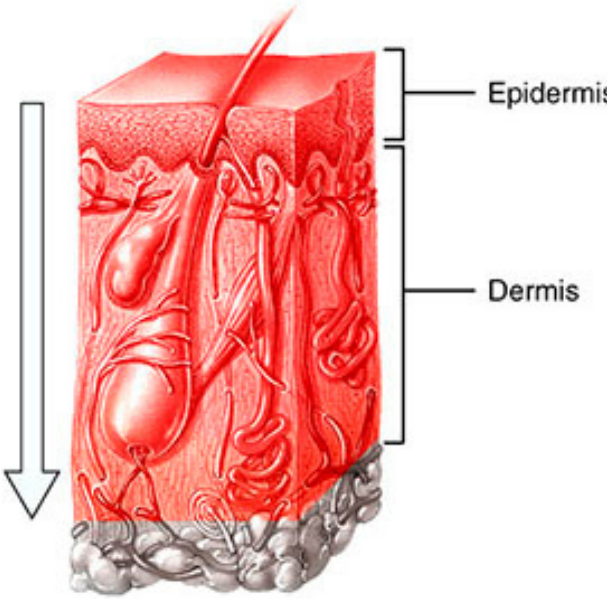
	• **Characterization:**
	  ○ May not have pain, blanching indicates healing, pseudoeschar with protein buildup
	  ○ blotchy
	  ○ whitish
	  ○ painful
	  ○ pressure sensation intact
	  ○ light touch diminished
	• **Color:**
	  ○ Light pink to mottled white
	
	<u>Healing</u>
	
	• Healing time delayed 3-5 weeks due to impaired vascularity
	• Increased risk of scarring
	  ○ often grafted
	• Can develop hypertrophic scarring
		
		 

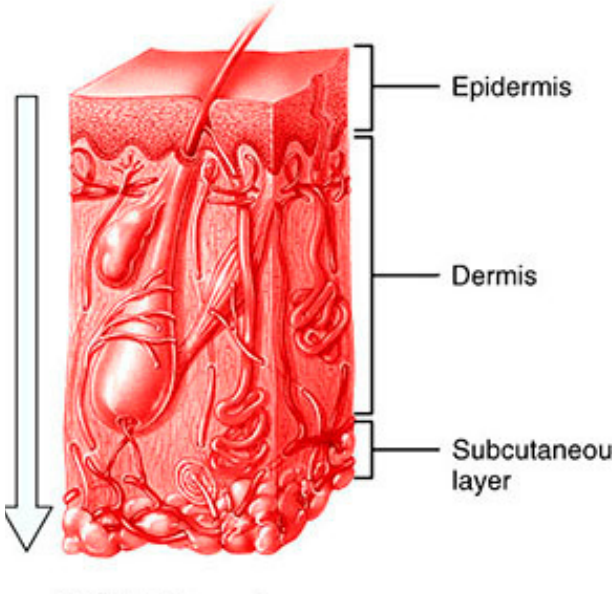
Full Thickness	• **Layers affected:**
	  ○ Cells in the dermis and epidermis are destroyed or deeper to bone
	• **Characterization:**
	  ○ dry, leathery
	  ○ painless
	  ○ hair falls out easily
	  ○ white or waxy in appearance
	  ○ insensate-destruction of nerve endings
	• **Color:**
	  ○ Mixed white, waxy, pearly
	
	<u>Healing</u>
	
	• Require surgery
		
		 

Electrical Burns	• Electrical injuries are when high-energy current travels through the body due to contact with an electrical source. • Consists of an entrance and exit wound **Symptoms** • The point of entry tends to be **depressed and leathery** • the exit wound is typically more **extensive and explosive.**	

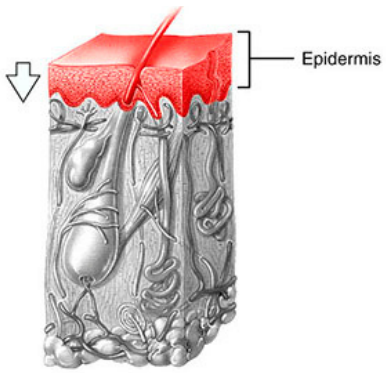
Match the degree of injuries to their appropriate pairings

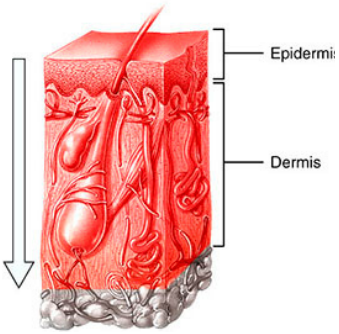


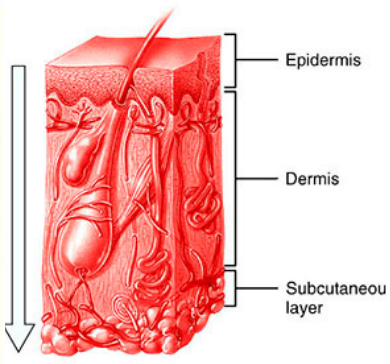




List 2-3 physical indications that the burn image represents the degree of injury (ex: first degree burns may not blister)







Burn Phases + Limiting Factors

For best viewing, please use this link

Burn Phase	OT Goals / Medical Team Goals	Interventions/Other things that may occur

Emergent Phase
 	
Initial injury- 72 hours post-burn
	OT
	
	• Complete OT screen
	• Splinting & positioning regime
	• Functional status prior to admit
	• **Medical Team Goals**
	• Stabilize patient via:
	  ○ Fluid resuscitation
	  ○ Adequate tissue perfusion
	  ○ Cardiopulmonary stability
		• **Dressings**
		  ○ protect against infection
		  ○ maintain contact- topical agent and wound
		  ○ Debridement (removal of devitalized tissue from the wound)
		  ○ Patient comfort

Pre-Op Phase	• Maximize motion and function
	• Protect structures
	• Control Edema
		• **Contracture formation**
		  ○ Abnormal physiological response to open wound
		  ○ Predictable patterns
		  ○ Severely limit function
		• **Splinting**
		  ○ Prevent deformity/contractures
		  ○ Provide optimal positioning pre/post-graft
		  ▪ **Wrist:** 20- 30 degrees of extension
		  ▪ **Maximum MP**: joint flexion
		  ▪ **PIP&DIP**: joint extension
		  ▪ **Thumb palmar abduction**
		  ○ Protect exposed tendons and joints
		  ○ Aid in controlling edema
		• **Edema Management**
		  ○ Upper extremities PROM vs. AROM
		  ○ arms are positioned: 20-40 degrees of shoulder flexion
		 
		• **Range of Motion**
		  ○ Prevent muscle atrophy
		  ○ Prevent tendon adhesion/joint
		  ○ stiffness
		  ○ Control edema
		  ○ Prevent capsular shortening
		• **Limiting Factors of ROM**
		  ○ Excessive edema
		  ○ Eschar with decreased elasticity
		  ○ Tension from newly deposited collagen

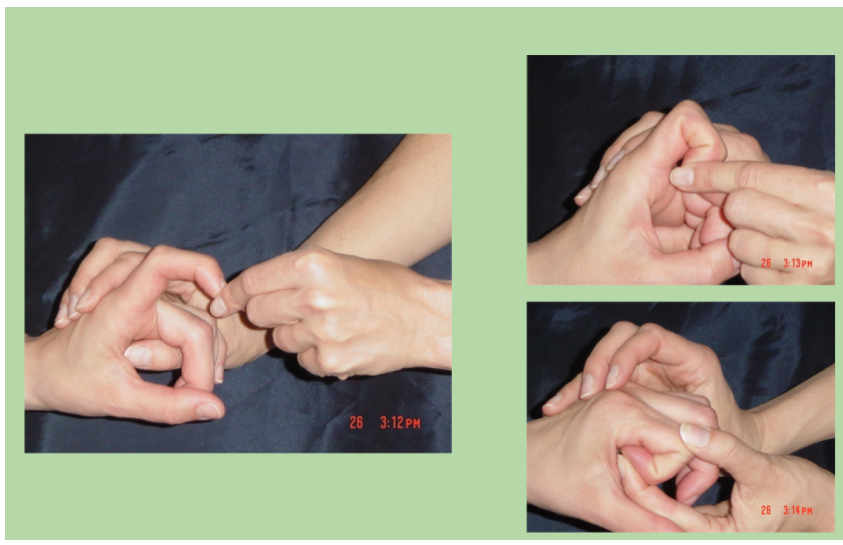
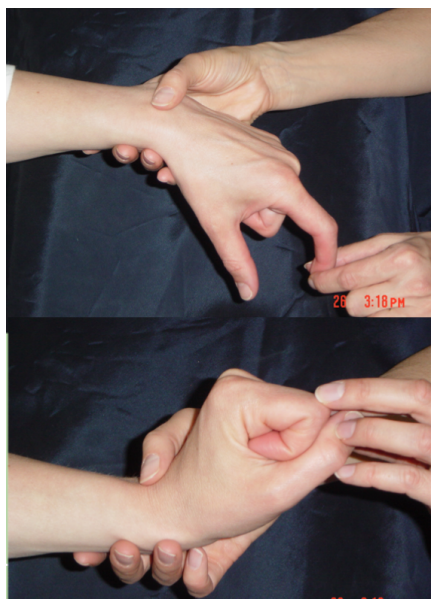
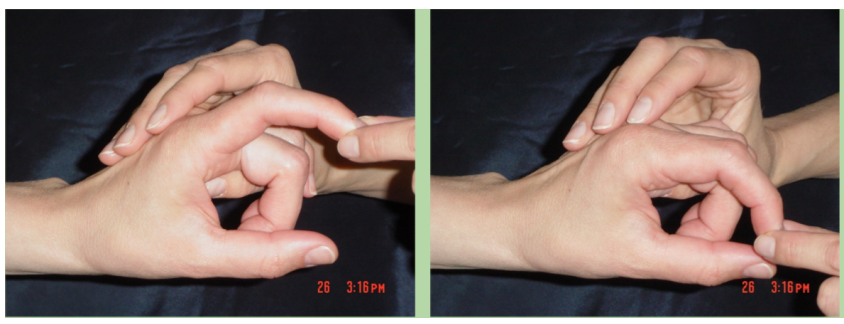
Surgical Procedure	• Medical team grafts skin	• **Temporary grafts**
		  ○ **Xenografts (bovine)**
		 
		  ○ **Allograft (cadaver)**

- **Biological dressings (Biobrane)**
- **Autografts**
  - Autografts
    - **Full thickness-** full thickness of the skin and subcutaneous tissue
    - **Split thickness**-Epidermis and part of the dermis
    - **Sheet grafts vs. meshed grafts**

Post-Op Phase	• Promote function
	• Maximize motion
	• Minimize contracture
		Range of Motion
		• **Xenograft**
		  ○ noROM limitations/as pain allows
		• **Autograft**
		  ○ hold ROM for 7 days post-op
		  ○ Strengthening initiated 2 weeks post op if skin integrity allows
		• **Integra-**
		  ○ gentle ROM 5-7 days post op
		  ○ Delay ROM if issues with healing

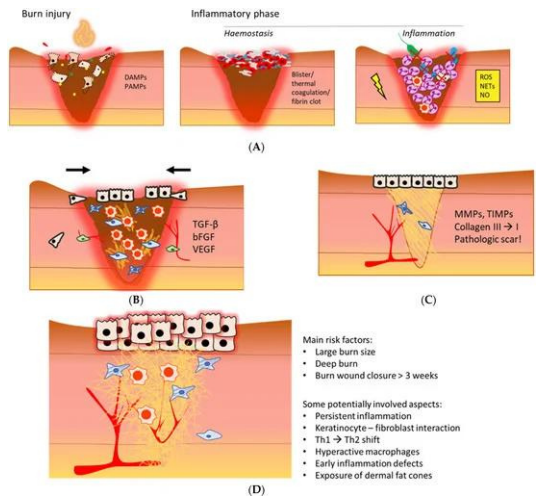
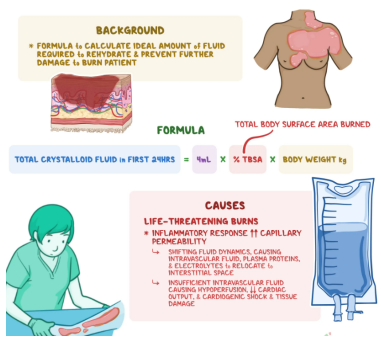
Rehabilitation Phase	Continue to facilitate individuals return to prior level of functioning	• Functional activity tolerance
		• Sensation (Desensitization)
		  ○ Desensitization kit (cold pack)
		 
		• Scar Management
		  ○ Massage
		  ○ Pressure Dressings
		  ○ Silicone
		  ○ K-Tape
		  ○ Iontophoresis
		• Strength
		• ROM
		  ○ Daily stretching
		  ○ Blanching
		• Coordination
		
		<u>Factors that limit ROM</u>
		• Intrinsic muscle tightness
		• Extrinsic muscle tightness
		• Joint tightness
		• Skin tightness

Factors that Limit ROM

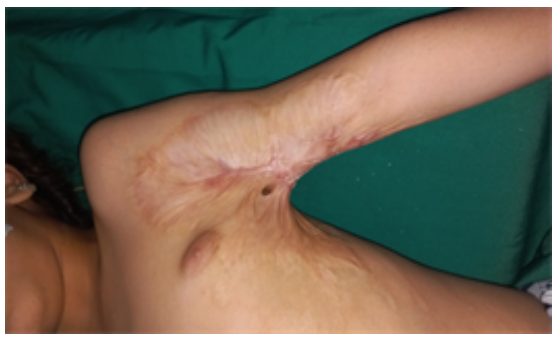
Limiting Factor	**Description**	**Images**
Intrinsic msucle tightness		
Extrinsic Flexor tightness	• Unable to extend digits with wrist extension • Able to extend digits as patient moves into flexion	
Extrinsic Extensor tightness	• Unable to flex digits with wrist flexed • Able to flex digits as patient moves into extension	
Joint tightness	Limitation of ROM due to the joint	
Skin tightness	Limitation of ROM due to the formation of skin after an injury/wound/burn	

Burn Healing, Scar Formation and Treatment

For best viewing, please use this link

Burn Healing Phase	Description
Fluid Resuscitation Phase	**Immediate Response to Thermal Injury** 1. Tissue burn- direct coagulation and microvascular reactions 2. Large systemic response trigger by loss of skin barrier 3. Release of vasoactive mediators (increased potential for infection) 4. Interstitial edema, initially decreased cardiac output/metabolic rate  **Fluid Resuscitation** • Administered within 18-24 hours post-burn • Brooke or Parkland Formula used to determine volume of infusion 
Inflammation	the first 48–72 hours after trauma, supposed to be started by the release of IL-1 by keratinocytes 
Proliferation	May last up to 6 weeks. Healing begins as new cells proliferate into affected area 
Remodeling	Scars mature during a period of at least 1 year 

Factors that affect scar healing

Limiting Factor	Description	Treatments	Images
Keloids/Hypertrophic Scarring	• Keloids and hypertrophic scars occur anywhere from 30% to 90% of patients • characterized by pathologically excessive dermal fibrosis and aberrant wound healing. • Damage to epidermis and dermis results in a • wound closure dominated by fibrous • collagen/protein	• Massage • Adhesive tapes • Silicon Products • Conformers • Pressure • Tubi-grip sleeve • Coban • Isotoner glove • Jobst Garments • Conformers • Corticosteroid injections • Laser and light-based therapy • Cryotherapy Radiotherapy(keloids) • Botulinumtoxin(Botox®)	
Axillary Contracture	• Limit Upper Extremity ROM	• Axillary Splint	
Puritis	• persistent itching • due to nerve regeneration	• compression garments • moisturizers • cold packs • antihistamines	
Microstomia	• Oral commissure contracture	• Oral commissure splints	
Heterotrophic ossification	• the presence of bone in soft tissue where bone normally does not exist	• Manage Edema • Encourage limited ADL performances • Promote Scar Mobility and proper remodeling • Promote full ROM of affected joint • Encourage quality muscle contractions	

Identify this type of burn

Identify this type of burn

How do you know?

Identify this type of burn

How do you know?

Identify this type of burn

What OT inteventions would be most relevant for this type of burn (wound care, splinting, PAms, exercises etc).

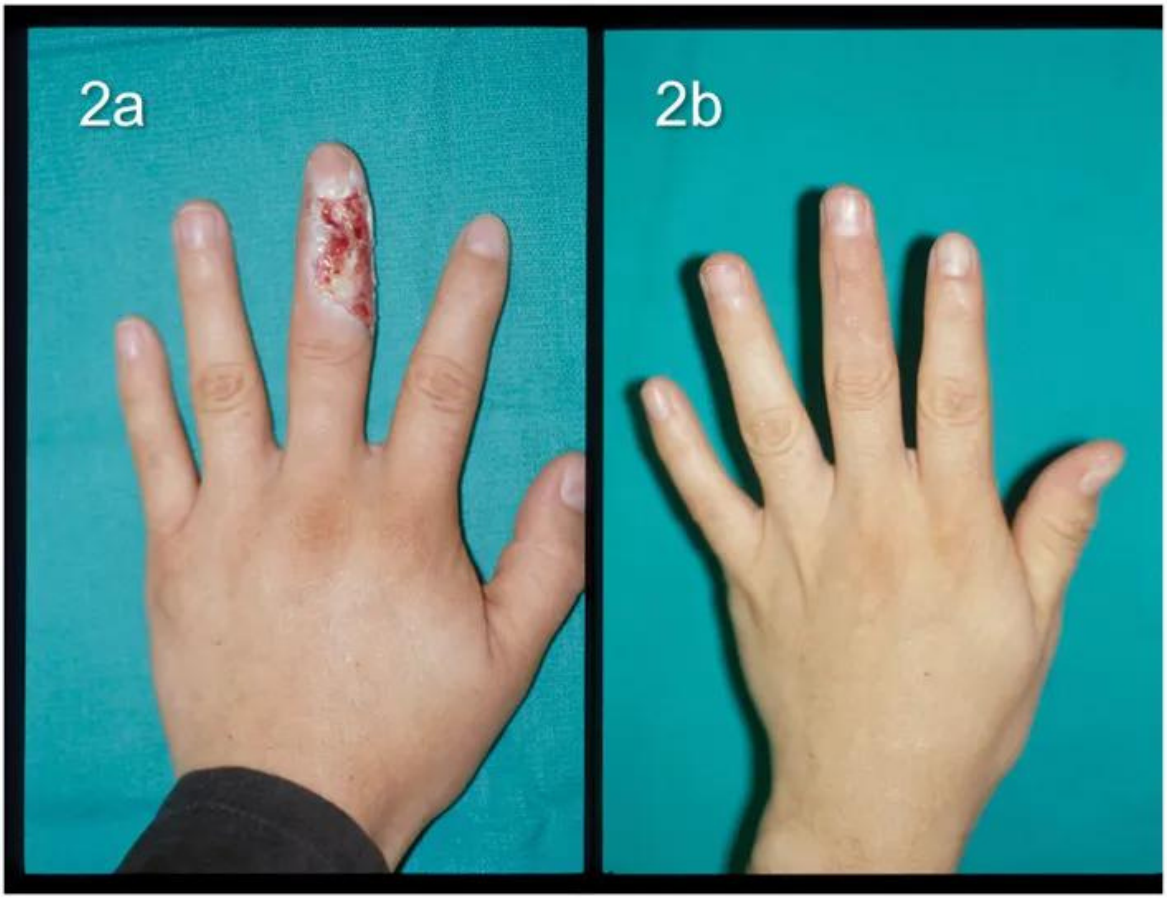
Identify this type of burn

Given the level on injury, what is this patient at risk of? What are specific interventions to prevent these risks?

Identify this type of burn

What OT inteventions would be most relevant for this type of burn

This is a burn before and after treatment



What OT inteventions would be most relevant for this type of burn

This is a burn before and after treatment

What OT interventions would be most relevant for this type of burn

CONTENT WARNING

GRAPHIC IMAGES AHEAD

Review the images and use them to answer the following questions

Case Study: Mr.Ramirez

Mr.Ramirez is a 55-year-old truck driver. He has three children in high school, lives with his older brother and younger sister. Mr. Ramirez has delivered gasoline to gas stations throughout the Southern California region for the past 30 years. When not delivering gas, he takes on other truck driving gigs for several weeks straight in hopes to “take my kids to Disneyland one day.” On a particularly hot day, Mr. Ramirez was waiting for the station workers to pump the gas from his truck into the gas reserves. Unfortunately, a customer was smoking a cigarette nearby and caused an intense gasoline explosion. Mr. Ramirez survived the incident but sustained severe burns all over his body. He was admitted to the Emergency Room unconscious and was immediately tended to by the ER doctors. After 24 hours, begins to stabilize and wakes up, the wound care/burn team (which you are a part of) are called to contribute to his plan of care.

Case Study: Mr.Ramirez

Mr.Ramirez presents with the following:

- Extreme pain in some parts of his body and numbness/loss of sensation in other parts of his body
- Hypersensitivity
- Edema in his upper extremities
- Exposed wounds
- Deep partial burns to his:
  - neck
  - axilla
  - elbow
  - knees
  - ankles
  - hands/wrists
- Mr. Ramirez is currently being intubated and while awake, is highly sedated due to pain

The medical team believes that he is a strong candidate for autografting

Case Study: Mr.Ramirez

Taken immediately after admission to the ER

Case Study: Mr.Ramirez

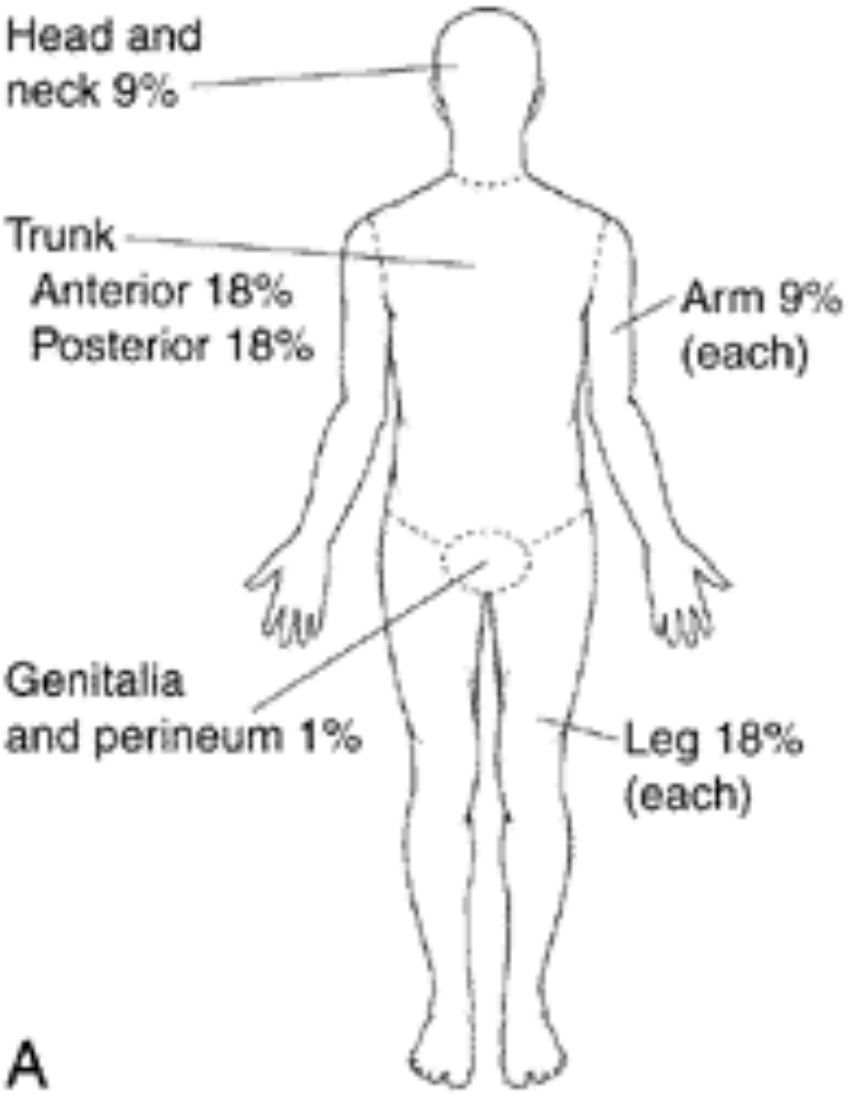
Taken immediately after admission to the ER

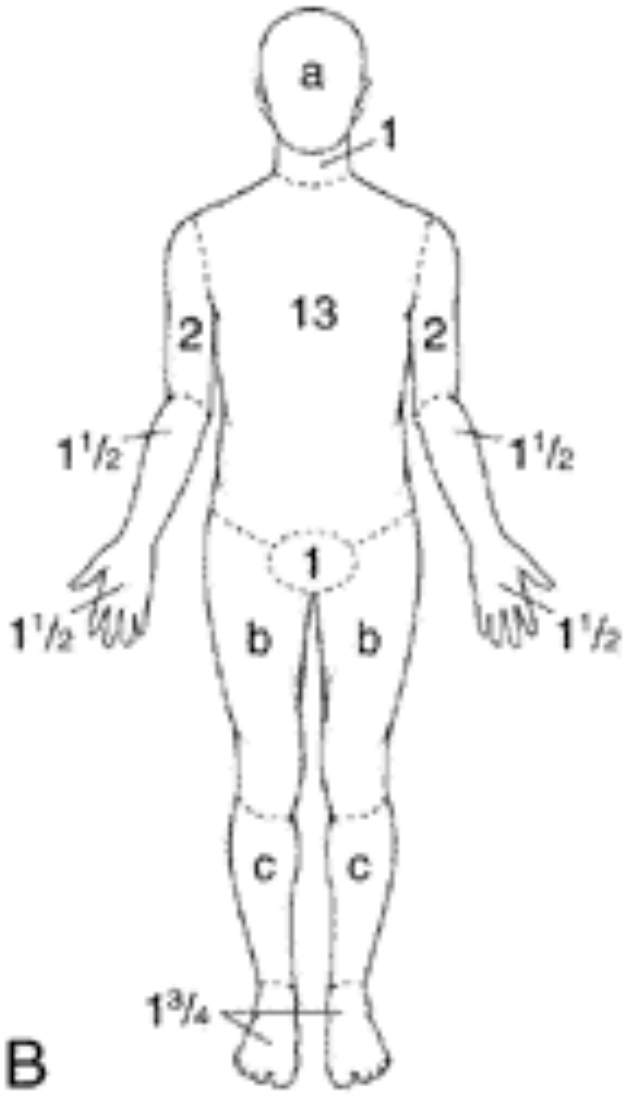
What depth of injury can be observed here

Case Studies: Mr.Ramirez

Posterior side
of Mr.Ramirez’s TBSA chart

Fill out the anterior
side of Mr.Ramirez's TBSA chart





ANTERIOR

Post Escharotomy

Release through eschar (burnt tissue). Done with 24 hours of admission due to circumferential burns and risk of compartment syndrome. Escharotomies generally improve elasticity

- What could be your OT role in helping Mr.Ramirez in this phase?
- What would you want to know abour his condition to best inform your treatment

24-48 hours after admission

- Mr.Ramirez's family comes to visit and it's clear that they're worried and concerned. They're confused about some of the things the doctor said and isn't sure what Mr.Ramirez's timeline is.
- As you support Mr.Ramirez to use active assist ROM to move around some of the lines and tubes hitting his face, the family asks you to stop. They say: "Aren't you doing more damage if he moves? You're putting him in pain?"
- What is your response to their concerns?

After cleaning of the skin

What depth of injury can be observed here

4-5 days Post-Autograft Surgery

The MD clears OT to begin working on motion for Mr.Ramirez at 4-5 days post autograft surgery. How may your intervention look like?

12 days Post-Autograft Surgery

Use your knowledge of wound care. What can you observe in Mr.Ramirez's hand

Positioning

You observe your clinical instructor (CI) positioning Mr.Ramirez like this. She asks if you can use your clinical reasoning to explain to Mr.Ramirez and/or his family why he may be put in this position.

Positioning

What can you observe about this positioning?

Positioning Continued

The MD/Surgeon have written orders for OT to begin “Active motion to severely affected areas” What might these areas be? (hint: use the case study) How would you address each of these areas?

Areas

Intervention

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

2 months Post-Autograft Surgery

The exercises you've been doing with Mr.Ramirez has improved significantly. He asks if you could "make it harder" so that he can heal faster. Why would or wouldn't you want to do that?

Mr. Ramirez has improved significantly. However, he reports some tightness in his armpit area. What positioning would you recommend for him to do? What other OT intervention may be indicated?

Work Cited

Aghajanzade, M., Momeni, M., Niazi, M., Ghorbani, H., Saberi, M., Kheirkhah, R., Rahbar, H., & Karimi, H. (2019). Effectiveness of incorporating occupational therapy in rehabilitation of hand burn patients. Annals of burns and fire disasters, 32(2), 147–152.

Dimander, J., Andersson, A., Miclescu, A., & Huss, F. (2022). Two Modified Questionnaires for the Assessment of Nutrition Impact Symptoms in the Rehabilitation Phase after Burn Injury: A Content Validation Study. European Burn Journal, 3(1), 156–164. https://doi.org/10.3390/ebj3010013

Gittings, P. M., Grisbrook, T. L., Edgar, D. W., Wood, F. M., Wand, B. M., & O'Connell, N. E. (2020). Corrigendum to 'Resistance training for rehabilitation after burn injury: A systematic literature review & meta-analysis' [Burns 44 (2018) 731–751]. Burns, 46(5), 1240–1241. https://doi.org/10.1016/j.burns.2020.02.012

Hartl, G., Fletchall, S., & Velamuri, S. R. (2023). Burn Injury Cutaneous Functional Units: Allocating Occupational Therapy Resources and Influencing Practice. Journal of Burn Care & Research, 44(5), 1117–1124. https://doi.org/10.1093/jbcr/irad037

Kara, S., Seyhan, N., & Öksüz, S. (2023). Effectiveness of early rehabilitation in hand burns. El yanıklarında erken rehabilitasyonun etkinliği. Ulusal travma ve acil cerrahi dergisi = Turkish journal of trauma & emergency surgery : TJTES, 29(6), 691–697. https://doi.org/10.14744/tjtes.2023.22780
Orroth, A (2023). "Burns" Hand and Upper Extremity Certificate, 28 March 2024, Tufts University, Medford, MA. Lecture.

Khanipour, M., Lajevardi, L., Taghizadeh, G., Azad, A., & Ghorbani, H. (2023). Effects of an Occupation-Based Intervention on Hand and Upper Extremity Function, Daily Activities, and Quality of Life in People With Burn Injuries: A Randomized Controlled Trial. The American Journal of Occupational Therapy, 77(5). https://doi.org/10.5014/ajot.2023.050115

Lange, A. M., & Grajo, L. (2021). Promoting Social Participation for Adolescents with Burn Injury: A Guideline for Occupational Therapy Practice. The Open Journal of Occupational Therapy, 9(4), 1–15. https://doi.org/10.15453/2168-6408.1805

Luce, J. C., Mix, J., Mathews, K., Goldstein, R., Niewczyk, P., DiVita, M. A., Gerrard, P., Sheridan, R. L., Ryan, C. M., Kowalske, K., Zafonte, R., & Schneider, J. C. (2015). Inpatient Rehabilitation Experience of Children with Burn Injuries: A 10-yr Review of the Uniform Data System for Medical Rehabilitation. American Journal of Physical Medicine & Rehabilitation, 94(6), 436–443. https://doi.org/10.1097/PHM.0000000000000195

O'Reilly, S., Strong, J., Ziviani, J., Brown, J., & McAuliffe, T. (2023). The Role of the Outpatient Occupational Therapist Treating Patients With Small Burns: A Retrospective Audit of Practice. Journal of Burn Care & Research, 44(1), 87–94. https://doi.org/10.1093/jbcr/irac123

Smith, J (2020). "Acute Care Back to the Basics: Burn Care." Retrieved from https://www.occupationaltherapy.com/articles/acute-care-back-to-basics-5164-5164

Twichell, M. (2023). Inpatient Rehabilitation Following Burn Injury. Physical Medicine and Rehabilitation Clinics of North America, 34(4), 755–765. https://doi.org/10.1016/j.pmr.2023.06.002

Young, A. W., Dewey, W. S., & King, B. T. (2019). Rehabilitation of Burn Injuries. Physical Medicine and Rehabilitation Clinics of North America, 30(1), 111–132. https://doi.org/10.1016/j.pmr.2018.08.004