Rehabilitation for Burn Injury Survivors: Bringing Research to Practice

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No Disclosures to Report

Learning Objectives

Describe

Describe potential roadblocks for burn survivors during functional recovery.

Discuss

Discuss the use of cutaneokinematics as a possible predictor for disability in the presence of scars.

Examine

Examine potential complications of burn scar contracture and remediation strategies for management.

Defining a Burn

“A burn is an injury to the skin or other organic tissue primarily caused by heat or due to radiation, radioactivity, electricity, friction or contact with chemicals.” -World Health Organization (2023)

Non-fatal burns are a leading cause of injury, extended hospitalizations, disability, and often result in stigma.

US healthcare cost of $88,218 ($704- 717,306) (WHO)

Hospital LOS 1-1.5 days/percent of injury

Healing Timeline

Superficial

Heals spontaneously in 1 week; exfoliation

Superficial Partial Thickness

Reepithelialization in 7-20 days

Deep Partial Thickness

Weeks to months; Potential grafting; + Scar

Full Thickness

Requires grafting; + Scar

Non-Burned Skin

- Is elastic and stretches with movement
- Helps regulate body temperature
- Regulates fluid homeostasis
- Barrier to the outside environment
- Protects from harmful effects of the sun
- Sensory organ
- Cosmetic/Social (Skin is what you see)

Burn Injured Skin

- Becomes tight, can limit motion
- Impaired thermoregulation
- More susceptible to infections
- More sensitive to sunlight.
- More hyper or hypo sensitive at burn or surrounding areas
- Scar formation impacts function and cosmesis of burned skin

What research tells us about burn injuries

Larger burns = Worse health outcomes

Spronk et al., 2018

Larger burns - Greater contracture risk

Godleski et al., 2018; Yelvington et al. 2019

Scars complicate recovery by reducing available joint motion

Bartell et al., 1988; Leblebici et al., 2006; Parry et al., 2019; Schneider et al., 2006

Skin Recruitment and “Stretch”

Tissue Recruitment must happen for joint ROM to occur

Richard et al., 2009

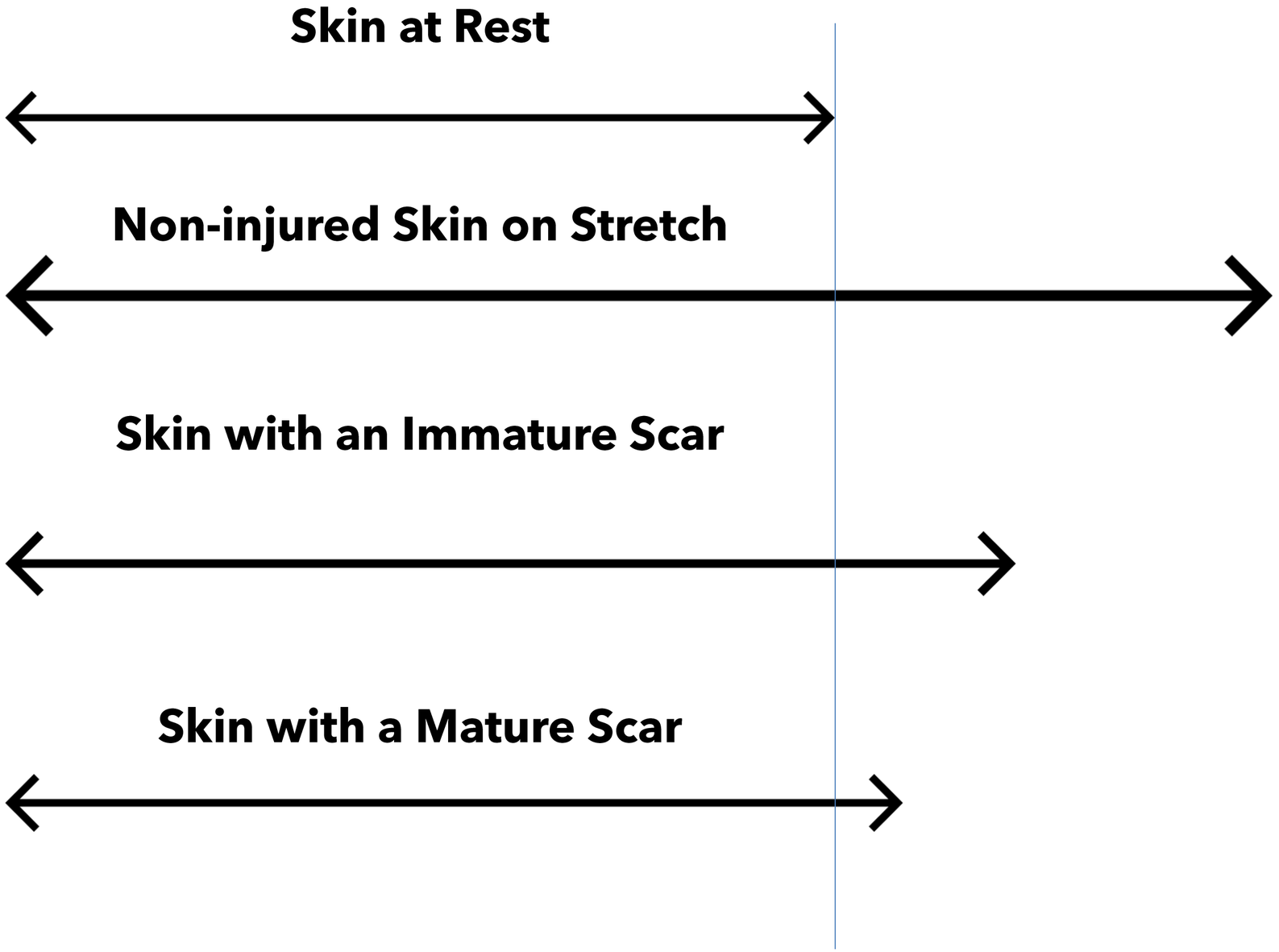
Non-burn Skin is extensible up to 50% of its length

Bartell et al., 1988

Elastometric values for burn-scarred skin were as much as 60% less than normal mirror image skin

Bartell et al, 1988

Skin Elasticity



Timeline for Development of Tissue Restrictions

Burn Scar Contracture (Skin)

1-4 Days

Tendons and Tendon Sheaths

5-21 days

Adaptive Muscle Shortening

2-3 weeks

Ligament and Joint Capsule

1-3 months

Scar Contracture Risks (things we can not control)

- Depth of burn
- Location of burn
- Time to wound closure
- Patient compliance
- Medical status (overall)
- Genetics
- ???

18-50% of all burn survivors develop contractures

- Therapy Interventions
- Dressing and Orthosis Application
- Positioning
- Encouragement and Coaching

Contractures can lead to:

Increased:

- Pain
- Demand on staff
- Need for orthosis use
- Pressure area risk
- Operative procedures

Decreased:

- Functional Movement
- Wound Healing
- Fit of orthoses
- Outcomes
- Psychosocial Adaptation

Traditional Therapy

- ROM
- Prolonged stretching
- Tissue Elongation
- Myofascial/Muscle work
- Scar Management
- Edema Management
- Orthosis Fabrication
- Mobility
- Functional retraining

Limitations of Traditional Therapy “Logic”

- How do we determine if someone has full motion?
- How do we measure joint mobility or ROM?
- What is the theory for current goniometric models?
- Can an osteokinematic or arthrokinematic model measure burn scars?

Cutaneokinematics at Work

Burn healing results in replacement of naturally pliable skin with an inadequate quantity and quality of extensible scar tissue.

Body limb segments change length as joint ROM occurs

Fields of skin contribute to range of motion (CFU)

Adjacent joint position impacts the amount of skin recruitment

Richard et al., 1994; 1996; 2009; 2014; 2017

“New” EBP Concepts

Positive relationship between percentage of cutaneokinematic involvement and contracture risk

Richard et al., 2014

Size of the burn within the impacted CFU is negatively correlated with ROM of the associated joint (pediatrics)

Parry et al., 2017

Rehab time per CFU may be the greatest predictor of preventing burn scar contracture

Richard et al., 2014

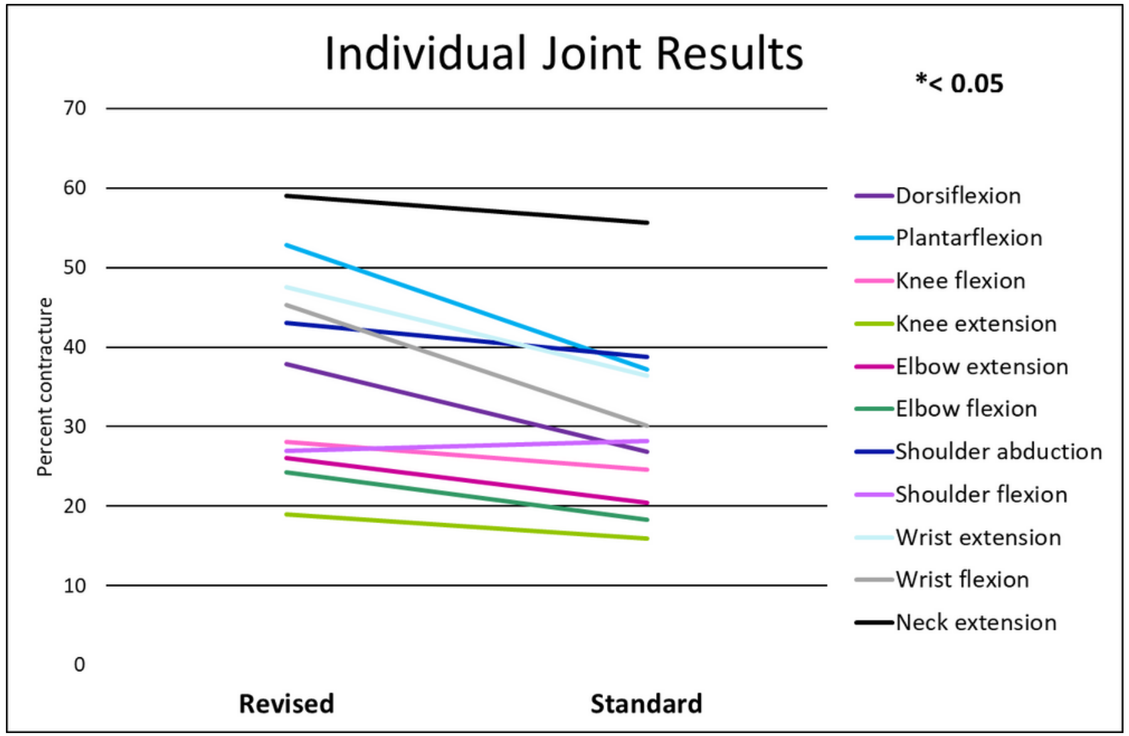
Percentage of CFU involvement is independently related to moderate-severe limitations in ROM at the joint level.

Lensing et al., 2020

2019 CLINICAL RESEARCH PAPER AWARD WINNER, TOP 5 ABSTRACT WINNER

Goniometric Measurement of Burn Scar Contracture: A Paradigm Shift Challenging the Standard

Ingrid Parry, MS, PT, BT-C,* Reg Richard, MS, PT, BT-C,† James K. Aden, PhD,‡ Miranda Yelvington, MS, OTR/L, BT-C, BPCR,‖ Linda Ware, OT, CHT,§ William Dewey PT, CHT,¶ Keith Jacobson MPT,** Julie Caffrey, DO, MS,†† and Soman Sen, MD, FACS*



Burn survivors have a high frequency of movement problems and functional limitations

Standard goniometrics underestimates impairment in the presence of burn scars

Revised positions recommended for ROM measurements for burn survivors

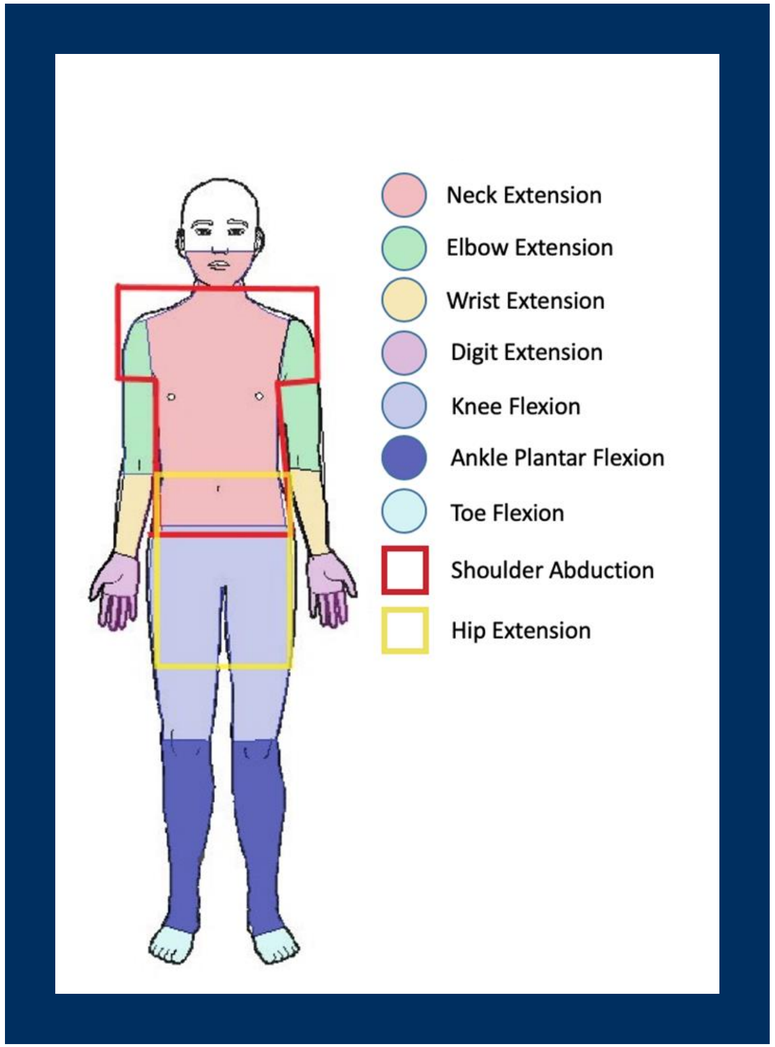
Resources

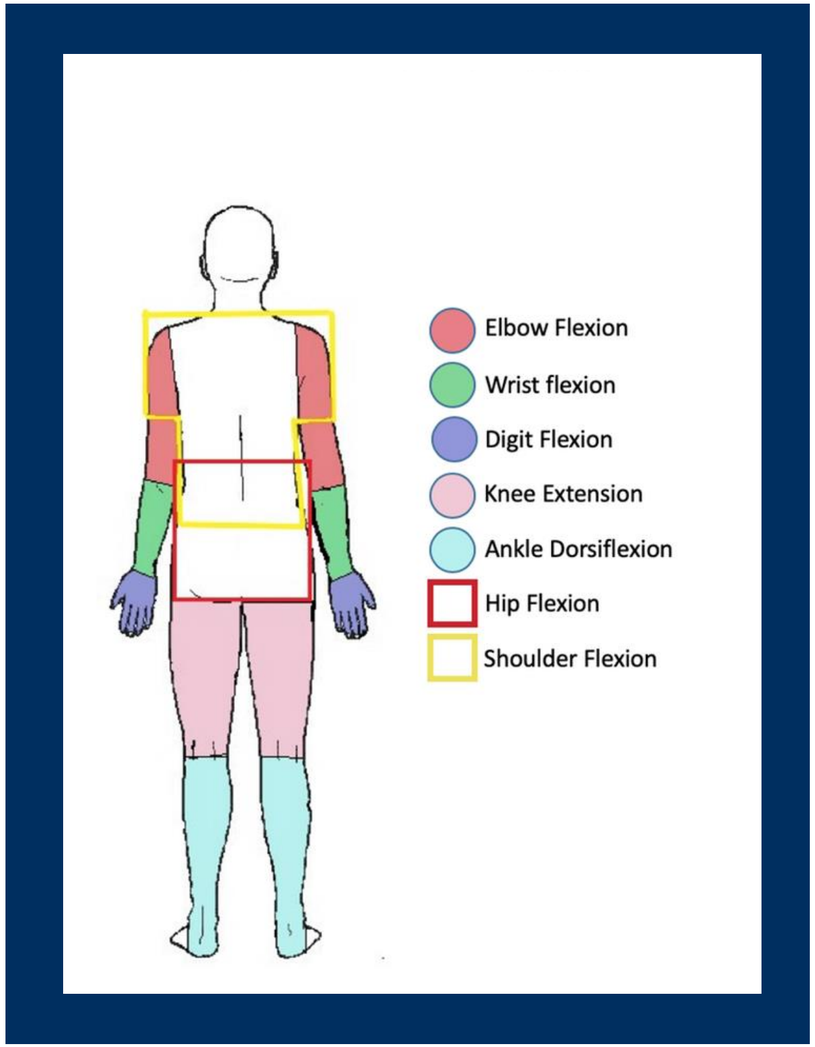

SCAR GONIOMETRY
Let's begin


SCAR GONIOMETRY
Joint to measure
Choose from categories
Goniometry was founded on arthrokinematic principles and does not consider the effect of skin restriction on movement. Scars that replace normal skin have less pliability to accommodate movement of adjacent and distant joints. Scar Motion protocol is recommended for clinical use and use in research when scars are the potential limiting


KNEE EXTENSION
Equipment
1 - Associated Cutaneous Functional Units

Cutaneokinematic Mapping





Yelvington & Parry, 2023

Benefits of CK Model

Increase in APPROPRIATE referrals

Link between day one evaluation and projected long-term outcomes

Risk benefit discussions with patients and families

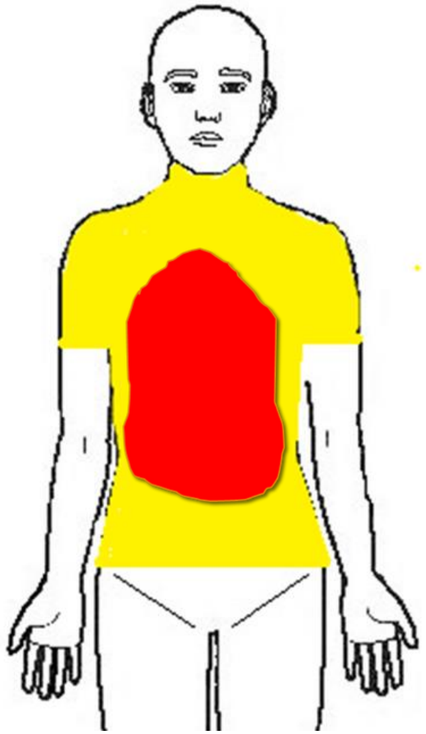
Can act as a “guideline” for therapy evaluation and treatment

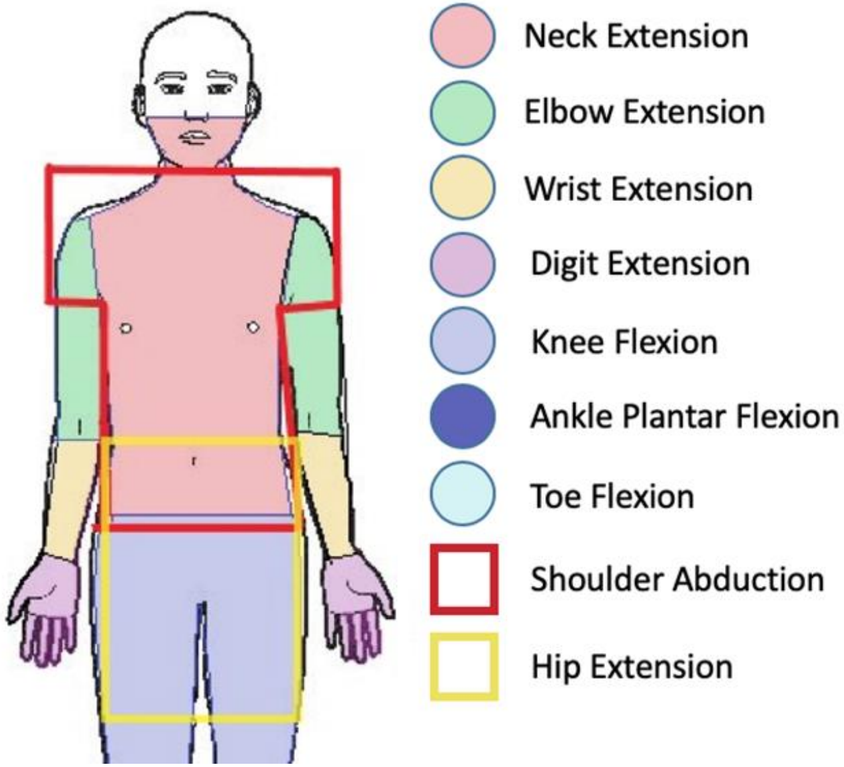
Good learning tool for new staff and students

Starts to answer the “why” of contracture development

Prioritize limited therapy time

Case Discussion





Treatment Considerations

Who is consulted for this patients rehab?

Neck Extension
Shoulder Abduction
Hip Extension

What are potential ADL or functional implications?

What happens as this patient grows?

Hypertrophic Scars

- Will likely be present even with therapy
- Elevated, thick, firm, reddish scars
- More common in wounds that took longer to heal
- May cover large areas but do not extended beyond the original burn wound

Scar Management

Pressure

- Accepted for 4 decades as a first line therapy for scars
- Applied with garments, inserts, gel sheets, elastomers
- Cost/benefit questions prevalent in the literature

Heat

- Warmth increases collagenase activity (2-3 degrees)
- Often work toward neutral warmth - prevent cooling
- Neoprene Model

Hydration

- Occlusion of underlying skin
- Decreases capillary activity and collagen production
- Help prevent evaporation

Functional or Cosmetic Concerns

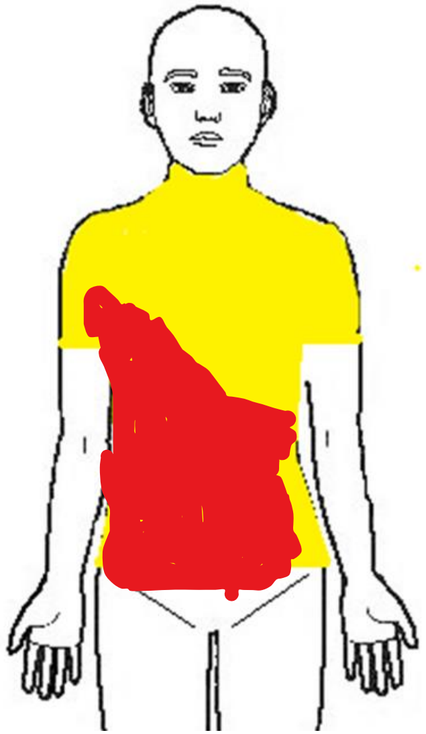
Restoration of deformities that impose functional limitations

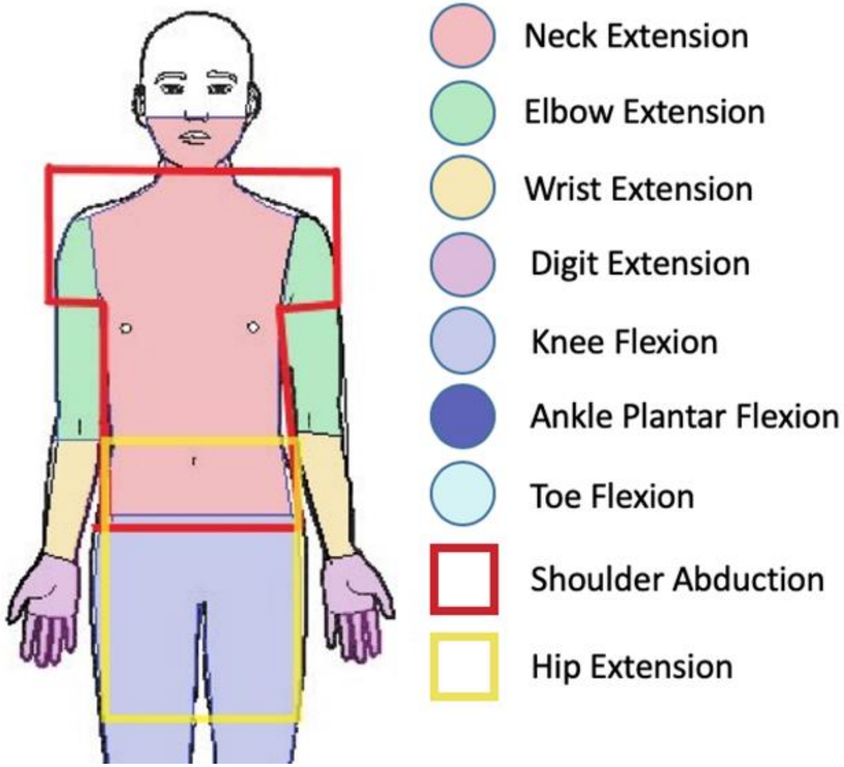
Typically delayed until recover from initial phase of injury

Levels of reconstruction options

- Laser
- Injections
- Z-plasty
- Primary Closures
- Reconstruction
- Skin Substitutes
- Grafting
- Flaps

Case Study




Neck Extension
Elbow Extension
Wrist Extension
Digit Extension
Knee Flexion
Ankle Plantar Flexion
Toe Flexion
Shoulder Abduction
Hip Extension

Scar Management

Pressure

- Wearing Garments x3 months with worsening scars
- Difficult area to apply consistent pressure
- Standing vs sitting vs movement

Heat

- Garments provide some neutral warmth

Hydration

- Consistent with moisturizers
- Scar appears well hydrated

Next step? Full Reconstruction?

Long Term Challenges for Burn Survivors

- Respiratory Endurance
- Musculoskeletal Complications
- Skin Sensitivity/Integrity
- Decreased coordination, strength, and endurance
- Contractures (present or risk)
- Garments
- Anxiety
- Heat/Cold Intolerance
- Sunlight Sensitivity
- PAIN and Itching
- Chemical sensitivity
- Changes in sweating pattern
- Psychosocial and Adaptive Challenges

Contact

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