Burn – 16th Lecture

PHYSICAL THERAPY MODALITIES TO MANAGE BURN CASES
A. MOST EFFECTIVE METHODS OF BURN PATIENTS POSITIONING AND SPLINTING

1. Proper Positioning Program:

Proper positioning is one of the fundamental tents necessary for successful burn patient rehabilitation. A burn patient's positioning program is designated to minimize edema formation, prevent tissue destruction and maintain soft tissue in an elongated state to facilitate function recovery. Burn scar contractures can be anticipated by the location, extent of the body involved, and the depth of the burn wound. Positioning the burn patient should be implemented to the extent that contractures are averted without compromising mobility and function.
Total body and specific site positioning techniques are used to minimize pathophysiologic effects from burn, enable optimal wound care and prevent localized neuropathies.

In addition to positioning, the use of fluidized air, and pillows bed and special mattress provides pressure reduction for patient with a large burn. These beds are equipped with adaptations that allow the patient to be positioned as needed to minimize contracture formation. A positioning program is developed to meet each individual patient's needs and should be modified throughout hospitalization. Adjustments in the alignment of the extremities are made when altering the patient's position in bed. Daily monitoring of the patient's medical status, range of motion, and skin condition will assist the therapist in deciding how long positions are to be maintained and what other modifications are necessary in positioning program, (specific positions are used to align individually the extremities, neck and trunk and are considered to be "anticontracture" positions.)
The popular adage "the position of comfort (fetal position) is the position of contractures appears well founded. In general, the patient should be positioned in the opposite direction of comfort, that is, opposite the bum wound and impending contracture.

Figure (4) and table (2) illustrate the most commonly used anti contracture positions.

The positioning program is instituted on the day of admission to the bum center. Each patient's positioning needs are different and the possibilities in positioning are limited only by imagination and creativity of the physical therapists.

(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,)
The proper positioning program for function is initially based upon the depth and area of the bum wound. Subsequently, the area of bum is the most indicator for planning the function program positioning left in place 20 to 30 minutes^The involved area is maintained in the stretched position with splints. After paraffin treatments, deep massage and stretching exercises promote additional scar softening and increased range of motion.

Managing the consequences of scar tissue formation should include a program of pressure application, positioning, splinting and exercise.
Larson et al. (1974) and Baur et al. (1977) documented the effect of pressure (25 mmHg) as an effective treatment in reducing scar tissue response. Pressure may be applied to the bum scar by a variety of methods. Methods commonly used to apply pressure are elastic wraps and custom-fit pressure garments.

These methods may be augmented with splints or open-cell foam placed over the scar tissue to enhance pressure in selected areas. To affect early scar formation while wounds are still open, bias cut stockinet, pressure wraps, splints or foam may be applied over the bum dressing. The combination of foam and pressure dressing is an excellent method for applying pressure to areas where hard splint may shear new skin or where conformity to an irregular surface is difficult.
General Body Positioning for Prevention of Contractures
<table>
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<th>Body Area</th>
<th>Contracture Predisposition</th>
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<td>Flexion</td>
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<td>* Anterior Axilla</td>
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<td>Shoulder Adduction</td>
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<td>* Wrist</td>
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<td>Dorsal/hand/finger</td>
<td>MCP Hyper extension, IP Flexion, thumb adduction</td>
<td>MCP Flexion, IF Extension, thumb palmar abduction</td>
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<td>* Palmar hand/finger</td>
<td>Finger flexion, thumb opposition</td>
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<tr>
<td>* Planter toes</td>
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<td>Extension</td>
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a. Basic Positioning Techniques in Edema Control:

Initially, a positioning program focuses on reducing edema through elevation of the extremities. Edema develops with 8 to 12 hours after burn injury and peaks at approximately 36 hours. Failure to reduce edema in the first 48 to 72 hours can result in organized edema components creating fixed deformity. Furthermore, improper elevation during the initial period of edema may lead to calcification and increased bone density, especially in elbow. 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. If head of the bed position is changed, the position of extremities will need to be changed accordingly to maintain proper elevation. In addition, the upper extremities must be maintained while patient is lying, sitting or ambulating. Lower extremities should be elevated when the patient is sitting by placing them on a foot stool.
b. Positioning Following Reconstructive Surgery:

Although positioning is important during the acute burn phase, positioning following reconstructive surgery requires considerable attention to prevent repeated surgical procedures to the same area. The positioning program will be necessary for a successful reconstructive outcome. The use of splints or other positioning aids will need to be instituted to ensure maintenance of proper positioning. For example, some burn centers utilize halo traction following surgical neck release. Customized neck splints can be constructed prior to the surgery that allows the patient to sit or ambulate while securing the head in an immobile position. Also, surgical dressings can be reinforced with plaster and additional supports if necessary.
Johnson and Silverberg (1995) found that serial casting is a conservative method and effective modality in correcting contracture resulting from burns. It has been used to promote increased range of motion to facilitate patient compliance with positioning and to prevent the patient from scratching the burned area. This case report describes the use of serial casting for resolution of ankle planter-flexion contractures that occurred in the acute phase of burn injury. Skeletal suspension was used for the facilitation of skin grafting and for functional positioning in the surgical correction of burn-acquired deformities and finely the rate of complications was low.
c. Continual Teaching and Communication for Effective Position Program:

Continual education of burn team members, patients and their caregivers is one of the most important aspects for the therapists to address in regards to positioning. In the hospital, positioning education must be sent to all nursing staff, because the positioning program is necessary 24 hours a day. This information is very important for nurses who are unfamiliar specialized burn rehabilitation techniques. There are many methods or effective ways of teaching and communicating the positioning program to the burn staff. These methods may range from simple positioning diagrams at bedside to very detailed care plans. A specific positioning program can be explained by circling the specific patient positions on a comprehensive positioning charts. The medical staff at some burn centers may find that writing in the medical record care plan or on erasable marker boards is sufficient.

Additional methods to communicate ideal or proper positioning are photographing the correct patient position using an instant camera or using a plastic slider holder to display diagrams of individual patient positions.
A positioning video could be part of an in-service library for reference or orientation of the burn unit staff. Direct patient education, as well as staff communication during rounds, is helpful method for achieving a good positioning program. To assist the therapist in communicating correct positioning for the pediatric patient, developmental or batty stickers with pictures of the desired positions. Pictures are easily posted at the bedside for staff reference or provided to family members for home instruction.
2. Splinting Techniques:

Historically, splints have been used to support burned extremities, maintain joint positions following surgery and correct or prevent deformity. The design of splints can widely, but the intended results are the same. The chosen design, however, is less important than the timely application and proper fit of the splint.

The length of time a patient needs to wear a splint depends on the depth of burn, the degree of activity of the hypertrophic scar, and the patient's adherence to the self exercise program.

Splinting is an extension of the therapeutic positioning program. Splinting is indicated when the patient is unable to voluntarily maintain proper positions, when voluntary positioning is ineffective in preventing contracture, or when the patient must be immobilized for an extended period such as after surgical wound closure.

Splinting may be initiated at any time in the acute burn period depending on individual patient needs and functional range of motion.
Some areas, especially the hands, require splinting immediately after burn injury to aid in edema resolution and to maintain function joint position. **Continuous splinting is indicated in treatment of**

1. burn wound edema in the hands;
2. exposed tendons,
3. peripheral neuropathies: and
4. uncooperative or unresponsive patients.

These splints must be removed several times daily and with the exception of exposed tendons, the involved areas should be undergo exercise.

Splints may be used with nearly every type of burn wound treatment including grafts and other biologic dressing. Frequent assessment, at least on a daily basis, is the key to effective splinting, thus insuring proper fit and function.
a. Using of splints and protection of Joints and tendons:

Splints play an important role in prevention further trauma to joints and tendons or preserving anatomical structure and function. Stabilizing joints reduces external stresses, such as shearing or pressure, which can cause tissue damage.

b. Role of splinting in edema reduction:

Supportive splints are used to maintain maximal limb elevation for resolution of edema. Splints used for this purpose are generally of a trough design. Exact contour of the extremity is not always necessary. The pressure support of air splints may assist edema reduction.

c. Splinting following skin grafting:

Splints are applied intraoperatively to immobilize a skin graft recipient site and prevent accidental shearing of the graft. When grafts are restricted to the upper body, splints enable the patient to be ambulatory without risk of graft disruption.
d. Splints for uncooperative or unconscious patient:

Splints are used to maintain a function joint position or prevent contracture development when a patient is unable or unwilling to participate in therapy programs. Adults may develop joint stiffness following immobilization and range of motion should be assessed each the splint is removed. Children rarely develop joint stiffness as a result of prolonged immobilization. Continuous use of a splint assures proper positioning until a patient is able to actively participate in the rehabilitation program or the risk of contractors is reduced.
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 postgraft 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.
APPLICATION OF THE MOST EFFECTIVE METHODS FOR BURN PATIENT POSITIONING ON SPECIFIC AREAS OF THE BODY

1. **Head and Neck:**

Patients who have sustained head burns that include the ears should not be allowed use of a pillow in order to avoid a development of chondritis of the ear. A foam gel filled donut is useful to elevate the ears from the bed. A partially filled intravenous (IV) bag is an alternate method. If a patient's head needs elevation for eating or drinking, raising the head of the bed rather than using a pillow is the preferred method.

Anterior or circumferential neck burns predispose patients to neck flexion contractures. Contracture of the anterior neck is the most common contracture requiring surgical release. Pillows which position the neck in flexion should not be when burns cover the anterior neck. Positioning is necessary to maintain neck extension or hyper extension, exercises can be used to maintain rotation.
Several options for neck positioning can be used to extension easy and quick method is a towel roll placed under the patient's shoulder or between scapula. A foam cervical collar or donut around the patient's neck is useful to prevent neck flexion when lying in bed and during upright activities. The use of hyper extension or staggered mattress also encourages neck extension. A towel roll or pillow can be placed under the head if the top of mattress is too high. Extension neck exercises should be encouraged.
If a neck burn is asymmetrical; a lateral flexion contracture toward the side of the burn can be expected. This can cause muscle imbalance and lead to a postural deformity. The neck should be positioned so that the head is held in midline. Towel rolls, wedges or sand bags placed lateral to the head, on the same side as the burn, minimizes lateral tightness. Positioning environmental stimuli such as television; toys, bed trays, and visitors on the nonaffected side will encourage the patient to turn and stretch the neck. Lying prone with the head rotated away from the side of the burn may be utilized to stretch the neck. When a neck burn is posterior and the ears are not affected, a pillow may be used to elevate the head and lengthen the posterior tissues.
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).
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.
2-Trunk:

There is a good relationship between the location and extent of burns and spinal postural deformities, i.e. burns extending from the pectoral region to an area below the umbilicus may cause a kyphosis. Burns of the lower back may lead to a lordosis, while a lateral trunk burn may cause a scoliosis with the concavity toward the burned side. In addition to these postural deformities, improper trunk alignment might impair chest expansion required for good ventilation.
When the chest is burned, the shoulder girdles should be positioned in retraction. Positioning for chest burns may include placing a square towel, or bath blanket between the scapulae alternatively, the patient can lie supine with hands clasped behind the head with elbows resting on the bed. A figure-of-eight elastic wrap to pull the shoulders into retraction, cervical fracture braces and clavicular straps can be used when skin integrity allows. Deep breathing exercises are the only procedures that can be used to maintain maximum chest mobility. The forward tilt of the shoulders which often occurs as a result of burns of the anterior chest wall can be prevented by positioning the arms in 90 degrees of abduction. Back brace or spinal support can be applied to limit the amount of postural deviation from scar tissue tightness (Fig. 8). Lateral trunk burns require the trunk burns to be maintained straight to prevent scoliosis of the spine. Towel roll, blankets, and foam wedges can be utilized to maintain trunk alignment while in bed by placing them on the side of the trunk where the bum is located.
3-Shoulder:

The normal resting position with arms at the side is the one least likely to help maintain range of motion in the shoulder joint. The most advantageous position for maintaining range is shoulder abduction to 90 degrees. A patient with burns of the anterior axilla will tend to posture in shoulder adduction and internal rotation, therefore shoulder abduction and external rotation is the position of choice to prevent deformity. The recommended position for the shoulder when the axilla is burned is 90° of abduction With 15° to 20° of 'horizontal adduction to avoid stretching and compression of the brachial plexus.
When the burn involves the elbow and the shoulder, elbow extension must be maintained during shoulder positioning. Children can be motivated to move 'their arms by placing soft toys with bells on them in strategic positions on the side of the bed, many options are available to hold a patient in the positions just described. Murphy slings, made from stockinet and attached to an IV pole or an overhead ceiling tract, are especially helpful in the early stage of positioning to achieve elevation along with shoulder abduction (Figs. 9 and 10).
Fig. (8): Spinal Support Brace.
A soft restraint at the wrist, which is tied to the headboard, maintains shoulder abduction and external rotation with the elbow flexed. Foam wedges, towel rolls, pillows and bath blankets placed between the axilla and trunk are convenient positioning devices. Several commercial shoulder abduction troughs are available as bed attachments. These troughs fasten onto the sides of the bed and are utilized not only for shoulder positioning but also may be used to elevate the upper extremity to decrease hand edema. Skin grafts of the arms or axilla require special positioning to prevent shearing tissue from contact with the bed, an arm cuff and traction bars may be used to protect upper extremity skin grafts.
The position of comfort for the patient is one of forearm pronation. Although elbow is a more functional position than extension, the tendency of the patient to withdraw into flexion in response to pain quickly produces an elbow flexion contracture. The position of choice is elbow extension with some elbow flexion exercises. Burns to the antecubital space and circumferential burns to the upper extremity can lead to elbow flexion and forearm pronation contractures. The recommended positions for the shoulder in this case is extension elbow and supination of the forearm. Many of the devices used for shoulder positioning also can used for elbow positioning. Arm troughs allow the elbow to rest in an extended position. Elbow splints are an effective means of positioning (Fig. 11). Wrist restraints, when used in conjunction with elbow splints and attached to the head of the bed, provide a quick method for combined shoulder and elbow positioning. The use of an air splint is an alternative for positioning the upper extremity and it can be used provide pressure apply, helps control edema.
5- Forearm and Wrist:

Burns to the volar surface of the forearm will predispose the patient wrist flexion and forearm pronation contractures, while burns to the dorsal surface of the forearm may cause a wrist extension contracture. The forearm frequently assumes a pronated position with the wrist in flexion when a patient elevates the forearm and hand, or rests the segment on a pillow. Therefore, the forearm is always positioned in supination except in the case of isolated dorsal wrist burns, the wrist should be positioned in extension. The recommended functional position of the wrist is from neutral to 30° of extension. This position can be initially or temporarily accomplished by placing a small towel or gauze roll in the palm of the hand. If the wrist range of motion becomes limited in a specific direction, splinting the wrist in the opposite direction would be indicated (Figs. 12 and 13). Circumferential forearm burns require the wrist to be positioned in neutral or slight extension due to the effects of gravity and the strength of the flexor musculature.
6- Hand:

During early hospitalization, the hand must be elevated to minimize edema formation. Elevation can be achieved using Murphy's slings, surgical netting or pillows. Elevation must be maintained while the patient is in bed, sitting, or ambulating the antideformity or recommended 'position of the hand with a dorsal burn is that of "the duck-bill", "clam digger" position. The fundamental hand positioning components are:

(1) wrist extension,
(2) metacarpophalangeal joint (MCP) flexion,
(3) proximal interphalangeal (PIP) joint and distal interphalangeal (DIP) joint extension, and
(4) thumb palmar abduction.
This position can be achieved by wrapping a gauze roll or piece of foam into the palm and extending it through the thumb web space or hand splint can be used. The use of many types of splints is an alternative for positioning of the 'burned' hand. Palmar pan splint is a thermoplastic splint that positions the joint opposite the anticipated deformity or contracture, it also to maintain tendon balance and functional position and prevents rupture of extensor mechanism. Wrist splint is wrist orthosis for immobilization and positioning (Fig. 14). Thumb spica can be used for immobilization and positioning the thumb and wrist. Thumb web spacer is a thermoplastic splint that comforts to the index finger, thumb web space and thumb to provide positioning and/or pressure (Fig. 15).
7- **Hip:**

When a burn is on the anterior or posterior aspect of the hip area, the hip should be positioned in neutral rotation with slight abduction. If the patient is not positioned correctly, hip flexion, external rotation, and/or adduction contractures can result. A patient positioned with the hips in external rotation and the knees flexed for a prolonged period of time is at risk for peroneal nerve injury caused by stretch of the nerve. The results of this position can be completed the paralysis with a foot drop or some degrees of muscle weakness of the anterolateral compartments.
Towel rolls or sand bags, placed lateral to the thigh, can assist to position the hip in neutral position. A triangular foam wedge or bath blankets can be placed between the lower extremities to maintain hip abduction. Lower extremities abduction splints position the hips in abduction and neutral rotation, while knee extension splints can minimize hip flexion, by preventing knee flexion when the patient lies supine. Prone position is an excellent position for hip extension. Anterior hip spica splint made from thermoplastic material to maintain hip extension and abduction while preventing hip flexion and adduction (Fig. 16). Hip abduction splint made from thermoplastic material and secured in place with foam straps (Fig. 17). Spreader bar fastened posteriorly to two knee extension splints to maintain abduction of the lower extremities (Fig. 18).
Thumb Web Spacer
Spreader Bar Attached to Knee Gutter Extension.
8- Knee:

The tendency of the patient to withdraw into flexion in response to pain makes maintenance of hip and knee extension a vital procedure.

Burns to the posterior surface of the knee cause flexion contracture, while anterior surface burns rarely cause extension contractures. The patient with a burn to the flexor surface of the lower extremity must be positioned with the knee in extension. The extremity may be placed in bulky dressing to mechanically impede knee flexion especially after a skin graft. Pillows placed under the knees while patient is supine are not recommended as they may cause knee flexion contractures. Positioning a patient prone with the feet over the end of a mattress is a means of achieving complete knee extension. Placing a pillow under the
ankle counteracts this desired effect by producing knee flexion. For edema reduction, the foot of the bed can be elevated with pillows placed under the leg, excluding knee, to encourage knee extension. Those patients who can not maintain the position of knee extension can be supplied with splint. Knee extension splints are extremely helpful to maintain extension. The common examples of knee splints are (1) Gutter or/trough splint, can be applied to the flexor surface of the joint to maintain extension, (See Fig. 19), (2) knee conformer is applied to the flexor or extensor surface of a joint for immobilization and application of pressure, and (3) Air splint inflated to apply pressure, immobilization and assist with edema control.
9- Ankle and Foot:

The planter flexion contractures are the most common problem in a foot and ankle burns. One of many problems, planter-flexion puts the gastrosoleus muscle complex on slack, encouraging heel cord tightness, therefore, placing the ankle at neutral is the optimal position for posterior or circumferential burns of the ankle-methods used to maintain or achieve a neutral ankle position for circumferential or posterior burns of the ankle and foot are splints as (1) a foot-board (2) sponge booties, prefabricated splints (posterior foot splints, anterior ankle conformer and toe conformer). Figures (19) and (20) may be utilized for positioning ankle and foot burns. If the burn is isolated across the anterior surface of the ankle and foot, positioning in planter flexion is preferred while patient is resting. If the dorsum of the foot is involved, extension contractures of toes are likely. If the patient is ambulatory and the ankle is not burned, special positioning is not indicated.
The overall aims of treatment for burns are healing of the skin and restoring the patient to a normal active life as soon as possible.

The rehabilitation begins the day the burned victim arrives at the hospital. The physical therapist should be present during the initial evaluation of the patient. Physical therapist can then formulate a treatment plan for the patient's entire hospital course. At this time" bed positioning of the patient is discussed with other staff. The physical therapy program and treatment plans are explained to the patient to encourage him to participate actively in his own rehabilitation. The main purpose of an active physical therapy program for a burned patients is to prevent deformity and maintain maximum function. The physical therapists treat patients with burn injuries to maintain function, to maximize cosmetic results and to return them to their preinjury life styles.
Some of the most effective methods of burn patients positioning are positioning program and splinting techniques. The main aims of positioning program are, minimize edema formation; prevent tissue destruction, maintain soft tissues in an elongated state to facilitate function recovery, prevent scar contractures; and in some surgical cases, it is necessary for successful reconstruction outcome. Positioning consists of elevating extremities and or/placing the soft tissue in an elongated state, in opposition to a contracting burn scar. The recommended positioning program was consistent throughout the hospitalization period. The hand was maintained in an elevated position to facilitate gravity-assisted lymphatic drainage. The remaining upper extremity positions stressed an anticontracture orientation. Burns to the anterior axillary fold tend to limit shoulder abduction, and so abduction was the position of choice.
The typical pattern of restriction with circumferential burns about the elbow, forearm, and wrist is limited elbow and wrist extension with forearm pronation. Thus the positions chosen were to offset the tendency for contracture. A position of hip extension was emphasized with the patient for two reasons, first to deter tightness from forming across the inguinal crease and second, to maximize the stress applied to the healing tissue of the trunk throughout all contiguous areas of involvement.
When the positioning is necessary during the day as well as at night, care should be taken to see that it does not interfere with necessary movement. The positioning program may require the removal of equipment such as a pillow or the use of special equipment such as abduction boards or splint. Wound contraction, however, continues after wound closure is complete. If this continued contraction occurs across a flexed joint, the outcome is a debilitating flexion contracture. It is well known that patients sustaining a burn injury assume the flexed position, which is the position of comfort. For this reason, immediately upon admission, the patient is positioned in the anti deformity, extension position with elevation for control edema. To enhance compliance, the patient must be fully aware of the purpose of splinting and functional limits and deformities that can occur. There are three types of splint, primary post-graft; and follow up splints
Splints are continued until functional and cosmetic results are achieved. A combination of positioning and splinting are among the most effective methods by which physical therapists can help the acute burn patient achieve mobility and independence:

Positioning and movement must be closely integrated into a total program for function if maximum benefits are to be obtained. Movement alone will not prevent the contractures, and positioning alone will only determine the position of contracture. A judicious balance between the positions to maintain the end of the range most susceptible to contracture formation.