

**PEDIATRIC BURN TREATMENT**

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**OBJECTIVES**

1. Learn the nomenclature of burns.
2. Understand the expected rate of healing.
3. Methods for wound closure and the associated outcomes.
4. Systems of care supporting burn injuries.
5. Acute burn management in the field.
6. Acute burn management in the trauma center.
7. Indications for transfer to a pediatric burn center.
8. Long term management of pediatric burns.

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**DISCLOSURES**

Consultant to Mimedx  
Grant recipient from Medline

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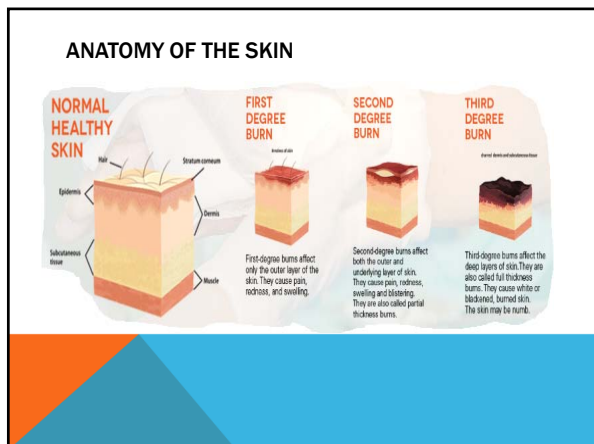
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### 1<sup>ST</sup> DEGREE BURN

Affects only the first layer of skin

Mildest type of burn

Often referred to as a "superficial burn"

Can be very painful

May require medical help

Sun Burn

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### 2<sup>ND</sup> DEGREE BURN

Results in damage extending beyond the top layer of skin

The skin will blister and become extremely red and sore

Should be assessed by a doctor for risk of infection

If over-the-counter pain relief is not sufficient, a prescription medication may be required

2nd Degree Burn

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### 3<sup>RD</sup> DEGREE BURN

Burn extends through every level of skin

One of the most severe burns

If extensive nerve damage has occurred, there may not be any pain

Common signs of a third-degree burn include:

- Bleeding
- Appearing a bit black
- Skin appearing dry or leathery
- May look a little bit black, or skin appears dry or leathery



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### 4<sup>TH</sup> DEGREE BURN

This is the most serious type of burn

Fourth-degree burns penetrate deeply beneath the skin


There is potential for nerve damage and injury to deeper tissues including muscles, tendons, and bones

Due to nerve damage, there may not be any pain

Burns may appear white, brown, yellow, or blackened

Seek emergency medical care immediately

Electrical burns go deep



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### PATHOPHYSIOLOGY OF BURNS

- inflammatory reaction leading to rapid edema formation. → direct heat effect on the microvasculature releases chemical mediators of inflammation.
- increased microvascular permeability. → vasodilation and increased venous permeability caused by histamine release
- vasodilation and increased extravascular osmotic activity

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### PATHOPHYSIOLOGY OF BURN INJURY

- Damage to the cell membranes partly caused by oxygen-free radicals released from polymorphonuclear leucocytes. → Prostaglandins inhibit the release of norepinephrine and may thus be of importance in modulating the adrenergic nervous system which is activated in response to thermal injury.
- Activates the enzymes catalyzing the hydrolysis of prostaglandin precursor (arachidonic acid) with rapid formation of prostaglandin. → Thermal increases in the numbers of vacuoles and many open endothelial intercellular junctions in the blood/lymph barrier.
- Enzymes catalyzing the hydrolysis of prostaglandin precursor (arachidonic acid) with rapid formation of prostaglandin. → Continuous loss of fluid from the blood circulation within the thermally damaged tissue causes increased hematocrit levels and a rapid fall in plasma volume, with decreased cardiac output and hypoperfusion on the cellular level.




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### PATHOPHYSIOLOGY: TREATMENT STRATEGIES

- If the fluids are not adequately restored burn shock develops. → Accurate I/O assessments.
- Burn wound provides a vast area of entry of surface infection with a high risk of septic shock. → Burn wound dressings and early wound closure.
- Hypermetabolic state → Need for enhanced nutrition.




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### STRATEGY OF BURN MANAGEMENT

**Prehospital goals**

- > remove from threat in environment
- > ABCs
- > remove burned clothing
- > cover with dry dressing
- > transport to nearest burn or trauma center

**Hospital goals**

- > accurate diagnosis of TBSA
- > accurate diagnosis of depth of burn
- > precise fluid resuscitation




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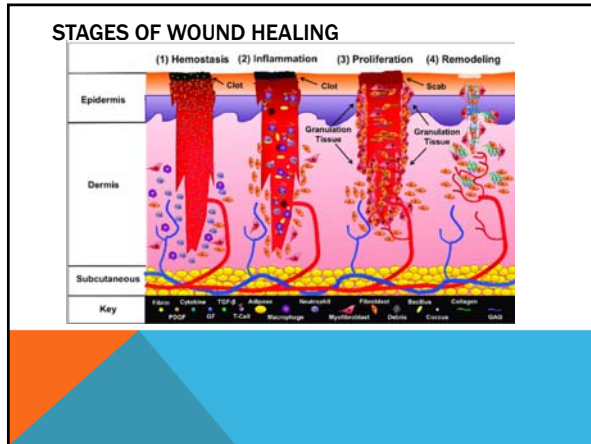
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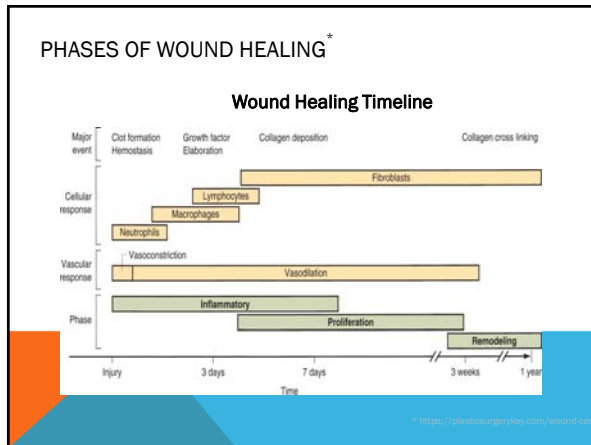
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### METHODS OF WOUND CLOSURE

- Moist wound healing: Hydrogel
- Antibacterial ointment: Bacitracin, Silvadene
- Calcium Alginate
- Mepilex / AG
- Suprathel
- Amnion
- Fish skin
- Cadaveric skin
- Auto grafts : meshed and full thickness
- Cell biopsy and culture

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### IDEAL PEDIATRIC GRAFT FOR SKIN SUBSTITUTE

- Protective barrier.
- Biocompatible.
- Available widely with long shelf life.
- Demonstrated clinical and scientific data.
- Flexible to the depth and contour of the wound.
- Easy to apply and secure.




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### STSG

- Lacks antigenicity - biocompatible.
- May not be available if burn volume large.
- Costly in pain and suffering to child.
- % take variable related to wound, infection.
- Meshed grafts flexible.
- Scarring and contracture rate high.
- Securing grafts in hands, face, feet, genitalia can be challenging.




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### STSG ALTERNATIVES

#### Biologic grafts

- Porcine or cadaveric skin (potential physiologic rejection).
- Placental derived allografts.
- Fish skin

#### Synthetic materials

- Hydrocolloids or hydrogels (moist wound healing).

#### Biosynthetics

- Suprathel , Integra® (requires graft), Apligraf® (short shelf life), Dermagraft® (foreskin)

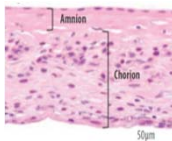


Image Above: Micrograph of Hematoxylin and Eosin (H&E) stained cross section of dehydrated Human Amnion/Chorion Membrane (dHACM), with cell nuclei.

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### EXPECTED RATES OF WOUND HEALING: 1<sup>ST</sup> AND 2<sup>ND</sup> DEGREE BURNS

- Hydrogels
- Antibacterial ointments
- 7-14 day expected wound closure




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### EXPECTED RATE OF WOUND HEALING: >14 DAYS

Standard of care

- Skin grafts
- Split thickness
- Full thickness
- Skin bx and culture




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### DHACM FOR TREATMENT OF PEDIATRIC BURNS

**Dehydrated Human Amnion Chorion Membrane as Treatment for Pediatric Burns**  
 Natasha Ahuja,<sup>1\*</sup> Richard Jin,<sup>2</sup> Colin Powers,<sup>2</sup> Alexandria Bill,<sup>2</sup> and Kathryn Bass<sup>2</sup>  
Department of Plastic and Reconstructive Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, USA

**Background:** Pediatric burns are a major cause of hospitalization. The disease of burn care can lead to lifelong functional loss and disfigurement. While all children who undergo burn care are treated with standard of care, split-thickness and full-thickness grafts, this approach is associated with morbidity, mortality, and long-term alterations in coloration and an increased burn-related scarring.

**Objective:** In the present study, we present a case series of 10 children with various types of burns treated with dehydrated human amnion chorion membrane (DHACM).

**Results:** We show that treatment with DHACM is associated with an overall rate of healing comparable to split-thickness skin grafts with less rate of postoperative pain and morbidity.

**Conclusion:** Treatment with DHACM is a particularly attractive as it consists of split-thickness skin grafts, but the grafts are not associated with the same morbidity, mortality, and long-term alterations in coloration and an increased burn-related scarring that is not seen with split-thickness and full-thickness grafts.

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- Authors: Natasha Ahuja, Richard Jin, Colin Powers, Alexandria Bill, and Kathryn Bass
- Publication: Adv Wound Care, 2019.
- Retrospective study

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### SUMMARY OF OUTCOMES

dHACM - time to closure accelerated - 15-21 days<sup>1</sup>

STSG average time to closure greater - >21 days<sup>1</sup>

dHACM scar and contracture 20.8%<sup>1</sup>

STSG scar and contracture as high as 57% to 64%<sup>2,3</sup>

Excellent cosmesis<sup>1</sup>

Low infection rate - one late fungal rash.<sup>1</sup>

1. Pineda et al. Am J Surg 2015; 210: 1000-1005. 2. Galloway et al. Burns 2005; 31: 1000-1005. 3. Pineda et al. Burns 2015; 41: 1000-1005.

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### SYSTEMS OF CARE

#### Prehospital

- ground crews
- air transport: helicopter, fixed wing

#### Trauma Centers

Level 1, Level 2, Level 3

#### Burn Centers

>10% TBSA burns, special considerations (hands, face, feet, genitalia)

#### Wound Care Centers

small and moderate burns, special considerations with advanced wound care.

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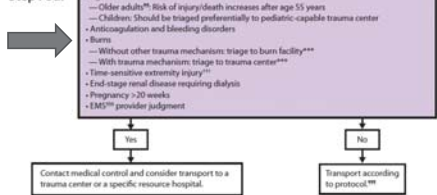
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### CDC FIELD TRIAGE CRITERIA

#### Step Four



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### PREHOSPITAL CARE

Ground transport

Air transport

- Remove from environment and remove affected clothing.
- ABCs
- Airway considerations
- Oxygen
- IV access for fluid bolus
- Wound coverage- dry and clean
- Attention to body temp regulation



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### PARKLAND BURN FORMULA- PEDIATRIC CARE

Charles R. Baxter, MD, (d. 2005)

- Director of the emergency department at Parkland Memorial Hospital in Dallas, TX
- Founded the Parkland Hospital Burn Unit and was an active researcher, making advances in the treatment of burn victims and trauma procedures.
- Dr. Baxter was also one of the physicians who unsuccessfully tried to save John F. Kennedy after he was shot in 1963.



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### PARKLAND BURN FORMULA

- For use in pediatric patients with acute burns.
- Used as a guide.
- Patient physiology guides titration of fluids : Mental status, HR, BP, urine output.
- Fluid creep- excessive fluid resuscitation is detrimental to patient outcomes.
- Inhalation burns may require less fluid - the lung will leak fluid and impair gas exchange via the alveolus.
- Electrical burns may require more fluid - deep space injury will increase the risk for compartment syndrome in the extremities.
- The Parkland Burn Formula was designed for children - to rapidly restore intravascular volume , avoid hypotensive shock, optimally preserve cell mass.



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**PARKLAND BURN FORMULA**

- > Use 4ml of LR solution.
- > Estimate or weigh the body mass in kg.
- > Estimate percent body surface area of burn -  
\*exclude 1<sup>st</sup> degree burns.

24 hour fluid requirement (ml) = 4 ml (LR) x Wt (kg) x %TBSA %

- Give the first half of the total volume calculated in the first 8 hours.
- Give the second half of total volume during the remaining 16 hours.




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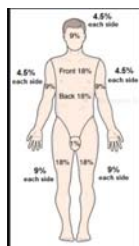
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**RULE OF NINES ADULTS**

- Each Arm : 9 %
- Each Leg : 18 %
- Head : 9%
- Front Torso : 18 %
- Back Torso : 18 %




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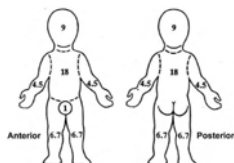
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**RULE OF NINES CHILDREN**

- Each Arm : 9 %
- Each Leg : 14 %
- Head : 18%
- Front Torso : 18 %
- Back Torso : 18 %




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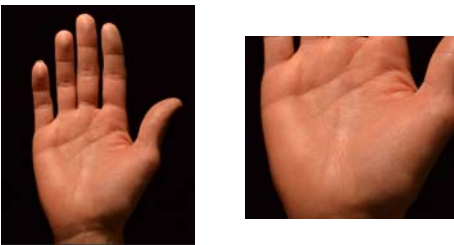
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### 1% TBSA MEASUREMENT



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### TRAUMA CENTER

**Resuscitation**  
ATLS protocol  
primary survey - calculate %TBSA  
start fluid resuscitation - 24 hour volume = 4ml LR/ kg/ hr  
1<sup>st</sup> half volume in first 8 hours.  
2<sup>nd</sup> half volume in remaining 16 hours.

**Admission**  
to the general surgery ward / IMCU for pain control , fluid management.  
to the PICU for critical monitoring , airway control, fluid monitoring.



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### BURN SEVERITY

**First Degree (Partial Thickness)**  
Superficial, red, sometimes painful.

**Second Degree (Partial Thickness)**  
Skin may be red, blistered, swollen. Very painful.

**Third Degree (Full Thickness)**  
Whitish, charred or translucent, no pin prick sensation in burned area.



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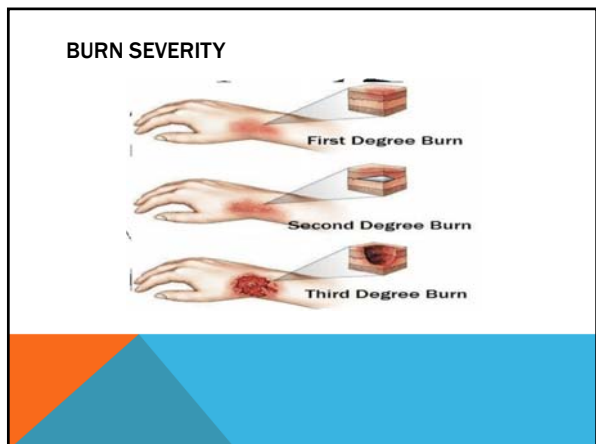
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SEVERITY ?



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SEVERITY ?



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INDICATIONS FOR TRANSFER TO BURN CENTER



Courtesy of the  
**American Burn Association**  
Advanced Burn Life Support (ABLS)  
Learn more about the ABA and ABLS at [www.ameriburn.org](http://www.ameriburn.org)

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### INDICATIONS FOR TRANSFER TO A BURN CENTER

1. Partial thickness burns greater than 10% total body surface area (TBSA).
2. Burns that involve the face, hands, feet, genitalia, perineum, or major joints.
3. Third degree burns in any age group.
4. Electrical burns, including lightning injury.
5. Chemical burns.
6. Inhalation injury.
7. Burn injury in patients with preexisting medical disorders that could complicate management, prolong recovery, or affect mortality.
8. Any patient with burns and concomitant trauma (such as fractures) in which the burn injury poses the greatest risk of morbidity or mortality. In such cases, if the trauma poses the greater immediate risk, the patient may be initially stabilized in a trauma center before being transferred to a burn unit. Physician judgment will be necessary in such situations and should be in concert with the regional medical control plan and triage protocols.
9. Burned children in hospitals without qualified personnel or equipment for the care of children.
10. Burn injury in patients who will require special social, emotional, or rehabilitative intervention.

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### BENEFITS: LOCALIZED SITE OF SERVICE

- No separation** of child from family.
- No hardship** for parents to travel.
- Less loss of time** from other family members.
- More time in home community** for work.
- Better access to other social supports** in home community.
- Eliminate health care costs of transfer.**

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### LONG TERM OUTCOMES:VANCOUVER SCAR SCALE

Vascularity	Normal	0
	Pink	1
	Red	2
	Purple	3
Pigmentation	Normal	0
	Hypopigmentation	1
	Hyperpigmentation	2
Pliability	Normal	0
	Supple	1
	Yielding	2
	Firm	3
	Ropes	4
Height	Contracture	5
	Flat	0
	<2 mm	1
	2-5 mm	2
	>5 mm	3
<b>Total score</b>		<b>13</b>

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