Rehabilitation of burn patients

Monratta Panuwannakorn
Department of Rehabilitation Medicine
Ramathibodi Hospital

Rehabilitation of burn patients

- Should begin soon after burn to try to prevent deformities and poor functional outcomes

Rehabilitation of burn patients

Divided into 4 phases
- Emergent phase
- Acute phase
- Post skin graft phase
- Convalescent phase

The emergent phase

- Begin in the first 24 – 72 hrs.after burn injury

The emergent phase

Goals
- To evaluate the patient and develop treatment goal & plan
- To control edema
- To maintain ROM of the injured part
- To prevent respiratory complication, esp.in inhalation burn

Initial evaluation

- Depth & area of burn wounds
- Observe the wound : exposed tendon or joint
- Edema
- Pain
- ROM
- Function
- Cooperation of the patient

Burn severity

Burn evaluation

Edema

- Result from fluid shift to extravascular space
- Develop 8 – 12 hrs. after burn injury
  peak 36 hrs.
- Result in : ischemia & fibrosis
  places the extremities in
  deforming position
  limited movement
  interfere function

Edema

- In SPT burn : fluid leakage has low protein content and transient
- In DPT and FT burn
  : both dermis and papillary plexus are injured
  fluid leakage has high protein content and rich in fibroblast cause prolonged and severe edema

Control edema & maintain joint mobility

- Control edema is imperative in this stage
- Thick inelastic eschar often necessitates escharotomy to release pressure
- Escharotomy do not preclude exercise

Control edema

- Elevation & positioning
  - elevate above heart level
  - avoid position that compromise circulation
- Active muscle pumping exercise in elevated position
  - depend on conscious & motivation of the patient and burn wound condition
- Compressive dressing / wrapping

Elevation & positioning




Elevation & positioning


Prevent respiratory complication

- Inhalation injury can cause mild to severe bronchial and alveolar changes
- Inhalation injury combined with edema formation and constricting eschar of neck can obstruct the trachea necessitate intubation and mechanical ventilation

Prevent respiratory complication

Pulmonary rehabilitation program

- Bronchial hygiene therapy :
  - postural drainage , percussion , vibration
  - cough training
- Improve ventilation & prevent atelectasis:
  - deep breathing , incentive spirometry

Pulmonary rehabilitation




Acute phase

- Extend from emergent phase until wound closure
- Early and proper intervention : necessary for collagen fibers orientation to minimize scar formation

Acute phase

Goal

- Control edema
- Maintain joint , skin mobility ,muscle strength and prevent stiffness / contracture
- Promote mobility and ambulation
- Encourage functional independence

Control edema

- Elevation
- Positioning
- Compression : EB
- Exercise
- Functional activities

Maintain joint and skin mobility & prevent stiffness/contracture

- Positioning
- Exercise
- Continuous passive motion
- Splinting

Positioning

- Combine appropriate position and compliance of the patient
- Appropriate position : antideformity
- Change every 2-4 hrs.

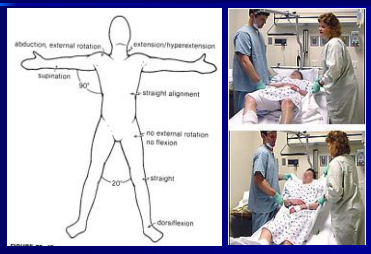
Antideformity position

- Designed to counteract the forces and patterns of wound contraction and scaring
- Required combined effort of rehabilitative and nursing staffs
- Require frequent repositioning

Comfortable position

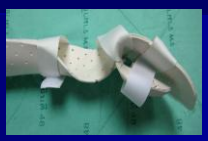


Antideformity position & repositioning



Positioning lower extremities

Splint for positioning wrist & hand



Exercise

- Type and duration depend on conscious, motivation , burn wound condition and pain

Exercise

- Prolonged immobilization will result in :
  - decrease cardiovascular fitness
  - muscle atrophy & weakness
  - joint stiffness
  - disuse osteoporosis
  - increase risk of thromboemboli
  - decubitus ulcer

Exercise

- Active / active assistive exercise
  - need patient's motivation & coordination
  - counteract the effect of prolonged bed rest & muscle atrophy
  - maintain ROM & strength
  - provide emotional support to the patient

Exercise

- Passive exercise
  - for patient who can not or does not willing to actively move : critically ill , sepsis , heavily medicated patient
  - to maintain ROM , elongate tissue and assess joint motion

Exercise

- Exercise is best tolerated during wound dressing
  - bulky dressing are off
  - use parenteral analgesics allowed more effective exercise
  - topical cream promote pliability of wound surface
- Avoid unnecessary bulky dressing

Exercise

- Do exercise every 1-2 hrs.
- Add oral analgesics to control pain
  - oral morphine
  - paracetamol
  - gabapentin
- Perform during hydrotherapy
  - reduced pain & relaxation
  - ease of exercise due to bouyancy

Exercise

Children

- Exhibit increased pain reactions during exercise due to fear and apprehension
- Playing and group activities are more appropriate to encourage active movement

Passive , active assistive , active exercise




Continuous passive motion

- Use to maintain or restore ROM
- Most benefit in :
  - extensive burn covering multiple area
  - impaired cognitive function
  - can not do appropriate motion due to pain,edema and anxiety
  - require passive motion for a prolonged time

Continuous passive motion

Contraindication/precaution for ROM exercise

- Exposed tendon
- Ruptured tendon , exposed joint or fracture

Splinting

- All burn patient are not necessary routinely splinted
- Splinting depend on :
  - depth and extent of wound
  - ROM & strength
  - co-operation with exercise , positioning and ADL

Splinting

- Splinting is necessary in :
  - unconscious or non co-operative patient
  - non co-operative children
  - immobilize the affected part : exposed tendon , exposed joint
  - muscle weakness or imbalance : peripheral nerve injury

Functional activities

- Encourage performing self care activities ⟶ increased ROM , strength and endurance of U/E muscles
- May need adaptive devices : built-up utencils , adaptive cup , plate guard

Assisstive & adaptive devices

Encourage functional & playing activities




Mobility and ambulation

- Ambulation should begin as soon as the medical condition stable
- Benefit of early ambulation

- Maintain or increase ROM , strength and endurance of L/Es muscles
- Provide cardiovascular conditioning
- Increase appetite
- Improve patient's well being

Progressive ambulation

- Progressive lower extremities dependency with bedside sitting
- May use tilt table

- Passive standing with totally support then partially support
- provide gradual weight bearing
- treatment for orthostatic hypotension

Progressive ambulation

- Elastic bandage wrapping prior to ambulation to decrease venous stasis and blood pooling
- Use extrapadding dressing or padded slipper in burn on sole of foot
- Use gait aid to protect , reduce pain or assist weight bearing

Contraindication for early ambulation

- Early massive edema of L/Es
- Exposed large tendons : Achilles tendon , Tibialis anterior tendon

Mobility & ambulation





Rehabilitation in post skin graft phase

- It is crucial to obtain full ROM before grafting
- Need to immobilized 5-7 days after grafting
- Proper positioning
- Maintain ROM of unaffected part
- Isometric exercise of affected part

Rehabilitation in convalescent phase

- Extend from the time of graft adherence or wound closure until scar maturation

Rehabilitation in convalescent phase

- Goal
  - Control edema
  - Decrease fibrosis & adhesion
  - Increase ROM , strength and endurance
  - Maximize independent functioning
  - Control scar
  - Provide education for skin care
  - Treatment burn scar contracture

Control edema

- Elastic bandage wrap / coban wrap
- Massage
- Functional movement

Elastic bandage / coban wrap , massage



Decrease fibrosis and adhesion

- Massage to freeing restrictive fibrous band
  - greater rotatory motion along the scar
- Cocoa butter cream applied before
- Do 2-4 times/day
- Heat application : H/P , paraffin , U/S

Exercise to increase ROM

- Evaluate total ROM across several joints
- Active exercise with terminal stretching
- Prolonged stretching may be needed
  - slowed sustained stretch is the most effective method

Exercise to increase strength and endurance

- Progressive resistive exercise
  - from manual resistance towards the use of weight and resistive tubing
  - concentrated on areas of weakness and muscles opposing scar tissue contracture

Strength and endurance training

Maximize independent functioning

- Encourage ADL
- Use adaptive devices
- Progressive ambulation
  - walk further with the least amount of support
  - correct abnormal gait

Control scar

- Hypertrophic scar : collagen arranged in random orientation with whorls and nodules

Hypertrophic scar

- Pathogenesis :
  - overzealous inflammation
  - prolonged re-epithelialization
  - overabandant extracellular matrix & collagen production
  - increase neovascularization

Hypertrophic scar

- Generally develop between 2-6 months after DPT and FT burn (8-12 weeks after wound closure)
- Increased level between 6-12 months
- Regress during maturation phase , 18-24 months
- More prevalent in areas of high skin tension : chest wall , shoulders and upper arm

Hypertrophic scar

- Factors predispose to development of hypertrophic scar

  - depth of burn , healing time , grafting and skin character

  - race , age , genetics , immunological response

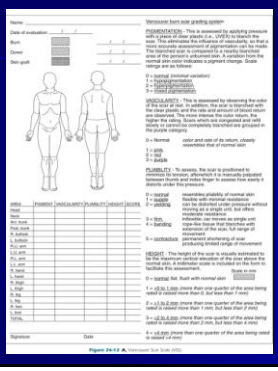
Scar assessment

- Vancouver Scar Scale (VSS)

  - vascularity , pigmentation , pliability and height

  - it's subjective , not accurate describe , not known which area
- U/S scanning : thickness of scar
- VDO camera : color of scar
- Laser Doppler Flowmetry : perfusion of scar

Vancouver Scar Scale



To control and treatment scar

- Mechanical pressure :

  - facilitate alignment of collagen fibers in more parallel , normal orientation

  - decrease blood flow and O2 to rapidly metabolizing collagenous tissue
- Pressure 25 mmHg. , at least 23 hrs./day

To control & treatment scar

- Mechanical pressure

  - start when the wounds are almost or completely closed

  - early form : elastic bandage , conforming thermoplastic along with bandage

  - may utilized tubular elastic bandage "Tubigrip ", Coban , prefabricated pressure garment , custom-made garment
- Use pressure garment until scar mature ; 18-24 months

To control & treatment scar

- Inserts
  - adjuncted to achieve effective pressure over certain anatomical location where pressure garments do not provide adequate pressure : concave body area ; face , neck , palm , web space , antecubital area
  - silicone gel , elastomer , thermoplastic

Pressure garment and splint to control scar


To control & treatment scar

- Scar massage
  - aids in softening or remodeling scar tissue by freeing adhering fibrous bands , allowing the scar to become more elastic and stretchy

To control & treatment scar

- Pulse dye LASER
  - flatten & decrease the volume of hypertrophic scar
  - improve texture , increase pliability and decrease erythema : usually seen after 2-3 treatment
  - can be used successfully in the early phase of wound healing and in established hypertrophic scar

To control & treatment scar

- Pulse Dye LASER
  - cause photothermolysis
  - is absorbed by hemoglobin leading to coagulation necrosis ⟶ tissue hypoxia ⟶ decrease the number and proliferation of fibroblast ⟶ collagen fibers realignment & remodelling

Pulsed Dye LASER in hypertrophic scar

Skin care

- Skin problems
  - Skin dryness and fragile
  - Itching / pruritus
  - Sunlight and heat intolerance

Skin dryness and fragile

- Avoid prolonged water immersion
- Frequent apply mineral oil or cocoa butter or petrolium jelly / oiled-based lotion
- Apply lotion or oil before exercise

Itching/Pruritus

- Incidence 80 – 100 %
- Severe itching : 70 % in children , 50 % in adult
- Maximum during proliferative phase of wound healing

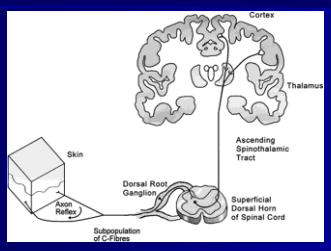
Itching/pruritus

- Severity depend on :
  - burn area involved : burn area > 40 %
    100 % of leg burn
    70 % of arm burn
    0 % of face burn
  - depth of burn : partial thickness greatest risk
  - duration of time to wound closure : wound left open > 3 weeks very likely to hypertrophic scar & pruritus

Itching/pruritus

- Share the same neuronal pathway as pain
- Primary mediator is histamine
- Transmit by unmyelinated C-fibers
- Synapse in superficial laminae of dorsal horn of spinal cord
- Transmitted through anterolateral spinothalamic tract
- Supraspinal processing in anterior cingulate cortex

Itch pathway



Current treatment of burn pruritus

- Treatment pillars : antihistamine
  emollients

Current treatment of burn pruritus

- Antihistamine
  - H1 receptor antagonists :
    Diphenhydramine , hydroxyzine , cetirizine
  - complete relief 20 % , partial relief 60 % , not relief 20 %

Current treatment of burn pruritus

- Gabapentin
  - significant better than cetirizine
  - faster onset of action
- Combine : Gabapentin & antihistamine

Current treatment of burn pruritus

- Emollients
  - act to moisture & improve skin quality
  - simple moisturizer : aloe vera , lanolin , liquid paraffin , coconut oil

Current treatment of burn pruritus

- Topical alternatives & adjuncts
  - 5 % Doxepin cream
  - Doxepin is TCA with potent histamine receptor blocking properties , 50 times more potent than hydroxyzine , 800 times more potent than diphenhydramine

Current treatment of burn pruritus

- Non-medication treatment
  - pressure garment
  - massage
  - TENS
  - LASER

Sunlight and heat intolerance

- Avoid sun exposure
- Apply total sun block lotion before sunlight exposure

Treatment burn scar contracture

- Paraffin bath combined with sustained stretch :
  - ↑collagen extensibility
  - make skin more pliable
- Ultrasound
- LASER

Treatment of burn scar contracture

- Splint
- Shoes modification or accommodation
- Assistive devices

Burn scar contracture

Special problems

Neuropathy after burn injury

- The most common is generalized peripheral neuropathy
- Peripheral neuropathy found about 18% of burn patient during acute hospitalization
- Not directly related to injured body region
- Associated with burn severity
- The most common sites were peroneal , ulnar , brachial plexus and median nerves

Neuropathy after burn injury

- Generalized peripheral neuropathy associated with severe burn may be caused by :
  - variant of critical care neuropathy
  - metabolic factors
  - medication used during burn treatment
  - neurotoxin
  - inflammatory cascade caused nerve dysfunction

Risk factors for development of neuropathy after burn

- Older age
- Burns >20% TBSA
- Length of hospitalization

Electrical injury

- Tissue of CNS , PNS , cardiac system and vascular ⟶ sensitive to electrical injury
- Susceptible to neuropathy
- LMN disease has been reported : SCI , ALS onset weeks to years after injury
- Vulnerable to cardiac complications: cardiac arrhythmia was the most serious

Burn hand

Burn hand

Acute phase

- Edema in DPT and FT burn ⟶ classic burn hand deformity or claw hand
- Severe edema with limited ROM : use Kling roll to support transverse palmar arch , should not splinted
- Moderate edema with limited ROM ⟶ splint in safe position
- Transient edema in SPT , moderate edema in DPT & FT with nearly full ROM ⟶ no need for splint

Acute phase



Splint in acute phase



Burn hand

After edema subsided

- Splint in antideformity position
- Circumferential burn :
  safe position – daytime
  palmar stretch – nighttime
- Dorsal hand burn : palmar splint in safe position
- Palmar hand burn :dorsal splint in full extension and abduction

Splint in antideformity position


Splinting

- May use dynamic splint to increase ROM in this phase

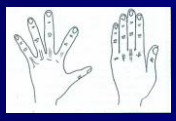
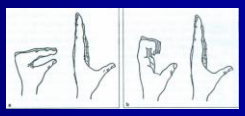
Dynamic splint



Active muscle pumping exercise

- Finger abduct/adduct
- Isolated MCP jt.flexion and isolated IP jt.flexion
- Composite finger flexion in SPT and DPT with no deep dorsal hand burn
- Avoid forced composite finger flexion in deep dorsal hand burn

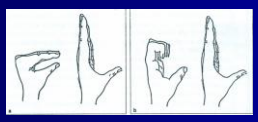
Active hand exercise

Precaution for ROM exercise

- Severe edema : avoid passive exercise
- DPT and FT burn at dorsum of hand
  - avoid composite finger flexion
  - monitor for extension lag
  - appropriate exercise : MCP flexion with wrist and IPjts.in extension
    PIP flexion with wrist and MCPjts.in extension

Exercise in DPT and FT at dorsum of hand



Exposed central slip of extensor tendon at PIP jt.

- Continuous splint PIP jt. in full extension , active ROM exercise of MCP and DIP jt.

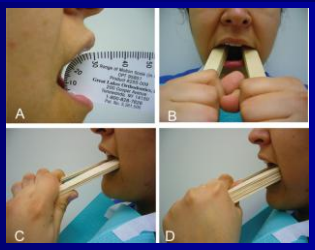

Ruptured central slip of extensor tendon

- Boutonnier deformity , can not actively extend PIP jt.
  - continuous splint PIP jt. in full extension 4-6 weeks


Oro-facial burn

- Wearing orthosis all night to preserve horizontal lip opening
- Massage and stretching of lip and jaw
  4 times a day to avoid scar contracture
- Maintain circular distance of orbicularis oris muscle with 5 min.hourly stretching

Lip stretching



Orthosis to preserve horizontal and vertical lip opening

Conclusion

In addition to burn injury , many forces and condition can contribute to loss of function and deformity

Treatment team must be knowledgeable of these forces and condition and must intervene appropriate and timely treatment . When combine with patient compliance , good outcome can be achieved.