Pediatric Hand Burns

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  - Department of Surgery, University of Colorado
  - Children's Hospital Colorado
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  - Department of Surgery, University of Colorado
  - Children's Hospital Colorado
  - CU Innovations

Today's topic will not reference anything related to the above disclosures

Overview

- Depth, size and ABA referral criteria
- Anatomical considerations
- Initial management
- Surgical management
- Types of hand burns
- Our experience
- Summary

Depth, Size and ABA Referral Criteria

Depth of Burn Injuries

2nd DEGREE

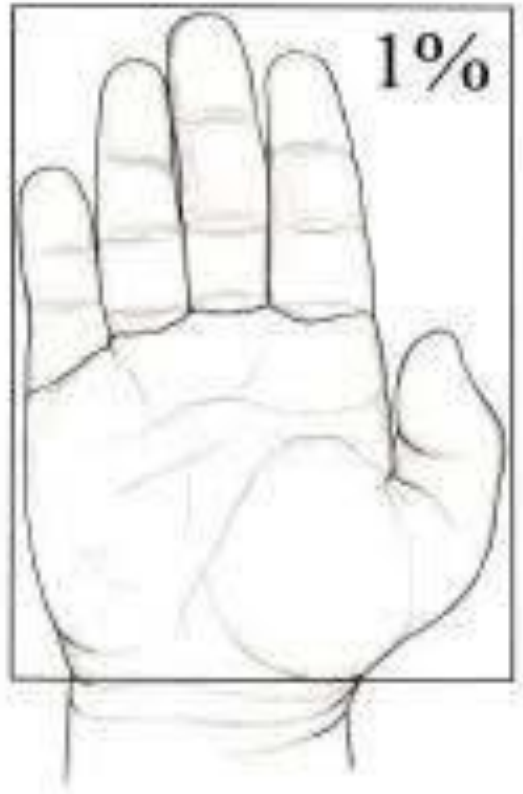
- Involves superficial to deep dermis
- Hallmark is blister
- Painful, moist
- Most heal in ≤ 21 days

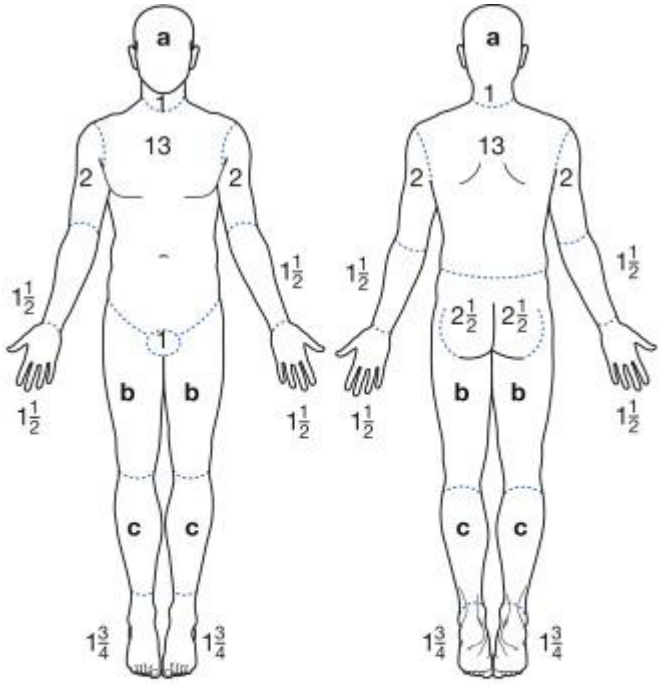
3rd DEGREE-FULL THICKNESS

- Burn into subcutaneous tissue
- Dry, leathery, and insensate
- Does not blanch
- Will probably need grafting

How to Calculate % TBSA

- Only include 2nd, 3rd, and 4th degree burns
- Palmar surface (hand + fingers + thumb) is 1% TBSA
- Use Lund Browder for larger burns





	Age in years					
	0	1	5	10	15	Adult
a - 1/2 of head	9 1/2	8 1/2	6 1/2	5 1/2	4 1/2	3 1/2
b - 1/2 of one thigh	2 3/4	3 1/4	4	4 1/4	4 1/2	4 3/4
c - 1/2 of one leg	2 1/2	2 1/2	2 3/4	3	3 1/4	3 1/2

ABA Burn Referral Criteria

University Hospital: ages ≥ 15

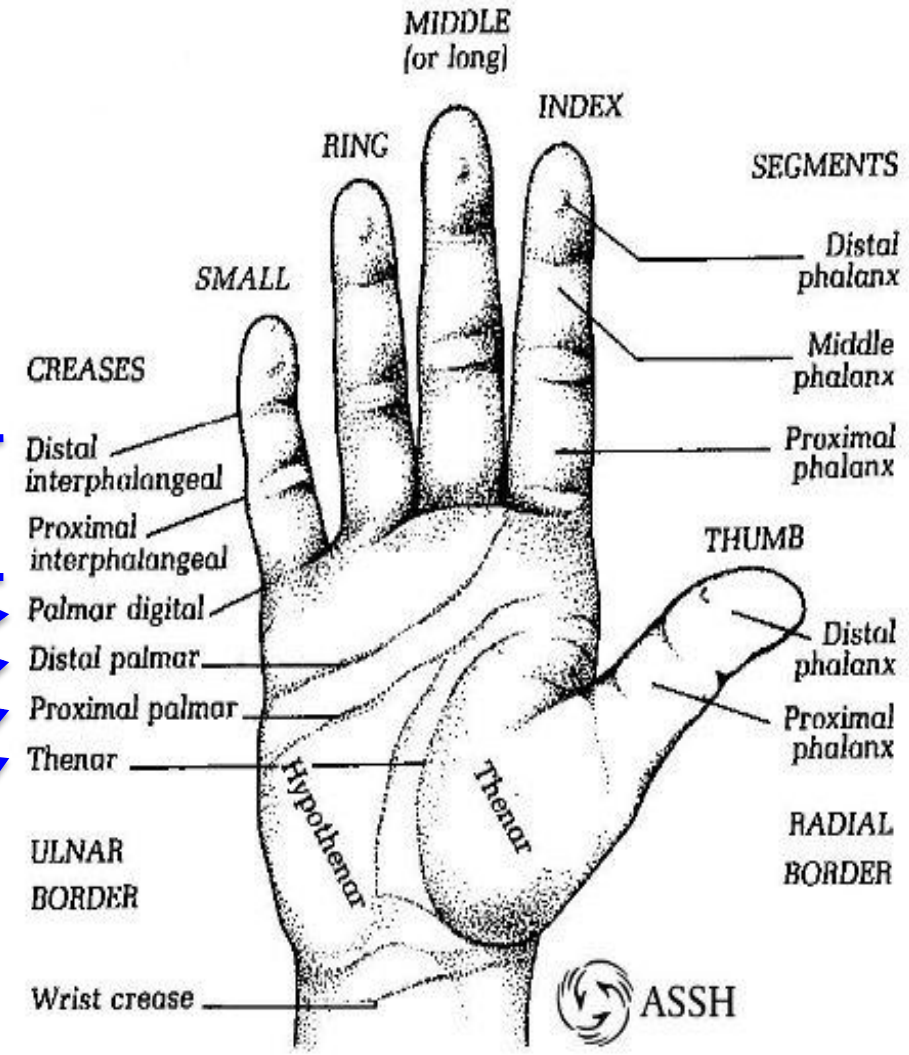
Children's Hospital: ages 0 – 14 (≤ 60% TBSA)

- (Partial thickness, age < 2, > 5% TBSA)
- Partial thickness, age ≥ 2, > 10% TBSA
- Burns of: face, hands (if burns cross joints and/or are deep), feet, genitalia, perineum, major joints
- Full thickness burns
- Electrical (incl. lightening)/chemical burns
- Special: infant, trauma/NAT, etc.

Anatomical Considerations

Anatomical Considerations

- Joints:
  - Interphalangeal joints
  - MCP joints
  - Wrist
- Creases:
  - Interphalangeal
  - Palmar digital
  - Distal palmar
  - Proximal palmar
  - Thenar crease



Anatomical Considerations

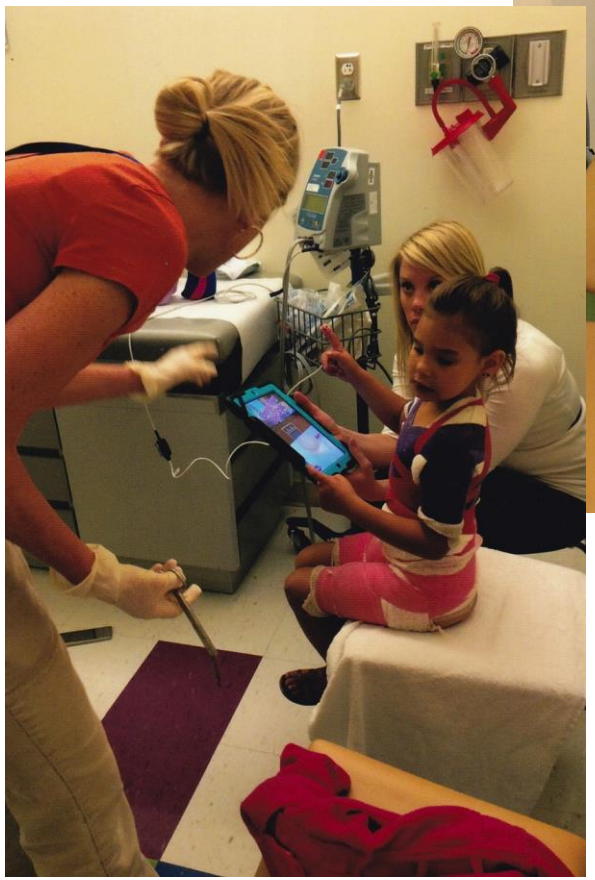
- Skin and sensation
  - Cutaneous sensation
  - Elasticity of the dorsal skin
  - Stability of the palmar skin and palmar fascia

- Biomechanical Forces
  - Power of the flexor tendons

Initial Management

ED and Outpatient Management

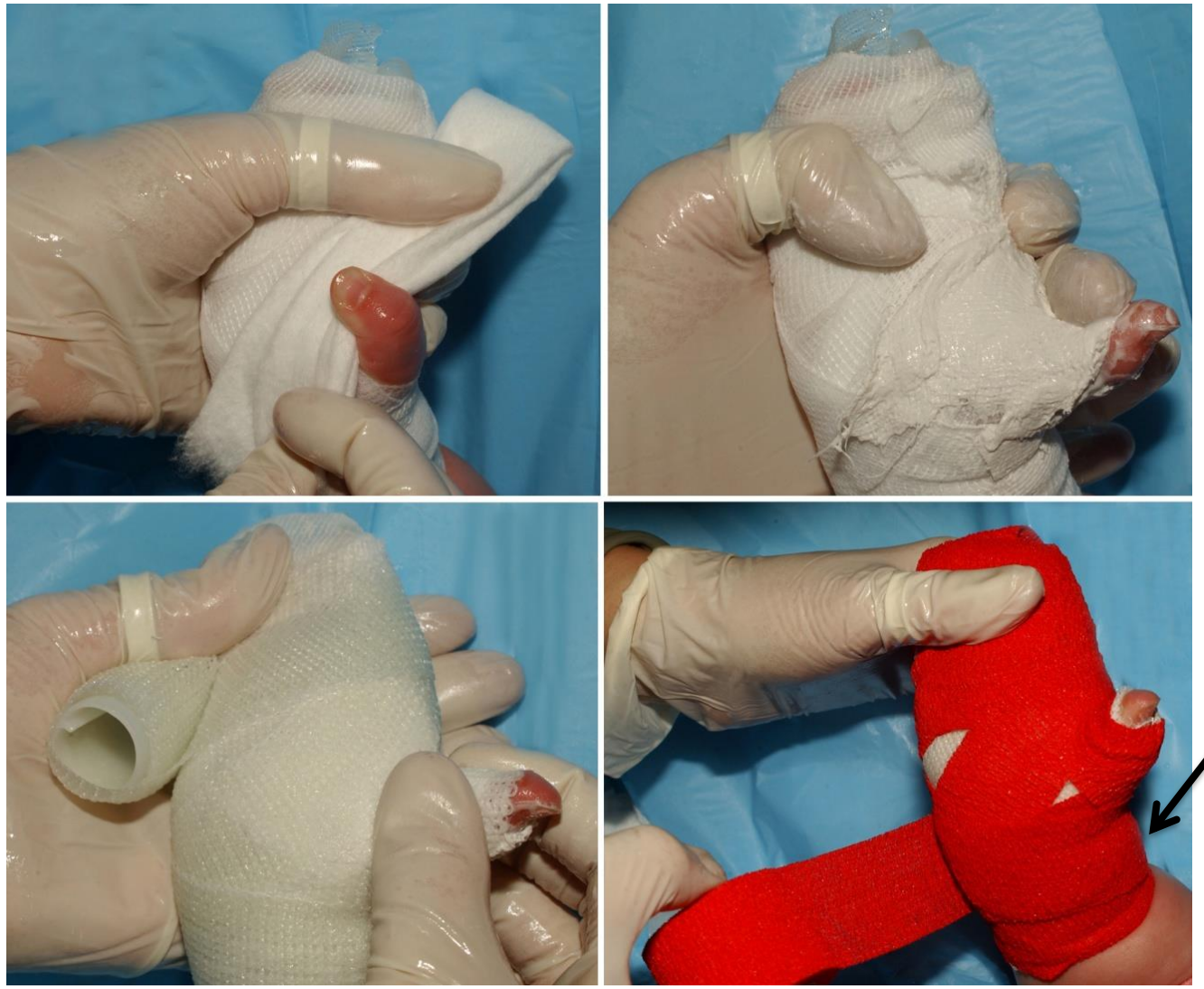
- Pre-medicate for pain
  - Small burn (1-2%)
    - Intra-nasal fentanyl (1.5 mcg/kg/dose)
    - PO acetaminophen + oxycodone
  - Moderate size burn (>3%)
    - IV narcotic or OR
  - Avoid NSAIDs if considering surgery
- Manage anxiety
  - Child-Life
  - Anxiolytic
    - Lorazepam



ED and Outpatient Management

- Blisters
  - If FLAT, leave them INTACT
  - If RAISED, then window or debride with scissors
- Dressings
  - TAO or Bacitracin in a non-adherent dressing
    - Inexpensive, easy to apply/remove; change once or twice per week
    - Switch to Nystatin (almost healed) at 7-10 days
    - Switch an active silver dressing with silicone adhesive (deep partial to full thickness) once drainage stops
- Discharge with oral pain medication (narcotic)
  - Dressing changes, physical activity, sleep

1. Window and/or debride blisters
2. Cover open areas with TAO impregnated non-adherent dressing
3. Wrap with 1 and/or 2-inch rolled gauze, bring proximal to wrist



Wrap proximal to wrist to prevent early removal

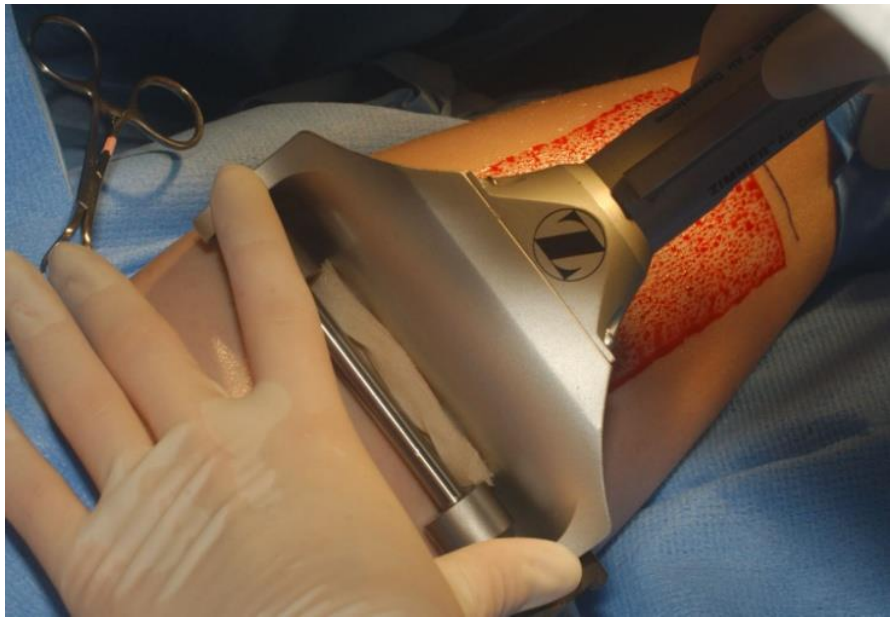
4. Apply soft cast pad around thumb and over palm
5. Apply plaster then wrap with 1 and/or 2-inch soft cast
6. Finish with 1 or 2-inch stretch wrap

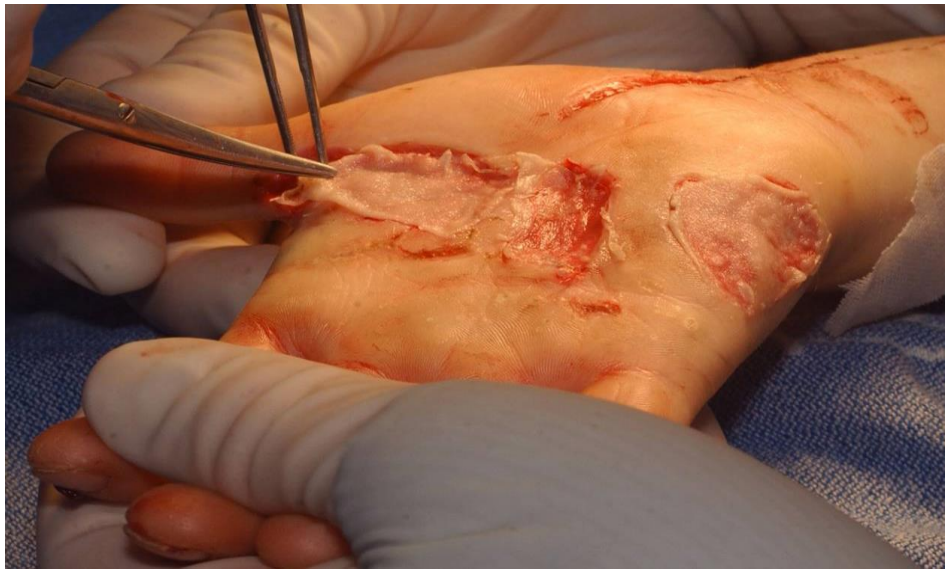
Surgical Management

Follow the 14 - 21 Day Rule to Preserve….

- Normal motor development
  - Growth spurts at ages
    - 2-3 years old, girls/boys
    - 8-13 years old, girls
    - 10-15 years old, boys
- Age-appropriate activities
  - Fine motor skills
  - Developmental/gross motor skill acquisition
- Activities of daily living
  - Handwriting
  - Self feeding

Split Thickness Skin Grafting

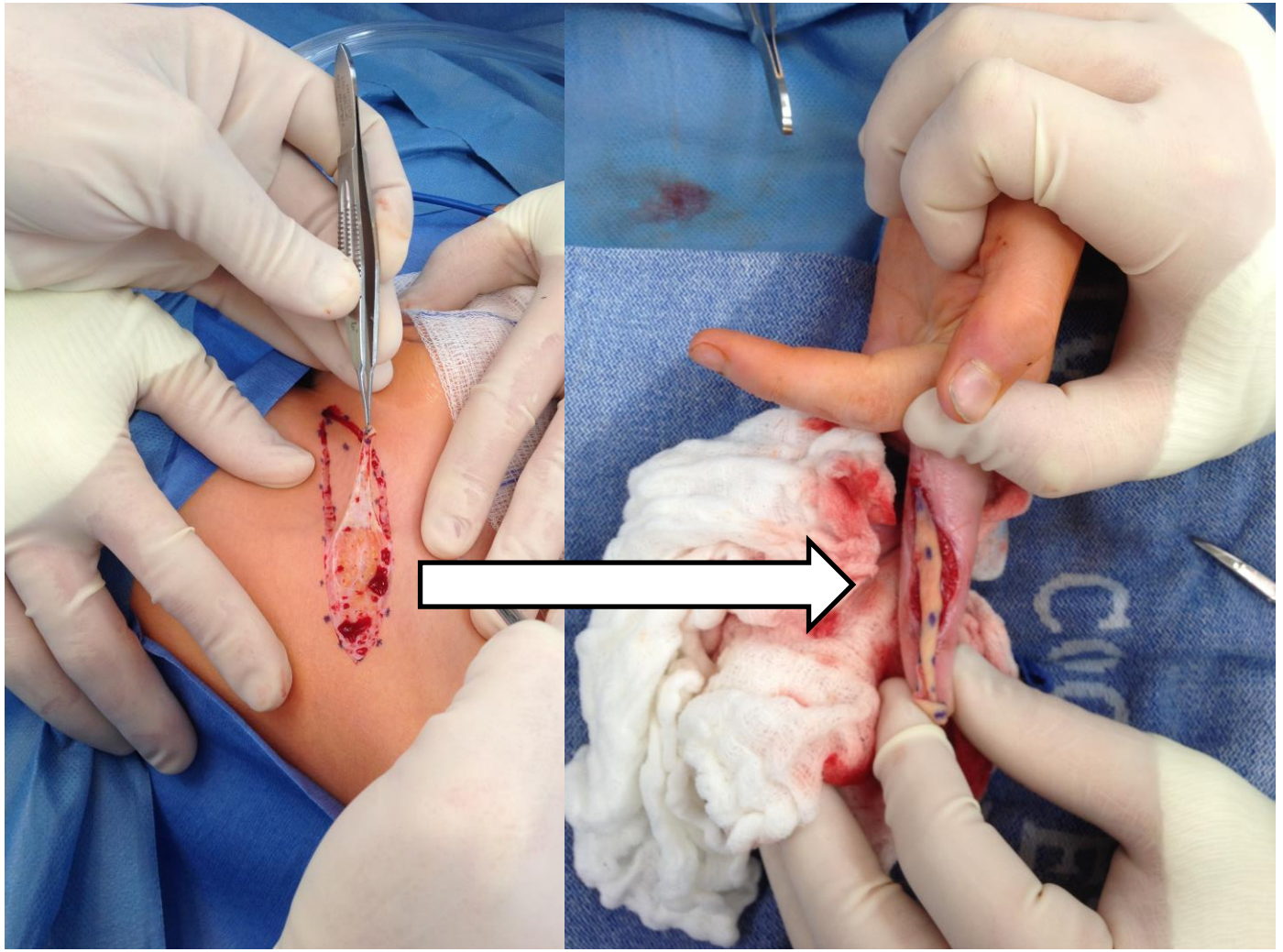




- Deep partial thickness burns
- Dorsum or large area in combination w/ FTSG
- Donor from thigh/buttock

Full Thickness Skin Grafting

- Ideal donor site
  - Soft, flexible skin
  - Non-hair bearing
  - Donor site easily hidden
    - Wrist crease
    - AC fossa crease
    - Lateral groin crease
    - Anterior abdominal wall
    - Thigh-buttock crease



Full Thickness Skin Grafting

Lotion massage
3-4x/day for
12-24 months

Specific Types of Hand Burns and Their Management

Heat Contact Type Injuries

- Most common cause of hand burns among children
  - Firepits (hot coals)
  - Stovetops
  - Glass fronted gas fireplaces
  - Oven doors
  - BBQs
  - Irons
    - Curling
    - Clothes

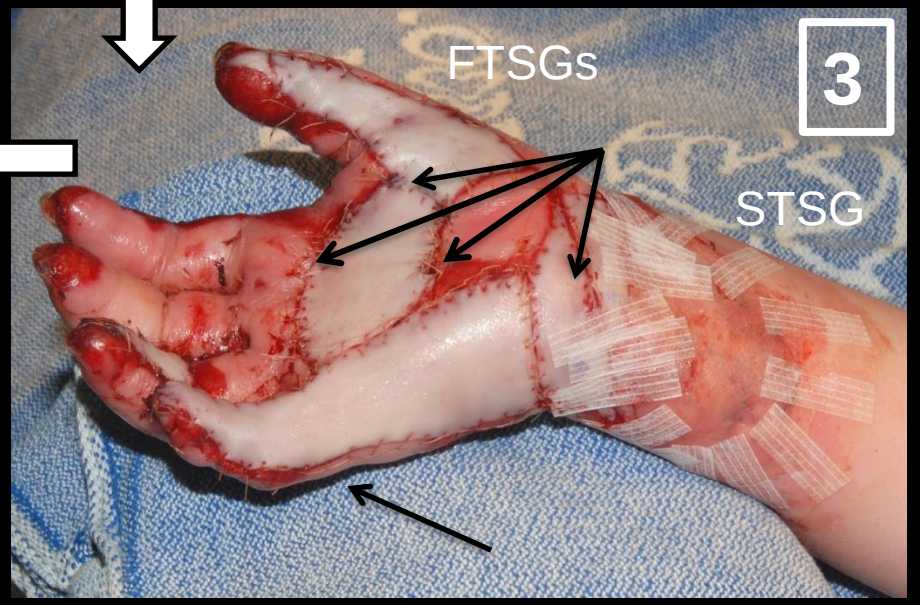

Clothing iron


Fell into campfire

20 month old male fell into campfire with hot embers

After 2 weeks of casting

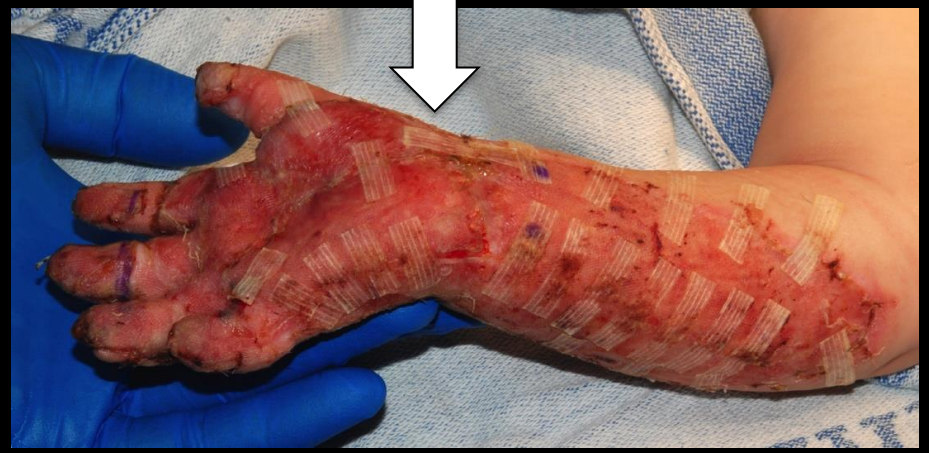
Harvesting full thickness grafts

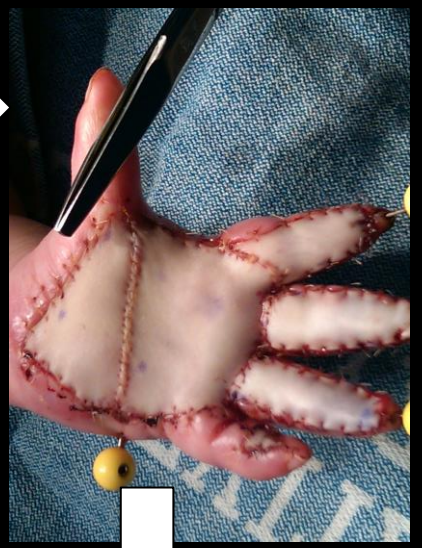


Intra-op full thickness and STSGs

One week post-op

Hot Glass Fronted Gas Fireplace (GFGF) Burn Injuries





25 months post-burn

Ten Year Follow-up in August 2021

ORIGINAL ARTICLE

A Multicenter Study of Preventable Contact Burns From Glass Fronted Gas Fireplaces

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Glass fronted gas fireplaces (GFGFs) have exterior surfaces that can reach extremely high temperatures. Burn injuries from contact with the glass front can be severe with long-term sequelae. The Consumer Product Safety Commission reported that these injuries are uncommon, whereas single-center studies indicate a much higher frequency. The purpose of this multi-institutional study was to determine the magnitude and severity of GFGF injuries in North America. Seventeen burn centers elected to participate in this retrospective chart review. Chart review identified 402 children ≤10 years of age who sustained contact burns from contact with GFGF, who were seen or admitted to the study hospitals from January 2006 to December 2010. Demographic, burn, treatment, and financial data were collected. The mean age of the study group was 16.8±13.3 months. The majority suffered burns to their hands (396, 98.5%), with burns to the face being the second, much less common site (14, 3.5%). Two hundred and sixty-nine required rehabilitation therapy (66.9%). The number of GFGF injuries reported was 20 times greater than the approximately 30 injuries estimated by the Consumer Product Safety Commission's 10-year review. For the affected children, these injuries are painful, often costly and occasionally can lead to long-term sequelae. Given that less than a quarter of burn centers contributed data, the injury numbers reported herein support a need for broader safety guidelines for gas fireplaces in order to have a significant impact on future injuries. (J Burn Care Res 2015;36:240–245)

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This study was supported by a grant from the University of Iowa Injury Prevention Center. The study sponsor did not have any role in study design; collection, analysis, or interpretation of data. The study sponsor had no role in writing the report and the decision as to where to submit the report for publication.

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- GFGFs temps 400 – 1,000 F (200-500 C)
  - Instantaneous 3rd degree burn 172 C
- 5-year multicenter retrospective study
  - 17 pediatric burn centers
  - 402 GFGF burn injuries
    - Mean age 16.8 months
    - 98.5% hand(s), 3.5% face
    - 3-11% required surgery
    - Successful outcomes: OTx with splinting, casting
  - 25% of US burn centers contributed
    - 80/year [20x > CPSC (4/yr)]

Flame Injuries

- Fireworks
- Campfires
- House fires

Friction Type Injuries

- Causes
  - Treadmills
  - Vacuum Cleaners
- Usually very deep
  - Exposed tendon/joint
  - Neurovascular bundle
- Areas of concern
  - Flexion contractures, which pull on landmarks
  - Proximal and distal palmar creases

Example Case 1

Straightforward

Example Case 2

Complex

Exposed joint capsules
Disrupted flexor tendon 5th finger

Scald Type Injuries

- Flow or spill pattern
  - Accidental?
  - NAT?
    - Telltale signs

Partial thickness flow pattern burns

- Immersion burns
  - Accidental?
  - NAT?
    - Telltale signs

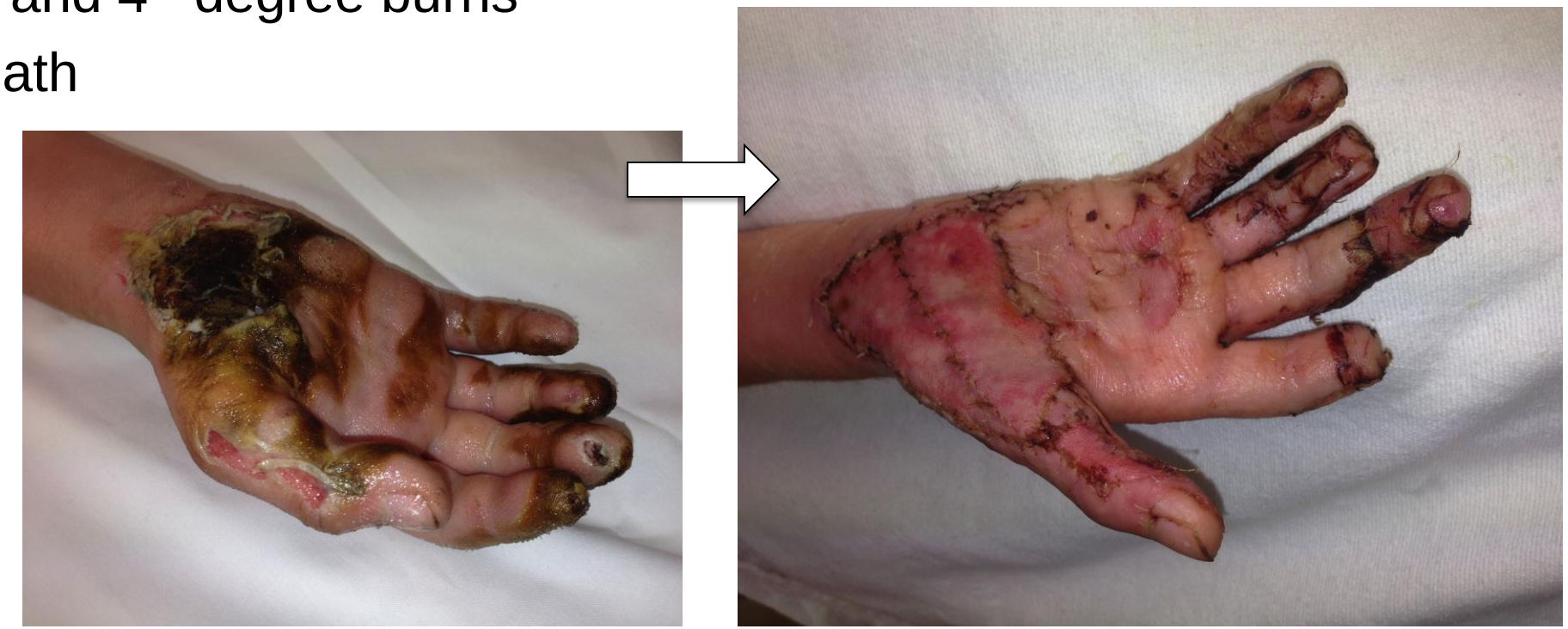
Deep partial to full thickness immersion pattern burns

Scald Type Injuries

- Spill pattern scald burns
  - Caused by
    - Reaching for coffee, tea, soup, ramen noodles
    - Hot showers
  - Keep:
    - Children out of the kitchen
    - Hot liquids up high, away from counter edge
    - Pots and pans on rear burners
    - Your water heater < 120^0

Electrical Type Injuries

- Low voltage ≤ 1000 volts
  - Frequent cause of cardiac dysrhythmia
  - If ECG normal, no further evaluation needed
- High voltage > 1000 volts
  - 3rd and 4th degree burns
  - Death



IV Infiltrate Injury

- 2 MO with biliary atresia
- Dressing changes
- PID 20 excised forearm to wrist, closed
- Casted for 3 weeks
- Scar management

IV Infiltrate Injury

- 20 MO w/ absent corpus callosum, Sz's
- OR for escharotomy
- At 2 weeks excised Ca^{2+} central area f/b wound closure
- Casted in wrist flexion
- Scar management

IV Infiltrate Injury

- 26 week pre-term male
- Dressing changes
- Casted
- No skin loss
- Healed

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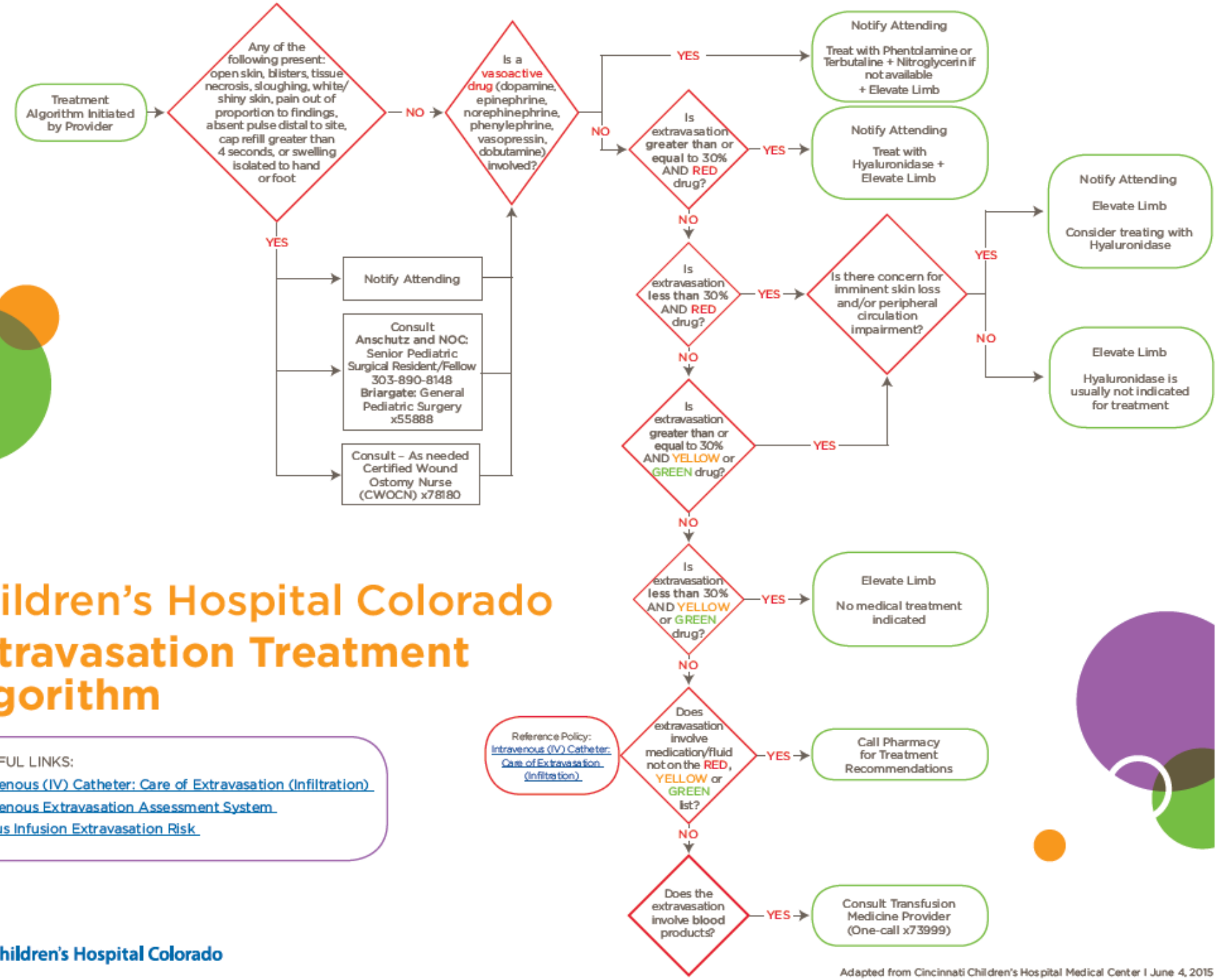
Extravasation Treatment Algorithm



HELPFUL LINKS:

Intravenous (IV) Catheter: Care of Extravasation (Infiltration)

Intravenous Extravasation Assessment System

Venous Infusion Extravasation Risk

Children's Hospital Colorado

Adapted from Cincinnati Children's Hospital Medical Center | June 4, 2015
NA_140447_2015-06

Experience Managing Pediatric Hand Burns at CHCO

Retrospective Review of Hand Burns

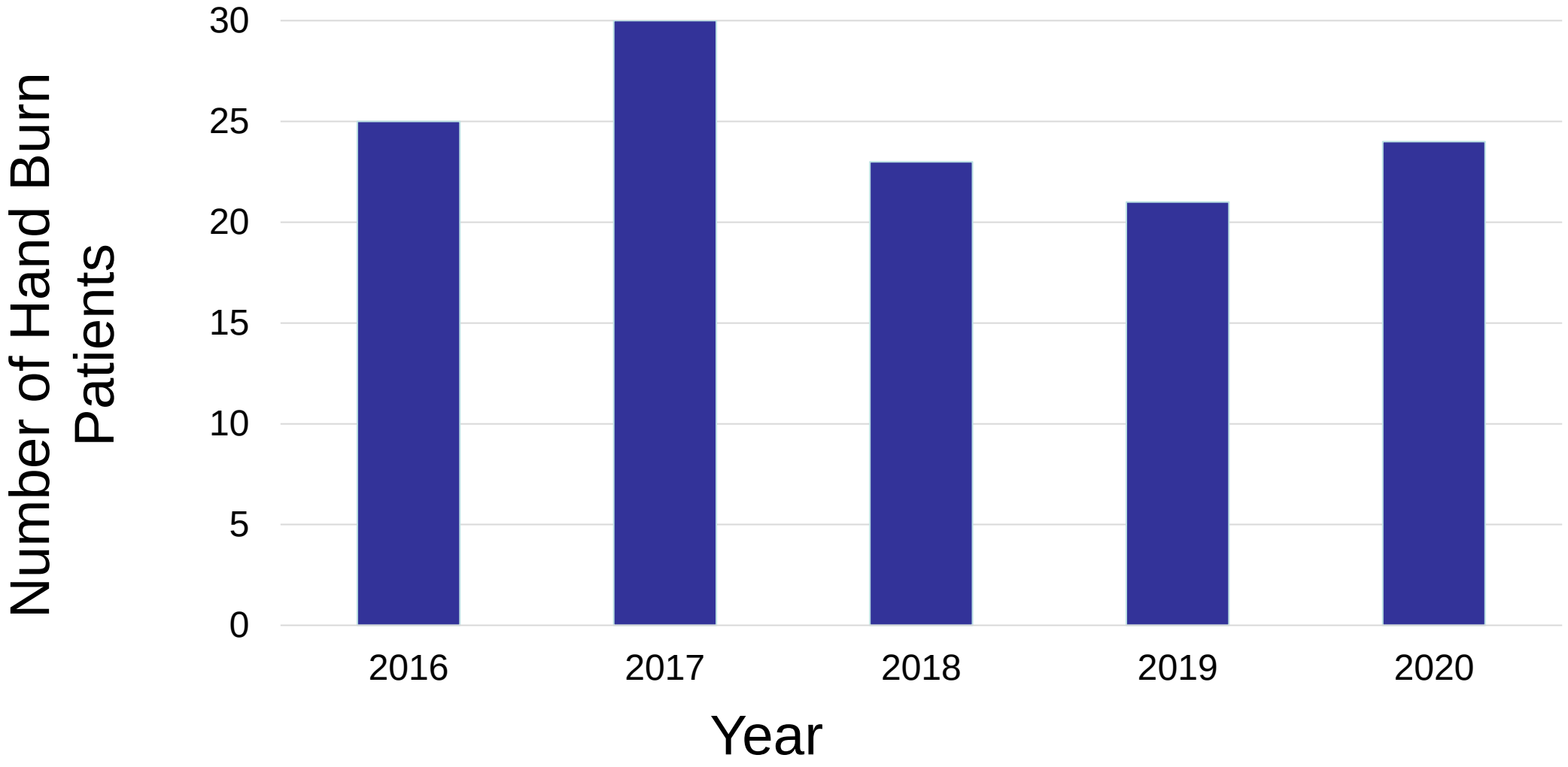
- Children ages 0-18 yrs. Old, managed in the outpatient (ED and clinic) or inpatient settings between 2016 and 2020

- **1980 (94.3%) outpatient**
- **120 (5.7%) inpatient**

	Hand Burns (n=2100)	**Operative*** (N=123, 1.1%)
Chemical	21 (1.0%)	3 (11.1%)
Contact	1270 (60.5%)	30 (2.4%)
Electrical	81 (3.9%)	2 (2.5%)
Fire/Flame	165 (7.9%)	15 (9.1%)
Grease	68 (3.2%)	3 (4.4%)
Road Rash/Friction	156 (7.4%)	61 (39.1%)
Scald	315 (15.0%)	7 (2.2%)
Other	7 (0.3%)	0
Unknown	17 (0.81%)	2 (11.8%)

*Percentages are representative of total number of patients burned by that mechanism

Yearly Hand Burn Cases Requiring Grafting



Characteristics of Surgical Patients

	Operative Population
Age (years)	3.80 (3.94)
Gender	
Male	80 (65.04%)
Female	43 (34.96%)
Race	
White	74 (60.16%)
Black	8 (6.50%)
Hispanic	29 (23.58%)
Asian	5 (4.07%)
Native American Indian	1 (0.81%)
More than One	2 (1.63%)
Other	4 (3.25%)

- 123 patients required skin grafting for their hand injury

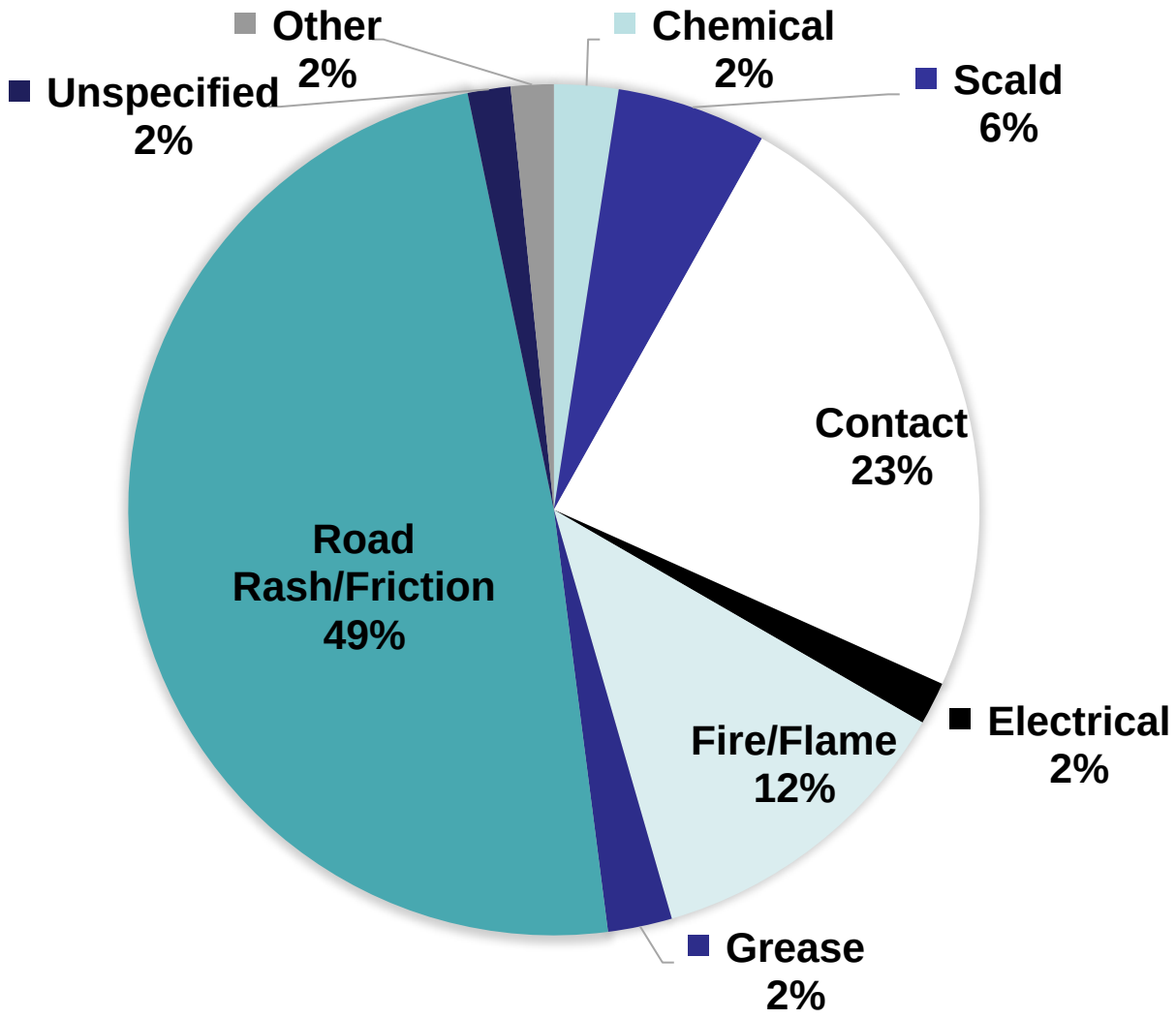
Seen as Outpatient First	Operative Population
Yes	107 (86.99%)
No (Admitted from ED)	16 (13.01%)
ED Disposition (n=16)	
PICU	9 (56.25%)
Floor	7 (43.75%)

Characteristics of Surgical Patients

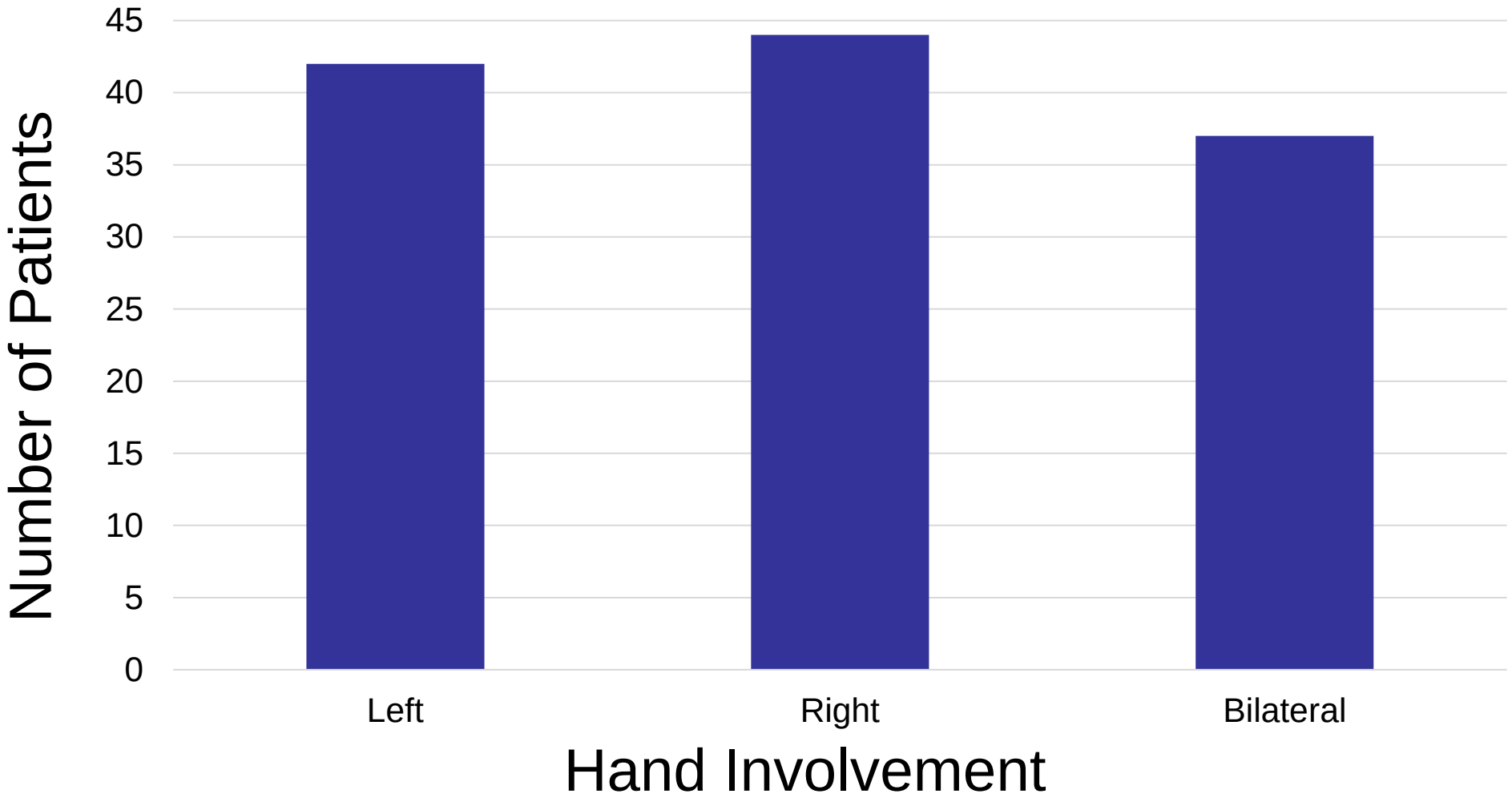
	Operative Population
Time from Burn Injury to First Clinic Visit (days)	4.14 (3.43)
Number of Clinic Visits Before Skin Graft	1.93 (1.15)
1st Primary Dressing Layer	
Antibiotic Impregnated	56 (45.53%)
Nystatin Impregnated	10 (8.13%)
Active silver	48 (39.02%)
Unknown	9 (7.32%)
Outer Dressing	
Soft Dressing	38 (30.89%)
Soft cast	81 (65.85%)
Unknown	4 (3.25%)

Mechanisms of Full Thickness Burn Injury Requiring Surgery

Mechanism	Operative Population (n=123)
Chemical	3 (2.44%)
Scald	7 (5.69%)
Contact	29 (23.58%)
Electrical	2 (1.63%)
Fire/Flame	15 (12.20%)
Grease	3 (2.44%)
Road Rash/Friction	60 (48.78%)
Unspecified	2 (1.63%)
Other	2 (1.63%)
TBSA	
Average (SD)	4.46 (10.51)
Median (Range)	1 (0.75, 69)



Hand Involvement



Operative Data

	Operative Population
Average Time from Burn Injury to Skin Graft	11.63 (5.44)
Number of Operations Needed Total	1.68 (1.61)
Type of Operation	
Split Thickness Graft	28 (22.76%)
Full Thickness Graft	90 (73.17%)
Both ST and FT Graft	5 (4.07%)
Time to Post Op Visit	11.21 (2.73)
Incomplete Graft Take	5 (4.07%)
Second Operation	0
Post-Op Infection	1 (0.81%)
Prophylactic Fluconazole	39 (31.71%)

Patients with Delayed Presentation

- 7 patients presented to clinic after hand burns had healed requiring scar contracture release with skin grafting

	Total Patients (n=7)
Time from Burn Injury to Burn Clinic Presentation	1.5 months – 4 years
Initially Managed by Non-Burn Clinician*	6 (85.7%)
Hospitalized for Burn	1 (14.3%)
Burn Mechanism	
Contact	6 (85.7%)
Road Rash/Friction	1 (14.3%)

**Data on initial management missing for patient seen 4 years after burn*

Key Points for Managing Pediatric Hand Burns

- Know your center's limitations (when to keep vs. refer)
- Critically evaluate the circumstances and pattern of every pediatric burn injury (be skeptical)
- Outpatient management
  - The vast majority (99%) heal without surgery, however…..
  - Position and soft cast in extension (serial casting is key)
  - Frequency of dressings and primary layer must match wound needs
- Parent education (no tub baths, no showers, hi cal/protein diet
- Scar management
  - Lotion massage and pressure with garments +/- gels or putty
  - Naptime and nighttime splinting as needed
  - Long term OT follow up (1-2 years)

Caring For Children With Burn Injuries is a Team Sport

Children's Hospital Colorado

No ordinary camps

Burn Camps Program

Improving the Lives of Burn-Injured Children

Thank You!

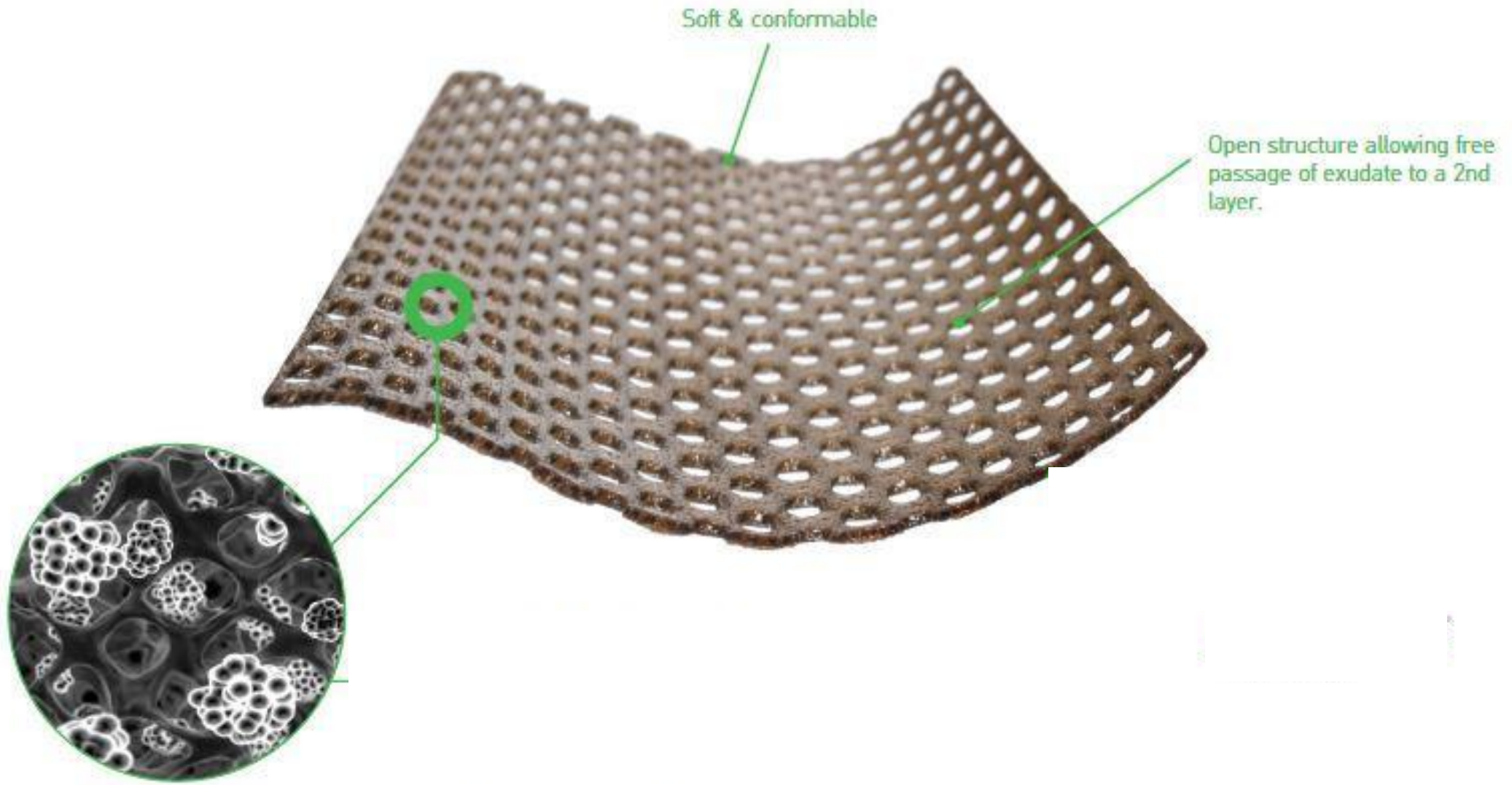
- Pediatric surgeon in-house 24h/day
- Burn clinic (qT, qW and qF)

  720-777-6604
- Patient transfers

  720-777-8838
- JFS and Burn Camps

  720 777-8295

www.noordinarycamps.org


Soft & conformable
Open structure allowing free passage of exudate to a 2nd layer.