BURN

Epidemiology

- Tissue injury caused by thermal, electrical, or chemical agents
- Can be fatal, disfiguring, or incapacitating
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- Can be fatal, disfiguring, or incapacitating

Risk Factors

- Fire/Combustion
  - Firefighter
  - Industrial Worker
  - Occupant of burning structures
- Chemical Exposure
  - Industrial Worker
- Electrical Exposure
  - Electrician
  - Electrical Power Distribution Worker

Types of Burn Injuries

- Thermal burn
  - Skin injury
  - Inhalation injury
- Chemical burn
  - Skin injury
  - Inhalation injury

        - Mucous membrane injury
- Electrical burn
    - Lightning
- Radiation burn
- Thermal burn
    - Skin injury
    - Inhalation injury
- Chemical burn
    - Skin injury
    - Inhalation injury
    - Mucous membrane injury
- Electrical burn
    - Lightning
- Radiation burn

Effects

- Burn injury causes destruction of tissue, usually the skin, from exposure to thermal extremes (either hot or cold), electricity, chemicals, and/or radiation
    - The mucosa of the upper GI system (mouth, esophagus, stomach) can be burned with ingestion of chemicals
    - The respiratory system can be damaged if hot gases, smoke, or toxic chemical fumes are inhaled
    - Fat, muscle, bone, and peripheral nerves can be affected in electrical injuries or prolonged thermal or chemical exposure

- Skin damage can result in altered ability to sense pain, touch, and temperature

Skin

- Largest body organ. Much more than a passive organ.
  - Protects underlying tissues from injury
  - Temperature regulation
  - Acts as water tight seal, keeping body fluids in
  - Sensory organ
  - Two layers
  - Epidermis
  - Dermis
  - Epidermis
  - Outer cells are dead
  - Act as protection and form water tight seal
  - Two layers
  - Epidermis
  - Dermis
  - Epidermis
  - Outer cells are dead
  - Act as protection and form water tight seal

  Epidermis

  - Deeper layers divide to produce the stratum corneum and also contain pigment to protect against UV radiation

  Dermis

- Consists of tough, elastic connective tissue which contains specialized structures
- Dermis - Specialized Structures
- Nerve endings
- Blood vessels
- Sweat glands
- Oil glands - keep skin waterproof, usually discharges around hair shafts
- Hair follicles - produce hair from hair root or papilla
- Each follicle has a small muscle (arrectus pillorum) which can pull the hair upright and cause goose flesh

CLASSIFICATION OF BURNS

Burn Classification – Depth Burn Classification - Depth

- Old terminology
  - 1st degree: only the epidermis
  - 2nd degree: epidermis and dermis, excluding all the dermal appendages
  - 3rd degree: epidermis and all of the dermis
  - 4th degree: epidermis, dermis, and subcutaneous tissues (fat, muscle, bone, and peripheral nerves)
- New terminology
  - Superficial: only the epidermis
  - Superficial partial thickness: epidermis and dermis, excluding all the dermal appendages
  - Deep partial thickness: epidermis and most of the dermis
  - Full thickness: epidermis and all of the dermis

Superficial

- Very painful, dry, red burns which blanch with pressure.
- They usually take 3 to 7 days to heal without scarring.
- Also known as first-degree burns.
- The most common type of first-degree burn is sunburn.
- First-degree burns are limited to the epidermis, or upper layers of skin.

Superficial Partial-Thickness

- Very painful burns sensitive to temperature change and air exposure.
- More commonly referred to as second-degree burns.
- Typically, they blister and are moist, red, weeping burns which blanch with pressure.
- They heal in 7 to 21 days.
- Scarring is usually confined to changes in skin pigment.
- Very painful burns sensitive to temperature change and air exposure.
- More commonly referred to as second-degree burns.
- Typically, they blister and are moist, red, weeping burns which blanch with pressure.

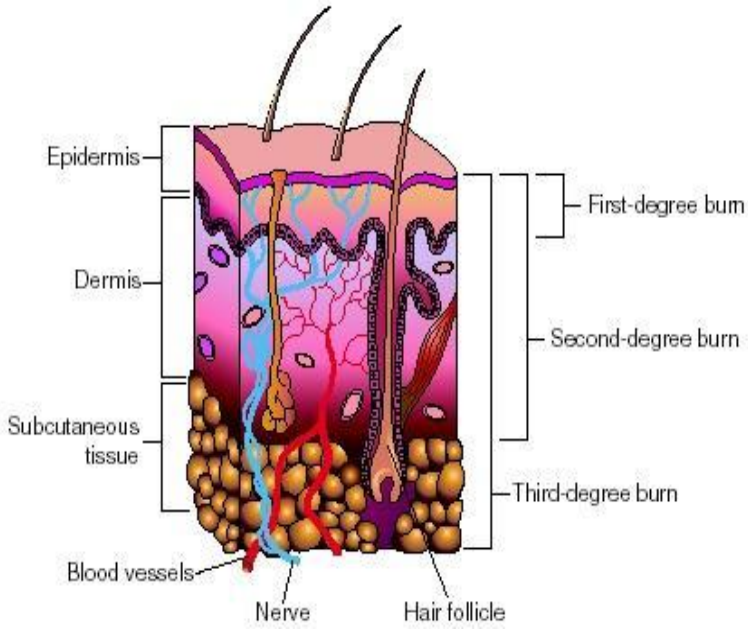
Deep Partial-Thickness

- Blistering or easily unroofed burns which are wet or waxy dry, and are painful to pressure.
- Their color may range from patchy, cheesy white to red, and they do not blanch with pressure.
- They take over 21 days to heal and scarring may be severe.

- It is sometimes difficult to differentiate these burns from full-thickness burns.

Full-Thickness

- Burns which cause the skin to be waxy white to a charred black a Burns which cause the skin to be waxy white to a charred black and tend to be painless.
- Healing is very slow, if at all, and may require skin grafting.
- Severe scarring usually occurs



- 1st degree (Superficial burn)
  - Involves the epidermis
  - Characterized by reddening
  - Tenderness and Pain
  - Increased warmth

        - Edema may occur, but no blistering
        - Burn blanches under pressure
        - Example - sunburn
        - Usually heal in ~ 7 days
- 2nd degree
        - Damage extends through the epidermis and involves the dermis.
        - Not enough to interfere with regeneration of the epithelium
        - Moist, shiny appearance
        - Salmon pink to red color
        - Painful
        - Does not have to blister to be 2nd degree
        - Usually heal in ~7-21 days
- 3rd degree
        - Both epidermis and dermis are destroyed with burning into SQ fat
        - Thick, dry appearance
        - Pearly gray or charred black color
        - Painless - nerve endings are destroyed
        - Pain is due to intermixing of 2nd degree
        - May be minor bleeding
        - Cannot heal and require grafting

Pathophysiology

- Pathophysiology refers to the complex chain of mechanisms that occur in the skin (local effects) and in other organ systems (systemic effects) when a burn injury occurs, as well as what happens as the skin regenerates and heals
    - Local Effects
    - Systematic Effects
    - Skin Regeneration and Scarring
    - Electrical Burns

Thermal Burn Injury Pathophysiology

- Emergent phase
    - Response to pain ⇨ catecholamine release
- Fluid shift phase
    - massive shift of fluid - intravascular ➔ extravascular
- Hypermetabolic phase
    - ↑ demand for nutrients ➔ repair tissue damage
- Resolution phase
    - scar tissue and remodeling of tissue
- Emergent phase
    - Response to pain ⇨ catecholamine release
- Fluid shift phase
    - massive shift of fluid - intravascular ➔ extravascular
- Hypermetabolic phase
    - ↑ demand for nutrients ➔ repair tissue damage
- Resolution phase

- scar tissue and remodeling of tissue

Thermal Burn Injury Pathophysiology

- Jackson's Thermal Wound Theory
  - Zone of Coagulation

    area nearest burn

    cell membranes rupture, clotted blood and thrombosed vessels
  - Zone of Stasis

    area surrounding zone of coagulation

    inflammation, decreased blood flow
  - Zone of Hyperemia

    peripheral area of burn

    limited inflammation, increased blood flow
- Eschar formation
  - Skin denaturing

    hard and leathery
  - Skin constricts over wound

    increased pressure underneath

    restricts blood flow
  - Respiratory compromise

    secondary to circumferential eschar around the thorax
  - Circulatory compromise

    secondary to circumferential eschar around extremity
- Eschar formation

- Skin denaturing

  hard and leathery

- Skin constricts over wound

  increased pressure underneath

  restricts blood flow

- Respiratory compromise

  secondary to circumferential eschar around the thorax

- Circulatory compromise

  secondary to circumferential eschar around extremity

COMPLICATIONS

- Fluid and Electrolyte loss ➔ Hypovolemia
- Hypothermia, Infection, Acidosis
- ↑ catecholamine release, vasoconstriction
- Renal or hepatic failure
- Formation of eschar
- Complications of circumferential burn

Psychological changes Psychological changes

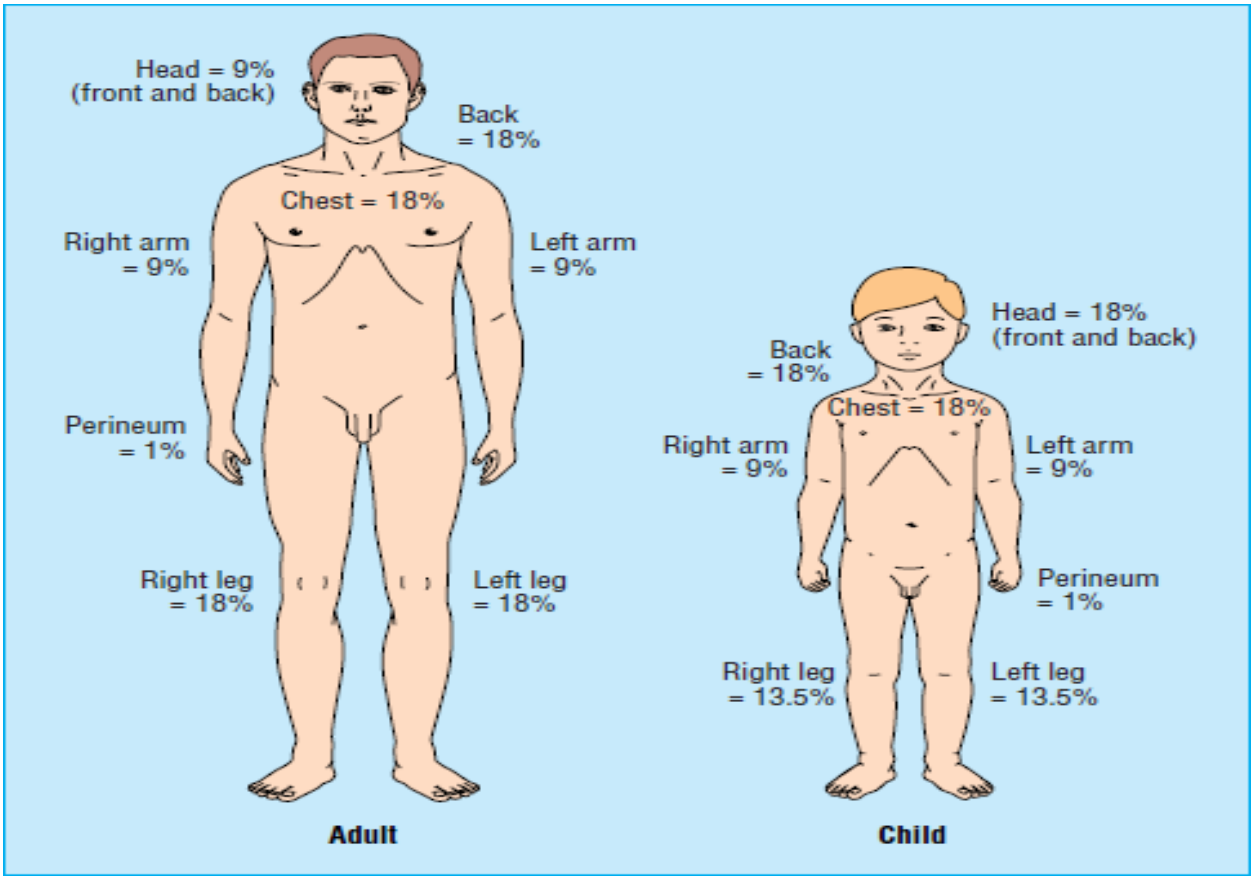
- Fear & anxiety
- Denial
- Depression
- Guilty feeling
- Grief &mourning

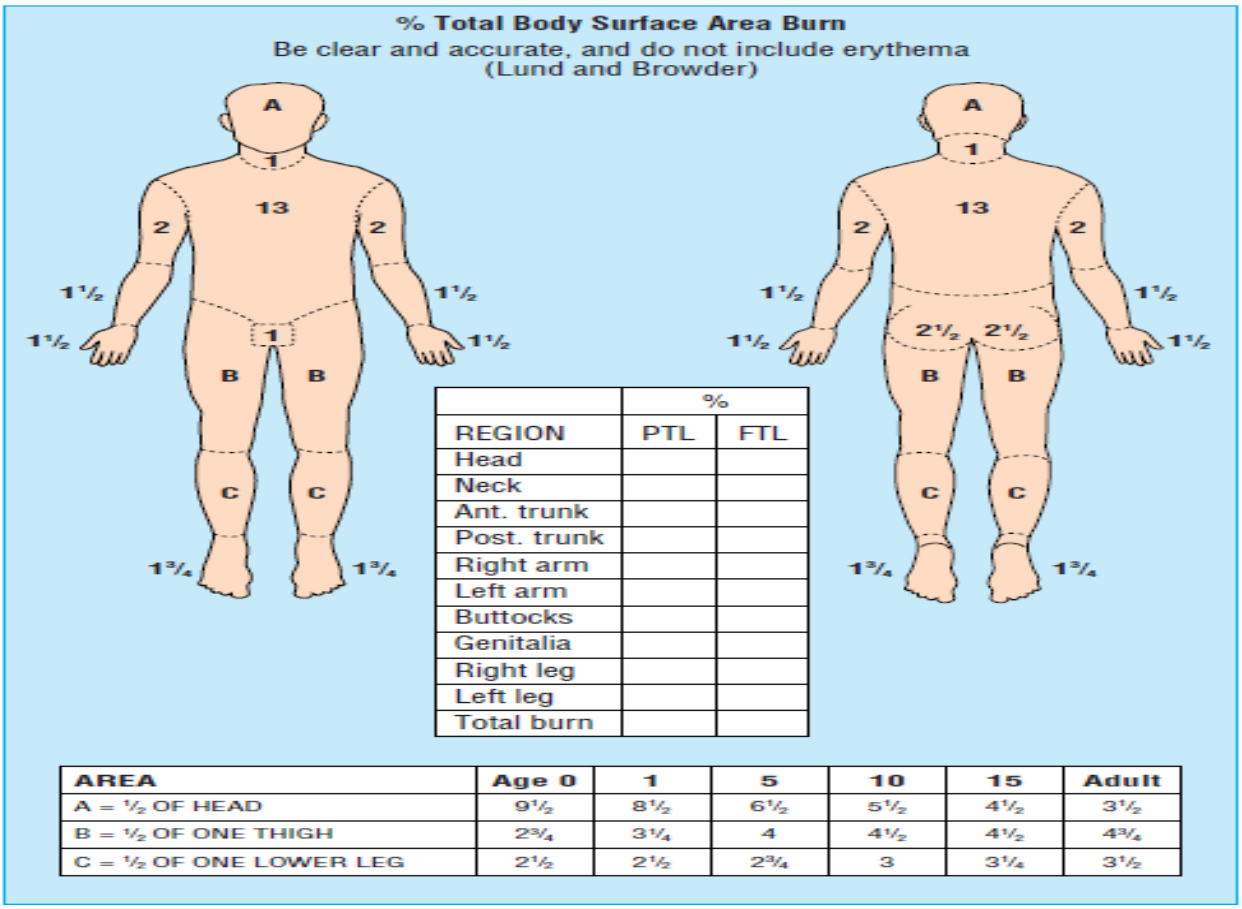
- Loss of will to live
- Apathy
- Necrophilous orientation
- Anger

BURN ASSESSMENT

Assessment of burn depth

	Burn type			
	Superficial	Superficial dermal	Deep dermal	Full thickness
Bleeding on pin prick	Brisk	Brisk	Delayed	None
Sensation	Painful	Painful	Dull	None
Appearance	Red, glistening	Dry, whiter	Cherry red	Dry, white, leathery
Blanching to pressure	Yes, brisk return	Yes, slow return	No	No





	%	
REGION	PTL	FTL
Head		
Neck		
Ant. trunk		
Post. trunk		
Right arm		
Left arm		
Buttocks		
Genitalia		
Right leg		
Left leg		
Total burn		

AREA	Age 0	1	5	10	15	Adult
A = ½ OF HEAD	9½	8½	6½	5½	4½	3½
B = ½ OF ONE THIGH	2¾	3¼	4	4½	4½	4¾
C = ½ OF ONE LOWER LEG	2½	2½	2¾	3	3¼	3½

- Factors to Consider
  - Depth or Classification
  - Body Surface area burned
  - Age: Adult vs Pediatric
  - Preexisting medical conditions
  - Associated Trauma

    blast injury

    fall injury

    airway compromise

child abuse

- Patient age
  - Less than 2 or greater than 55
  - Have increased incidence of complication
- Burn configuration
  - Circumferential burns can cause total occlusion of circulation to an area due to edema
  - Restrict ventilation if encircle the chest
  - Burns on joint area can cause disability due to scar formation

BURN CRITERIA

- 3^0 > 10% BSA
- 2^0 > 30% BSA
  - >20% pediatric
- Burns with respiratory injury
- Hands, face, feet, or genitalia
- Burns complicated by other trauma
- Underlying health problems
- Electrical and deep chemical burns

Moderate Burn Criteria

- 3^0 2-10% BSA
- 2^0 15-30% BSA
  - 10-20% pediatric
- Excluding hands, face, feet, or genitalia

- Without complicating factors

Minor Burn Criteria

- 3^0 < 2% BSA
- 2^0 < 15% BSA
    - <10% pediatric
- 1^0 < 20% BSA

Electrical Burns

- Usually follows accidental contact with exposed object conducting electricity
    - Electrically powered devices
    - Electrical wiring
    - Power transmission lines
- Can also result from Lightning
- Damage depends on intensity of current
- Current kills, voltage simply determines whether current can enter the body
- Ohm's law: I=V/R
- Electrical follows shortest path to ground
- Low Voltage
- usually cannot enter body unless:
- Skin is broken or moist
- Low Resistance (follows blood vessels/nerves)
- High Voltage
- easily overcomes resistance
- Severity depends upon:

        - what tissue current passes through
        - width or extent of the current pathway
        - AC or DC
        - duration of current contact
- Severity depends upon:
        - what tissue current passes through
        - width or extent of the current pathway
        - AC or DC
        - duration of current contact
- Pathophysiology of Injuries
        - External Burn
        - Internal Burn
        - Musculoskeletal injury
        - Cardiovascular injury
        - Respiratory injury
        - Neurologic injury
        - Rhabdomyolysis and Renal injury

Electrical Burn Management

- Make sure current is off
        - Lightning hazards
        - Do not go near patient until current is off
- ABC's
        - Ventilate and perform CPR as needed

- Oxygen
- ECG monitoring

Treat dysrhythmias

- Rhabdomyolysis Considerations
  - Fluid?
  - Dopamine?
- Assess for additional injuries
- Consider transport to trauma center
- Any patient with an electrical *burn* regardless of how trivial it looks needs to go to the hospital. There is no way to tell how bad the burn is on the inside by the way it looks on the outside.

Pediatric Burns

- Thin skin
  - increases severity of burning relative to adults
- Large surface/volume ratio
  - rapid fluid loss
  - increased heat loss ➔ hypothermia
- Delicate balance between dehydration and over hydration
- Immature immunological response ➔ sepsis

Geriatric Burns

- Decreased myocardial reserve
  - fluid resuscitation difficulty
- Peripheral vascular disease, diabetes

    - slow healing
- COPD
    - increases complications of airway injury
- Poor immunological response - Sepsis
- % mortality ~= age + % BSA burned
- Decreased myocardial reserve
    - fluid resuscitation difficulty
- Peripheral vascular disease, diabetes
    - slow healing
- COPD
    - increases complications of airway injury
- Poor immunological response - Sepsis
- % mortality ~= age + % BSA burned

WOUND IFECTION/SEPSIS

- Colonization
- Invasive wound sepsis
- Sepsis

  Prevention by aseptic measures
- Local anti microbial therapy/systemic antibiotics/wound debridement
- Early excision of necrotic tissues and skin grafting
- Treat septicemia

WOUND HEALING

- Stage of inflammation

- Stage of proliferation/tissue repair
- Remodeling
- Stage of inflammation
- Stage of proliferation/tissue repair
- Remodeling

WOUND DEBRIDEMENT

- Mechanical- wet/dry
- Hydrotherapy- immersion/spray
- Enzymatic-sutilains
- Surgical-sequencial/fascial excision & escharotomies

Proteolysis-fibrinolysis-collagenolysis

WOUND DRESSINGS

- Biological dressings/skin graft
- Synthetic dressings
- Topical antimicrobials

Assessment & Management

HYPOVOLAEMIC SHOCK

- Hypotension
- Oliguria
- Tachy cardia
- Sweating
- Pallor
- Hyper ventilation

- Clouding of consciousness

SEPTIC SHOCK

- Increased T*
- Hypotension < 90 mmhg
- Oliguria < 30 ml
- Dry &pink exremities
- Altered pulmonary functions

SKIN ASSESSMENT

- Inspection
- Appearance
- Temperature
- Moisture
- Dryness
- Texture
- Color
- Size
- Palpate lymph nodes
- Cyanosis
- Pulses
- Area
- Duration
- Itching/burning

Parkland formula for burns resuscitation

Total fluid requirement in 24 hours =

4 ml×(total burn surface area (%))×(body weight (kg))

50% given in first 8 hours

50% given in next 16 hours

Children receive maintenance fluid in addition, at hourly rate of

4 ml/kg for first 10 kg of body weight *plus*

2 ml/kg for second 10 kg of body weight *plus*

1 ml/kg for >20 kg of body weight

End point

Urine output of 0.5-1.0 ml/kg/hour in adults

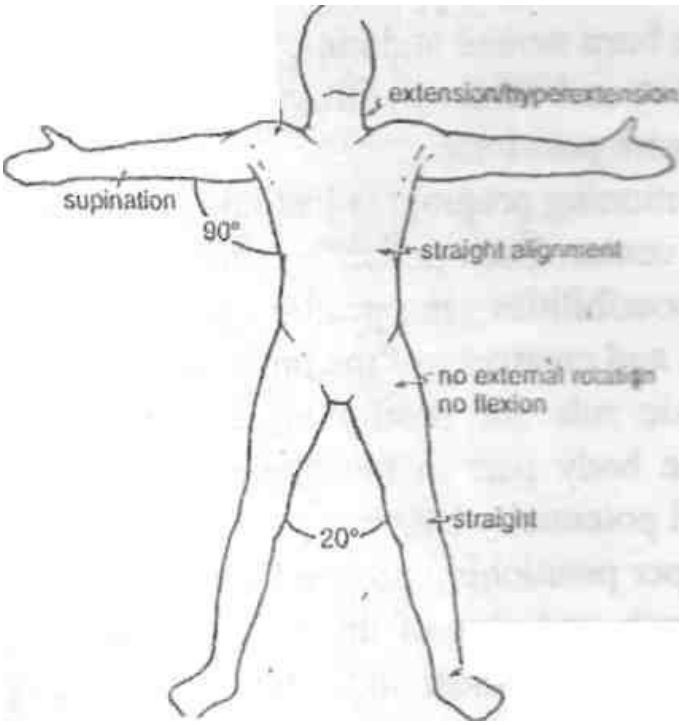
Urine output of 1.0-1.5 ml/kg/hour in children

PHYSIOTHERAPY MANAGEMENT

POSITIONING AND SPLINTING

- Minimize edema formation
- Prevent tissue destruction
- Maintain soft tissue in an elongated state to facilitate function recovery.
- "Anticontracture" positions
- "The position of comfort (fetal position)
- The basic rule for positioning burned areas is place and maintain the body part in the opposite plane and direction to which it will potentially contract

General Body Positioning for Prevention of Contractures



Burn Patient Positioning:

Body Area	Contracture Predisposition	Preventive Positioning
*Neck	Flexion	Extension/Hyper ext.
* Anterior Axilla	Shoulder Adduction	Shoulder Adduction
* Antecubital space	Elbow flexion	Elbow Extension
* Forearm	Pronation	Supination
* Wrist	Flexion	Extension- 30°
Dorsal/hand/finger	MCP Hyperextension IP Flexion, thumb adduction	MCP Flexion-80°, IF Extension, thumb palmar abduction
* Palmar hand/finger	Finger flexion, thumb opposition	Finger extension thumb radial abduction
Hip	Flexion, adduction external rotation	Extension, abduction neutral rotation
* Knee	Flexion	Extension
* Ankle	Planter flexion	Dorsiflexion
* Dorsal toes	Hyperextension	Flexion
* Planter toes	Flexion	Extension

Splints

- Splints and protection of Joints and tendons
- Splinting in edema reduction
- Splinting following skin grafting
- Splints for uncooperative or unconscious patient

Types of splints:

Three types of splinting for burn patients:

1) Primary splints:

During the acute phase and pre grafting period, static splints (without movable parts) are used to position the involved joints during sleep, inactivity, or periods of unresponsiveness. Whenever possible, these splints should be applied to adjacent intact skin.

2) Postural splints:

During the immediate post graft phase, splints are used to immobilize joints in proper functional position, but must allow access for continued wound care. These splints are worn continuously for 5 to 14 days until the graft is secure.

3) Follow up splints:

The chronic phase of burn care begins with wound closure and continues until full maturation of the wound (one to two years). Dynamic splints (movable parts) are used to increase function. They can provide support to the joint without restricting antagonistic movements, provide slow steady force to stretch a skin contracture, or provide resistive force for exercise.

Various types of splints that used for the treatment of anterior neck burns,

(1) Soft cervical collar is a circumferential foam neck orthosis covered with stockinet, it maintains neutral extension and prevents lateral flexion,

(2) Molded neck splint or collar, it is a total contact, rigid neck support, it maintains exact position (extension) and' prevents rotation and lateral flexion,

(3) Halo neck splint, it is a thermoplastic orthosis that positions the neck in extension using the head and upper torso for stabilization,

(4) Watusi collar, it is a series of cylindrical plastic or foam tubes fastened circumferentially around the neck. Additional tubes are added as neck extension improves (Figs. 5, 6 and 7).

(5) Neck Willis splint is one of the most effective means of preventing neck contractures. This splint should be applied directly over the burn wound or over a single layer of gauze.

When a tracheostomy has not been performed, the splint can be applied early and adjustments made as the edema subsides

Positioning Techniques in Edema Control

- Elevation of an extremity above heart level can be accomplished using common items such as pillows, bath blankets, towels, foam, wedges, beside tables, and stockinet.

Contracture

- Johnson and Silverberg (1995) found that serial casting is a conservative method and effective modality in correcting contracture resulting from burns.

SCAR MANAGEMENT

- Pressure therapy
- Silicone gel sheet
- Intra lesional injection
- Split skin graft
- Laser therapy
- Cryotherapy
- Radi0 therapy
- Combination therapy

CONTRACTURE MANAGEMENT

- Splinting/positioning
- Skin grafting(early)
- Plastic surgery
- Physiotherapy after surgery

  Functional Limitations

- Acute Limitations
  - Patients may experience delirium that precludes their participation in treatment

- Edema, pain, bulky dressings, and immobilizing splints impair the person's ability to perform usual daily activities
- Sleep is frequently disrupted
- Anxiety and fear can be present

- Post discharge Limitations
  - The most frequent functional limitations involve scarring and joint contracture
  - Other functional sequelae may result in permanent impairment

Vocational Limitations

- It should be emphasized that many of the functional limitations that have already been discussed are not overtly apparent
- If they are not recognized as valid, the RC could very easily conclude that a person is malingering, whining, or unmotivated
- Seriousness, etiology, and site of the burn injury can significantly affect return-to-work and how long it takes
- All of the studies cited in the text suggest that size, depth, and location are factors that influence time to return to work

Rehabilitation Burn Treatment

- Post discharge
  - Wound care continues
  - If there is a risk of hypertrophic scarring, or it has already started, continuous pressure applied to the area will prevent its progress
  - Garments need to be worn 20 hours per day for up to 1 year - uncomfortable, hot, and unattractive

- Contracture control continues through PT and/or OT
- Reconditioning and strengthening exercises begin
- Counseling is a possibility to work on emotional difficulties that have resulted from the burn injury
- Reconstructive surgery may be needed if the functional or cosmetic limitations are not responsive to rehabilitation treatment

The most important rehabilitative commitment after a serious burn trauma is to guarantee to the patient maximum autonomy and functionality in order to ensure the best possible quality of life in the social, family, and working environments. To achieve this aim, physiotherapists use a wide range of techniques, such as kinesiotherapy, and a number of devices. It is possible to distinguish three phases:

1. Acute phase. Prevention of:
    A. articular limitations
    B. muscle or tendon contractures
    C. breathing complications
    D. oedema
2. Post-acute phase. Aims:
    A. recovery of muscular tone trophism
    B. return of patient to normal overall condition
    C. restoration of patient's autonomy in shortest time possible (depending on pathology)
3. Chronic phase (sequelae). Aims:

A. scar prevention

B. treatment of orthopaedic sequelae

C. treatment of neurological sequelae

D. return of patient to social environment, family, and working life

In this paper we will consider the post-acute phase, i.e. the period when the burn patient is still in hospital but in the plastic surgery ward, and no longer in the intensive care unit. Once the acute phase is over, treatment will be oriented towards early neuromotor recovery in order to reduce the negative effects of overlong immobilization in bed.1,2

Contraindications to kinesitherapy

1. Poor general condition of the patient
2. Skin graft (at least 5-10 days of immobility are necessary; initiation of rehabilitation to be arranged with the plastic surgeon)
3. Presence of muscle or tendon injuries

Procedures

Various procedures are used:

1. Assisted active mobilization
2. Active mobilization
3. Mobilization against resistance
4. Dynamic proprioceptive re-education
5. Stretching

6. Postural sequences
7. Recommencement of standing (orthostatism)
8. Re-education for the recommencement of walking
9. Splinting

Exercises

1. Exercises performed with the help of the physiotherapist in order to overcome loss of articular and muscular movement.
2. Exercises performed autonomously by the patient during the day in order to improve circulation and metabolic exchange.
3. Exercises performed against resistance by the therapist in order to counteract muscular hypotrophy and restore the memory of movements.
4. Exercises in cases of neurological injury in order to make movements that are as precise as possible, using the whole kinetic chain and not just single isolated movements Exercises for the passive connective and active muscular parts of the body.
5. Kinesitherapy allowing the patient analytic recovery of movement. Postural sequences are the next step (variation of decubitus: lateral, sitting with legs straight, sitting with legs out of bed); helpful aids are elastic bandages on the lower limbs in order to prevent circulatory disorders. The patient will need to learn to do all this by himself in the shortest amount of time possible to reach autonomy in moving between bed and wheelchair and consequently in personal cleanliness.

6. There are two possibilities, depending on the patient's clinical conditions: a. transfer from bed to wheelchair; b. sitting up in bed. A long stay in bed requires exercises aimed at transferring weight distribution and controlling the trunk.
7. Various devices are used to assist walking in the early stages, an activity that gradually becomes once again autonomous. The physiotherapist plays an important role here: he or she teaches the patient how to walk, initially with devices and later weaning the patient from their use in order to achieve autonomous walking, if possible. Care must be taken when there are skin grafts and orthopaedic or neurological injuries. Walking helps to orient the positioning of grafted skin
8. Static-dynamic exercises counteract hypertrophy and scar contractures by using forces that release scar tension in a constant, continuous, and adjustable manner. Such exercises, in cases of neurological injuries, compensate for the loss of movement. Silicon may be interposed to increase compression at the level of the hand, palm, and back. This is very important from the acute phase on.

Bandaging - compression therapy

In 1968 Fujimori demonstrated that a moderate and constant compression of burned skin prevents scar hypertrophy. When compression is applied early, it prevents the formation of nodules and collagen spirals within the scar and creates hypoxaemia in its vascular network: this causes precocious, artificial ageing that will determine an orientation parallel to the cutaneous surface of the collagen fibres.

Bandaging is applied:

- in the acute phase, to prevent oedema
- after skin grafting
- in burns in the course of healing
- during the chronic phase

Compression is applied as follows:

- pre-packaged elastic girdle
- elastic bandaging
- elastic garments
- silicon

Girdles are made of elastic tissue that counteracts scar hypertrophy. Girdles are made to measure in order to adjust tension and compression (care must be taken to ensure they are be correctly worn, in order to avoid any haemostatic effect).

Adhesive bandaging can be applied by the physiotherapist (this is useful also during postural sequences in the acute phase for the reduction of circulation disorders) before the use of girdles, since the adhesive bandaging can be applied directly on the dressing; the only disadvantage is a further reduction in range of motion.

Made-to-measure elastic-compressive garments are useful only in the post-acute phase when oedema has stabilized and the skin has healed. These garments require continuous checking of their continued effectiveness.

Compression needs to be continuous over time to be effective; the use of pads in the lower back and subscapular area can be considered - this requires careful hygiene and good patient compliance.

Silicon has flattening, hydrating, decongesting, and softening effects on the scar. It can be placed in between elastic girdles (costs, however, are high).

Massotherapy is another useful technique. Massotherapy:

1. Reorganizes the capillary network and local circulatory flow
2. Reduces oedema and itching
3. Makes the skin more elastic, frees adhesions, and makes the new skin stronger
4. Helps the patient to regain sensitivity
5. Relaxes neighbouring tissues

Massaging must be gentle and superficial. Connective tissue massage is important as it stimulates body areas by modifying their connective trophism through the reflected action of the skin's sympathetic terminal reticulum. The daily use of rapidly absorbed hydrating lotions is recommended, as this prevents avoid maceration under the girdles.

Manual lymphatic drainage

Manual lymphatic drainage has analgesic and immunological effects on the vegetative nervous system, as also on the musculature of blood and lymph vessels. This technique is required when there is impairment of venous and lymphatic circulation, with consequent oedema; it enables the

lymph to flow - even by alternative routes - and thus prevents the creation of fibrous tissue and consequent sclerosis.

The association of various bandaging techniques cannot always be used since the scars may still be open.

1. Vegetative effect - the vegetative nervous system is composed of two antagonistic systems: the sympathetic and the parasympathetic nervous systems. The sympathetic nervous system prevails over the parasympathetic; manual lymphatic drainage acts on the latter, increasing its effect.
2. Analgesic effect. Manual lymphatic drainage can excite the cells that inhibit pain, thus reducing it (see the gate control theory).
3. Immunological effect. Manual lymphatic drainage permits an increase of the body's defence mechanisms by activating lymph routes. This defence depends on resistance, i.e. the set of possibilities for reaction activated by the organism before an immune response.
4. Effect on smooth musculature of blood and lymph vessels. Manual lymphatic drainage acts by toning the smooth musculature of blood vessels at capillary level, through contraction of the pre-capillary sphincters. Blood pressure diminishes, thus determining emptying of tissues.

ELECTROTHERAPY

1. Ultrasounds: these improve the detachment of adherences and reduce oedema (they reduce fibrosis): 3 Hz, intensity 1.5 W/m2.

2. Vacuum therapy: this therapy uses different-size nozzles that go over all the scars lengthwise. The action is exerted on the circulation in the scar, by increasing and reducing pressure.

At the end of each treatment it is useful to make an overall evaluation. This includes:

- cutaneous assessment
- articular, neuromotor, and breathing assessment
- assessment of functional recovery (functional independence rating), with particular reference to walking and management of personal care.