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# Basic Principles of Patient Positioning

*(An online continuing education activity)*

*A Continuing Education Activity*

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# BASIC PRINCIPLES OF PATIENT POSITIONING

***(An Online Continuing Education Activity)***

## OVERVIEW

This online activity reviews general guidelines for patient positioning. The role of the perioperative nurse in assessing the patient and the importance of advance planning for safe patient positioning is emphasized. Basic surgical positions are reviewed and potential pressure points indicated. Positioning devices and pads available in most operating rooms are described; including the procedure table itself and its mattress and various attachments. Appropriate selection criteria for positioning equipment and devices are listed. General risks associated with patient positioning are summarized. Postoperative assessment and documentation are mentioned.

## OBJECTIVES

After completing this online activity, the learner should be able to:

1. Discuss preoperative assessment and planning considerations related to patient positioning.
2. Describe the general types of patient positioning equipment and devices that are available in most operating rooms, along with appropriate criteria for their selection.
3. Discuss the risks to the patient that are associated with establishment and maintenance of surgical positioning.
4. Explain variations of basic positioning, the pressure points involved and patient safety considerations.
5. Summarize the required documentation for the nursing record.

## INTENDED AUDIENCE

This on-line activity is intended for use by perioperative nurses, surgical technologists, and other healthcare professionals who need more information regarding the principles of surgical patient positioning.

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# INTRODUCTION

The safety and well-being of surgical patients are in the hands of the perioperative team when they enter the OR. Even as technology continues to advance, one thing remains constant. Each and every patient must be correctly positioned for his or her procedure. This continuing education activity was developed to help ensure that every patient that comes into your OR is positioned correctly and safely. The goals are to create a safe environment and to improve patient outcomes. In general, outcomes of safe and appropriate positioning should include:

- Optimal exposure of the surgical site
- Airway management, ventilation and monitoring access for the anesthesia care provider
- Physiologic safety for the patient
- Maintenance of patient dignity by controlling unnecessary exposure

# GENERAL GUIDELINES FOR PATIENT POSITIONING

In their definitive text, Positioning in Anesthesia and Surgery, Martin and Warner identify four components of safe surgical positioning: knowledge, planning, teamwork and housekeeping.

- **Knowledge** includes both the theoretical and practical principles of arranging the posture of an unconscious or an awake patient for a particular operation and is required for safe positioning.
- **Planning** encompasses an understanding of the intended operation, as well as the specific problems that face the surgeon and the anesthesia provider with respect to the needs of a particular patient.
- **Teamwork** involves the careful coordination of the activities of all personnel. Ensuring a safe and comfortable environment for every surgical patient is the shared responsibility of everyone on the OR team. Working together, the surgeon, the surgical assistant, the anesthesia provider, perioperative nurses and surgical technicians improve patient outcomes by creating and maintaining the optimum surgical position.
- **Housekeeping** includes having the appropriate positioning devices on hand and ensuring that each part fits and functions as intended.

Implementation of safe patient positioning involves several steps which include:

- Assessing the patient's needs
- Developing a plan of care
- Assembling the necessary positioning devices
- The actual positioning of the patient

- Reevaluating body alignment and tissue integrity intraoperatively
- Evaluating patient outcomes with respect to positioning-related complications

## *Preoperative assessment*

The care of every surgical patient begins with a preoperative assessment. A thorough assessment takes into account the patient's individual physical and physiological needs and facilitates an optimum anatomical approach. Never underestimate the importance of this information-gathering step. Information and knowledge about the patient's medical history and condition, as well as possible risk factors, are needed to plan the necessary precautions and prevent positioning-related injuries.

### Chart Review

Begin the preoperative assessment with a thorough chart review. The patient's medical history may reveal risk factors or medical conditions that place him or her at increased risk of positioning-related complications. Such risk factors include preexisting diabetes mellitus, peripheral vascular disease, renal failure, neuropathy and/or obesity.

### Patient Interview

Before beginning the patient interview, introduce yourself to the patient and explain why you will be asking questions about his or her medical history. Asking in advance for the patient's active participation encourages a more cooperative and compliant response. Approaching the interview with a smile—with confidence and professionalism—promotes a more positive attitude on the part of the patient.

The preoperative interview should include specific questions that will determine the patient's ability to tolerate the planned procedure. Remember to take note of the patient's:

- General level of awareness
- Age
- Weight and height
- Skin condition
- Nutritional status
- Current medications
- Normal range of motion and limitations on range of motion
- Physical abnormalities or limitations, such as back problems or deformities
- Preexisting medical conditions (e.g., vascular, respiratory, circulatory, or neurological problems, immune compromise)
- Previous surgeries and surgical complications
- Implants, such as total joint prostheses

## Developing a Plan of Care

After the preoperative assessment, the next step is to develop a plan of care. Review the type of anesthesia to be administered, the planned surgical procedure, the surgical position required, the surgeon's preferences, the estimated length of the procedure and the patient's physical and mental status, as determined by the preoperative assessment.

Based on this information, discuss any potential problems or concerns with members of the team and formalize the positioning plan in advance. Ensure that the appropriate positioning devices and an adequate number of personnel are available to position the patient on the procedure table. While these things take time, the potential benefits outweigh any inconvenience. Remember: The patient always comes first.

## Assembling Positioning Devices

A variety of positioning devices and accessories are available to the surgical team to aid in achieving the optimum surgical position and to provide safety and comfort for the patient. Learn the storage locations for these devices and practice attaching them to the procedure table before they are needed during a case. Remember the old saying, "Practice makes perfect." Before use, make sure that all positioning devices are clean and in good working order.

Positioning devices available in most operating rooms include, but are not limited to:

- The procedure table itself, including general-purpose tables, specialty tables (e.g., fracture tables, ophthalmology carts/stretcher chairs) and fixed-base systems with interchangeable tabletops.
- Equipment that attaches to the procedure table (e.g., headrests/holders, overhead arm supports, stirrups, footboards).
- Support devices for the head, arms, chest, iliac crests and lumbar areas.
- Pads in a variety of sizes and shapes to protect pressure points (e.g., the head, elbows, knees, ankles, heels, sacral areas).
- Securing devices (e.g., safety belts, tapes, vacuum beanbags).

## Procedure Tables

Most procedure tables are made of stainless steel for easy cleaning. Patients are protected from hard surfaces by various forms of padding. Movement of the sections of the tabletop to achieve various positions is controlled either manually or by electric or infrared hand controls located at the end or side of the table. These controls raise or lower the table surface; raise or lower the back section; raise or lower the foot section; lock and unlock the table base; provide right, left, head-up, or head-down tilt; and turn the power on and off. Casters allow the table to be moved easily for cleaning, positioning and maintenance.

Specially designed tables are available to meet the particular needs of surgical specialties with unique requirements, including:

- Urology tables, which are shorter than general surgery tables, with emphasis on leg elevation, perineal fluid drainage and compatibility with radiography.
- Orthopedic tables, which come with a wide variety of standard orthopedic accessories, such as removable leg supports, collapsible arm extension devices, foot traction units, a transfer board for moving the patient, a nailing support or hip rest and traction extensions.
- Spinal surgery tables, which are designed to facilitate imaging and placement of the patient in the kneeling position.

Because many operations require intraoperative radiographs, the tops of procedure tables are designed to be radiolucent, with a space or tunnel for an x-ray cassette located between the tabletop and the platform supporting the patient. In addition, most tables are designed to allow maximum space beneath the table to accommodate the floor portion of a C-arm.

**Table Pads**

Soft, segmented table pads that adhere to metal surfaces are standard parts of all procedure tables. A full-length table pad offers maximum protection and comfort for the patient. Table pads may be made of standard foam, foam and gel, liquid displacement cells, silicone fibers or dry viscoelastic polymer. The addition of gel to a standard foam mattress appears to improve pressure distribution and prevent skin changes. If the goal is to reduce the risk of skin changes in settings such as short-procedure units where patients are younger and not seriously ill and surgeries that last less than 2.5 hours, a foam and gel mattress is sufficient. If the goal is to reduce pressure ulcer formation, the foam and gel mattress offers no real improvement over a standard foam mattress.

Viscoelastic dry polymer mattress overlays have been shown to significantly reduce the possibility of pressure sore development following surgery. The minimal cost of dry viscoelasstic polymer pads—compared to the cost of pressure sore treatment and the associated pain and discomfort for the patient—supports their general use. In tertiary care settings, where patients may be older and have more serious or chronic health problems, where vascular disease is more prevalent and where surgical procedures frequently extend beyond 2.5 hours, viscoelastic mattress overlays appear to offer an even greater benefit.

**Table Attachments**

Side rails run down both sides of the procedure table and sometimes on the ends. Locking sockets and clamps of various sizes and designs fit onto the side rails to permit the attachment of a variety of accessories, including:

- Leg holders, which include hanging straps that suspend the ankles and padded foot and calf supports
- Shoulder supports, which may be necessary to secure patients in a steep head-down tilt position
- Skull clamps to provide maximum stability of the positioned head
- Armboards, which may be contoured to cradle the patient's arm and protect the biceps, elbows and forearms
- Additional upper extremity support systems, which are designed to support the upper arm, forearm, wrist and/or hand
- Lateral positioning bars and posts

**Pads and Positioning Devices**

Any direct contact between the patient and the surface of a procedure table or positioning device has the potential to cause injury. A variety of pads and positioning devices are available that help distribute pressure over a wider area and thereby decrease the potential for pressure-related focal injury. Be aware of bony prominences and anatomical areas that are at greatest risk for pressure-related injury.

Pads and related positioning devices include:

- **Arm pads.** Arm pads redistribute pressure from pressure points to a larger surface area. They include ulnar nerve protectors and a variety of larger pads that cushion the whole arm.
- **Donuts.** Donut-shaped head pads are designed to protect and cradle the patient's head. Smaller donuts may be used to cradle other parts of the anatomy.
- **Rolls.** Full and half-round positioning devices are used to lift certain areas of the body off the mattress, restoring more physiological alignment and relieving down-side pressure points.
- **Heel cups/minipositioners.** Heel cups are appropriate for any procedure that is lengthy and involves pressure at the patient's heel area. A slit in back of the cup secures the patient's Achilles tendon. Heel cups can be used in multiples to provide quick, easy protection of any bony prominence or potential high-pressure area.
- **Egg-crate foam.** A convoluted foam mattress overlay (egg-crate foam) is effective in reducing pressure only if it is made of thick, dense foam that resists compression.

- **Vacuum beanbags.** Vacuum bags contain tiny plastic pellets. They are molded to the shape of the positioned patient and then the contained air is evacuated, stiffening the bag to help hold the patient in place. A cloth covering placed over the bag prevents direct contact between the plastic surface of the bag and the skin. This cloth cover absorbs moisture, which helps prevent irritation and possible abrasion of skin that may be in contact with the surface of the bag for prolonged periods of time.

Firm and stable positioning devices help distribute pressure evenly and decrease the potential for patient injury. Sometimes, specialty pads are supplemented with foam pads, blankets, towels and other materials. Flat foam pads are ineffective in reducing pressure, because they quickly compress under heavy body areas. Pillows and blankets may produce only a minimum of pressure reduction. Towels and sheet rolls do not reduce pressure and may contribute to friction injuries.

**Securing Devices**

Restraining straps are justified for most operations to prevent patients from falling off the table, but such straps must be used with care. Severe injury may result if the strap is excessively tight or it is placed over the wrong anatomic area.

**Choosing Positioning Devices**

Appropriate selection criteria for positioning equipment and devices include, but are not limited to:

- Availability in a variety of sizes and shapes
- Durability (if not disposable)
- Ability to conform to the patient's body, distributing pressure evenly without any "bottoming out" effect
- Ability to maintain a normal capillary interface pressure of 32 mm Hg or less
- Resistance to moisture and microorganisms
- Radiolucency
- Fire resistance
- Nonallergenicity
- Ease of use
- Ease of cleaning/disinfection (if not disposable)
- Ease of storage, handling and retrieval
- Cost effectiveness

All of these factors should be taken into account when choosing a line of positioning aids.

## *Positioning the Patient*

Before transferring the patient to the procedure table and placing him or her in the desired position, make sure that an adequate number of personnel and/or devices are available. Inadequate personnel and/or equipment can result in patient injury. Without proper support during transfer and positioning, indwelling catheters, tubes, or cannulas may be dislodged. Sliding or pulling the patient across a stationary surface can result in shearing and/or friction.

- **Shearing** refers to the patient's skin remaining stationary while underlying tissues shift or move, as might occur when the patient is pulled or dragged without support to the skeletal system or when a draw sheet is used.
- **Friction** occurs when skin rubs over a rough stationary surface. Maintaining the patient's correct body alignment and supporting extremities and joints decreases the potential for injury during transfer and positioning.

## *Reassessing Body Alignment and Tissue Integrity*

After the desired position is attained, reevaluate the patient's respiratory, circulatory, neurologic, musculoskeletal and integumentary systems. The risk of patient injury is increased by alterations in normal defense mechanisms due to anesthetic agents and medications and by the prolonged immobility that occurs during lengthy procedures. The risks to the patient include respiratory compromise, circulatory compromise, nerve and muscle injury and skin damage.

### Respiratory Compromise

Respiratory function can be decreased by mechanical restriction of the rib cage, which can occur with certain positions (e.g., prone, lateral or lithotomy). It is easy to see why the anesthesia provider plays such an important role in patient care in the OR. Some positions may impede air exchange or ventilations or create effects that may be undesirable.

### Circulatory Compromise

Anesthetic agents and surgical techniques may affect circulatory function, resulting in peripheral vasodilatation, hypotension, decreased cardiac output and inhibition of normal compensatory mechanisms. Hypotension, whether induced or spontaneous, reduces tissue perfusion and increases the risk of tissue injury. Certain positions—including the lithotomy and head-down positions—can cause redistribution and congestion of the blood supply. Circulatory responses to certain positions or position changes can be rapid and dramatic.

### Nerve and Muscle Trauma

The muscle relaxants typically given with general anesthesia may allow for overstretching of muscles, tendons and joints. Under general anesthesia, the patient's normal pain and pressure receptors are blocked and the patient is unable to inform the team of problems or discomfort. Nerves and vessels can be stretched or compressed, causing an injury.

The patient is at greatest risk of nerve and muscle trauma when upper extremities are abducted at greater than 90° to the body, hips are placed in excessive external rotation and/or the head and neck is hyperflexed or hyperextended.

**Skin Injury**

Intraoperative skin injury is a function of the intensity of pressure and the duration of that pressure. High pressure for short durations and low pressure for longer durations may be equally damaging to tissue.

- **Intensity of pressure.** It has been determined that the end arterial capillary pressure averages 32 mm Hg. This value is currently accepted as the external threshold pressure beyond which small vessels collapse and thrombose, resulting in occluded blood flow and depriving tissue of necessary oxygen, nutrients and lymphatic circulation. Toxic metabolites are produced at the cellular level, leading to tissue acidosis, increased capillary permeability, edema, cell death and pressure sore formation. External pressure exceeding normal capillary interface pressure can cause occlusion that will restrict or block blood flow. The resulting tissue ischemia will lead to tissue breakdown.
- **Duration of pressure.** The patient's risk of ulcer formation and other complications increases as the length of the procedure increases. Several studies have indicated that procedures longer than 2.5 to 3 hours significantly increase the patient's risk for pressure ulcer formation. The sustained pressure on tissue, nerves and vessels leaves the patient with an undesirable postoperative outcome.

Secondary factors contributing to pressure sore formation may be intrinsic or extrinsic. Factors intrinsic to the patient include decreased nutrition, increased age, sensory loss, chronicity, impaired mobility, decreased mental status and incontinence. Extrinsic factors include shear force, friction and pressure. Intraoperative factors that have been identified as contributing to pressure sore formation include patient weight, type of anesthesia, length of surgery and thermal blanket usage. Capillary closure as a result of pressure and shear is the main cause of skin breakdown. It is recommended that padding and pressure relief devices maintain a normal capillary interface pressure of 32 mm Hg or less.

The National Pressure Ulcer Advisory Panel stages pressure ulcers according to the degree of tissue damage, as listed in Table 1. Research indicates that many postoperative pressure ulcers are OR-induced. The incidence of pressure ulcers occurring as a result of surgery may be as high as 66% (in elderly patients with femoral neck fractures), with most being Stage I and fewer than 10% being Stage II or higher.

**Table I. Stages of Pressure Ulcers**

| Stage | Manifestations |
|---|---|
| I. | Observable pressure-related alteration of intact skin; includes a change in color and possibly in skin temperature, tissue consistency and/or sensation compared the adjacent or opposite area of the body |
| II. | Partial thickness skin loss involving the epidermis and/or dermis; ulcer is superficial and presents clinically as an abrasion, blister or shallow crater |
| III. | Full-thickness skin loss, possibly down to, but not through, the fascial layer; presents clinically as a deep crater with or without undermining of adjacent tissue |
| IV. | Full-thickness skin loss with extensive destruction, tissue necrosis or damage to muscle, bone or supporting structure (tendons, joint capsule); may be associated with undermining and sinus tracts |

# BASIC SURGICAL POSITIONS

Most surgical procedures are performed with the patient in some variation of one of the following four positions:

- Supine (face-up)
  - Head-up tilt
  - Head-down tilt (formerly known as "Trendelenburg")
- Lithotomy (face-up, with the legs elevated and hips abducted)
- Lateral (on the side)
- Prone (face-down)

## *Supine Position*

For the supine position—sometimes referred to as the horizontal supine position—the procedure table is flat and the patient lies on his or her back, as illustrated in Figure 1. The hips and knees are extended and the arms are usually placed alongside the trunk or are abducted on armboards.

The supine position is the most commonly used surgical position. It is the basic position for most abdominal surgery and is also frequently used in orthopedic, urologic, ophthalmologic, otorhinolaryngologic, plastic and thoracic operations.

**Figure 1: Patient in supine position**

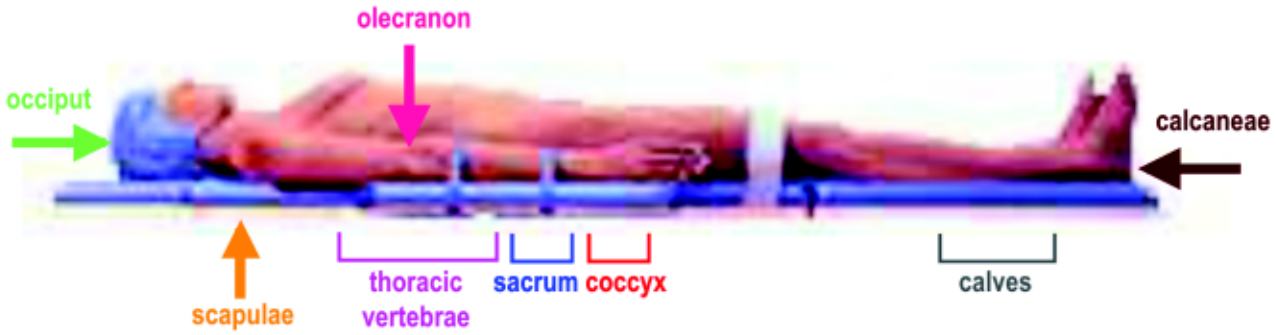
Variations of the traditional supine position include the contoured supine or lawn chair position, the frog-leg supine position and the supine hanging leg position.

- In the contoured spine (lawn-chair) position the hips and knees are flexed slightly, putting the abdomen in a more neutral position. This helps to relax the lumbar spine and creates a more comfortable position for the legs. It also helps minimize the pull on the ventral abdominal muscles that can be caused by prolonged extension of the hips and knees. Patients who are required to lie awake or are sedated and required to remain immobile for long periods of time will be more comfortable in the contoured supine position than in the traditional supine position.
- In the frog-leg supine position, the hips and knees are flexed externally with the heels rotated laterally and brought together at the midline. Because of the weight of the lower extremities, support must be provided under the knees, the lateral aspects of the thighs and the lower legs, as well as the lateral ankles.

- Orthopedic surgery of the knee uses the hanging knee position. For this position, the leg section of the OR table is lowered 90° and the legs are allowed to hang freely for knee joint access. The patient must be positioned enough caudally to avoid pressure on the dorsal lower legs.

Pressure points to be aware of when a patient is in the supine position are illustrated in Figure 2. They include the occiput, spinous processes of the thoracic vertebrae, sacrum and coccyx, scapulae (shoulder blades) olecranon processes (elbows), calves and calcaneae (heels).

**Figure 2: Pressure points in the supine position**




To avoid injury to these pressure points, provide appropriate padding. Align the occiput with hips. Place the arms on armboards or at the patient's sides, with the palms resting against the thighs. Legs should be parallel and ankles should not be crossed.

- To protect the occiput, prevent stretching of the neck muscles and maintain the head in a neutral position, rest the head on a small pillow or pad. The anesthesia provider is responsible for positioning and maintaining the patient's head in a neutral position.
- If armboards are used, they should be padded properly and should be attached to the table at the same height as the table and parallel to the floor. The angle of the armboards should be no greater than 90°. Hyperabduction of the arm greater than 90° or a difference of height between the table and the armboard may cause injury to the brachial plexus.
- Supinate (palms up)the hand on the armboard to rotate the ulnar nerve into a safe position, where there is less chance of the nerve being compressed on the armboard. For patients whose arms must be out on armboards for long periods of time, slight flexion of the elbow by placing a wedge under the forearm can help to reduce stretching of the nerves in the upper extremity.
- Do not lean against armboards during the procedure, as this can cause a compression injury.
- Note that the correct placement of the safety belt is about 2 inches above the knees. Be sure the belt is not too tight as to put undue pressure on the legs.

If a draw sheet is used to secure the patient's arms at the sides, tuck the sheet between the patient and the mattress and not between the mattress and the top of the table. This decreases the risk of the arms sagging over the sides of the table and causing compression of the ulnar or radial nerve.

In pediatric patients that are particularly susceptible to respiratory obstruction, especially without airway adjuncts in place, a roll may be placed underneath the shoulders to help ensure airway patency. If either a mattress of soft plastic foam or a heating mattress is being used, place the roll underneath this surface to allow the mattress to maintain contact with the body surface. If the head of an intubated child is turned to the side, head turning should not cause undue tension on the neck muscles or associated nerves for an extended period of time. The ears of young pediatric patients are soft and contain little cartilage; foam padding with cutouts for the ears usually provides adequate padding.

## *Head-Elevated Positions*

In a head-elevated position, the patient's head is elevated above the level of the heart to improve drainage of blood and cerebrospinal fluid away from the surgical site. Elevating the head decreases bleeding in the surgical field, reduces intracranial pressure and facilitates visual and instrumental access for the surgeon. Variations of the head-elevated position include the sitting position, the low sitting position and its variant, the reclining shoulder position, the head-elevated prone position and the head-elevated supine position.

### Sitting Position

The sitting position, the most frequently used head-elevated position, is used almost exclusively by neurosurgeons for posterior craniectomies and procedures on the upper cervical spine. In the conventional neurosurgical sitting position, the legs are at approximately the level of the heart and gently flexed on the thighs and the feet are supported at right angles to the legs, as illustrated in Figure 3. Subgluteal padding protects the sciatic nerve. The frame of the head holder is properly clamped to the side rails of the back section of the table. In the event of hemodynamically significant air embolism, the patient's head can be lowered simply and rapidly by lowering the back section of the table.

**Figure 3: Patient in sitting position**

In order to place a patient in the standard sitting position, take the following steps:

1. Beginning with a flat table, flex the top end of the table and lower the foot section.
2. Further elevate the back section.
3. Tip the table chassis down, while elevating the back section further, flexing the tabletop fully at the back-thigh hinge.
4. Adjust the foot section to maintain the legs at the level of the heart.
5. Position the patient's head in a head holder.
6. Remove the head section of the table.
7. Add a thigh strap and footboard.

The sitting position has a long history, but its overall use has decreased. It is difficult to establish, the intricate monitoring equipment required involves significant time and effort and its smooth creation requires a great deal of assistance from experienced OR personnel. Adequate surveillance for venous air embolism is crucial for patients in the sitting position, but early detection and vigorous treatment have significantly reduced its associated morbidity and mortality.

Although the sitting position is infrequently used in children, most of the preparations and precautions used for adults also apply to children, with the size of the patient and equipment availability influencing much of the care.

**Low Sitting Position**

The low sitting position is used for neck dissections or dental procedures. In most versions of the low sitting position, the torso is placed in the midline of the operating table and the back section of the tabletop is elevated only about half the amount needed for the standard sitting position.

A variant of the low sitting position, the reclining shoulder position, is intended for procedures involving the shoulder. In this position, the torso is moved laterally until much of the operative shoulder is off the edge of the table. By placing a pad under the shoulder and back, the shoulder is rotated and lifted off the table surface, exposing much of its lateral surface for surgical preparation and access.

**Head-Elevated Prone Position**

The head-elevated prone (Concorde) position is used for neurosurgical procedures, particularly on the posterior fossa. To aid venous drainage from the surgical site, the head is usually elevated to some degree above the heart. Parallel chest rolls allow better respiratory excursions and ventilation. Supporting the head with a three-pin head holder frees the face and eyes from pressure. Straps at the caudal edge of the buttocks prevent the patient from sliding toward the foot of the bed. The knees are flexed slightly by placing a pillow beneath the lower legs. Because the head is elevated to a lesser extent above the heart than in the standard sitting position, the Concorede position has a lower risk of air embolism.

### Head-Elevated Supine Position

The head-elevated supine position (sometimes referred to as "reverse Trendelenburg") is used for a variety of surgical procedures, including eye, ear, nose and throat procedures; dental operations; thyroidectomies and laparoscopic procedures in the upper abdomen (e.g., laparoscopic cholecystectomy). A footboard and a thigh strap prevent hip and knee flexion and anchor the patient on the table. The position allows the abdominal contents to move caudad, providing better exposure of upper abdomen. The head-elevated position has both hemodynamic and respiratory consequences for the patient. Cardiovascular changes can be alleviated and patient comfort enhanced by flexing the hips and knees.

## *Head-Down Tilt*

The head-down tilt position was developed to help move the abdominal viscera toward the head to clear a lower abdominal or pelvic operating field. In the original "Trendelenburg" position—popularized by Friedrich Trendelenburg in the late 19th century—the surface that supported the supine position was tilted about 45° head-down. Today, use of a "steep head-down tilt" (30° to 45°) has largely been eliminated. Its primary application is for lengthy laparoscopic abdominopelvic surgery in an abdomen that has been distended by peritoneal insufflation of compressed gas.

As reservations about the physical and physiologic safety of the steep head-down tilt have become more widespread, lesser degrees of head-down tilt (10° to 20°) have gained greater acceptance and are referred to as "minimal head-down tilt." Minimal head-down tilt is often requested for surgical procedures in the lower abdomen, pelvis and perineum. In view of the physiologic stresses associated with even minimal head-down tilt, its routine use in the presence of cardiorespiratory or central nervous system disease may not be advisable. Head-down tilt should be used only if it enhances surgical exposure and thereby shortens the operative time or it if prevents blood loss.

In the minimal head-down tilt position, which is illustrated in Figure 4, the tilted patient is secured in place on the table by the use of a special friction mattress and by a restraining strap placed over the distal thighs. Alternatively, the knees may be flexed and ankle straps applied over adequate padding. The head should remain in the midline, with padding under the occiput. If the head must be repositioned as a precaution against occipital alopecia during lengthy surgery, the degree of rotation should be minimal and the presence of acceptable bilateral ventilation must be confirmed after repositioning.

**Figure 4: Patient in minimal head-down tilt position**

Special care must be given to positioning the arms so that the brachial plexus is neither stretched nor compressed.

- If the arms are extended on armboards, palms should be supinated. The humerus should be abducted less than 90° from the body and the weight of the elbow should be supported at the olecranon process of the ulna. Restraining straps should be used to prevent the arm from falling off the armboard or the palm from pronating to rest the elbow on the cubital tunnel, a channel which allows the ulnar nerve to travel over the elbow. Padding should be used to distribute pressure away from the cubital tunnel.
- If the arms are placed beside the torso, the palms should contact the lateral thighs. Pads should be applied around the elbow to minimize pressure on the ulnar nerve.
- The arms may be folded across the chest if pressure can be kept off of the cubital tunnel and its contained ulnar nerve.

One variation of the head-down tilt position is a minimal head-down tilt plus low lithotomy, which is used when a lesion in the deep pelvis must be approached surgically through the lower abdomen as well as from the perineum. Another variation is the hyperlordotic position, which places the patient in a simultaneous head-down and foot-down position, with markedly increased lordosis of the lumber spine. The hyperlordotic position is used to provide transabdominal access to the ventral pelvis and retropubic area.

When the patient is in a head-down tilt position of less than about 20°, a patient of average size can be retained in position by a padded strap placed across the thighs. Steeper tilt may be sustained by: (1) wristlets affixed to the lateral rails of the tabletop; (2) shoulder braces on adjustable angle bars locked to the lateral rails of the table; or (3) ankle straps affixed to the distal portion of the leg section of the tabletop plus flexion of the patient's knees. Shoulder braces should be avoided; if necessary, they should be placed laterally so that they exert pressure on the area of the acromioclavicular joint and not directly on the clavicle or the root of the neck. A patient in steep head-down tilt who is restrained by anklets should be positioned carefully so that neither tension on the knee joints nor pressure on the calves of the legs is exaggerated when the foot section of the table is lowered.

At the end of the procedure, a patient in the head-down position should be returned slowly to the horizontal position.

The head-down position is rarely used for pediatric patients. When requested it is usually intended to facilitate surgical exposure during colorectal or genitourinary procedures. In general, the same concerns that apply to adult patients in this position also apply to pediatric patients, particularly the gravity-induced pressure exerted on the diaphragm by the abdominal contents, which can result in increased work of breathing during spontaneous ventilation and decreased residual capacity. Depending on the degree of head-down tilt, both the increased work of breathing and the decreased functional residual capacity can predispose to hypoxemia for infants or toddlers.

### *Lithotomy Position*

In the standard lithotomy position, as seen in Figure 5, the patient lies on the back, with the legs separated from the midline into 30° to 45° or unforced abduction and elevated in leg holders. The hips are flexed until the thighs are angled between 80° and 100° on the trunk, with the knees being bent until the lower legs are roughly parallel to the frontal plane of the torso. This position is primarily used by gynecologists or by urologic surgeons for cystoscopic surgery; general surgeons may use it for colorectal operations.

**Figure 5: Lithotomy position**

Various leg holding devices are available to elevate the legs in the lithotomy position. Any of these devices may be commonly referred to as "stirrups." Each is connected to a pole that is clamped to the side of the table:

- A "candy cane" shaped pole either suspends the ankle and instep by a strap or suspends the foot in a cloth boot.
- A "knee crutch" supports the popliteal space, but permits the foot and much of the lower leg to hang unsupported.
- A "calf rest" supports only the dorsal lower leg.
- Firm foot holders usually resemble the dorsal and/or plantar portions of a boot.

Variations of the lithotomy position include the following:

- **Low lithotomy position.** The angle between the thighs and the table surface is only about 40°, allowing an operator standing at the flank of the patient to reach across the thigh to manipulate a surgical instrument either in the vagina or in a perineal incision.
- **Hemi (split) lithotomy position.** One leg remains at the level of the torso, usually in traction, to assist with the repair of a fractured femur. Elevation of the nonoperative leg facilitates use of the C-arm.
- **High lithotomy position.** The thighs extend upward almost at right angles to the long axis of the turn, with the knees flexed only slightly, allowing the surgeon to stand while operating on the perineum.
- **Exaggerated lithotomy position.** The thighs are markedly flexed on the trunk, with the lower legs almost vertical above the middle of the patient's chest. This position improves transperineal access to retropubic structures, such as the prostate.
- **Tilted low lithotomy position.** Adding a head-down tilt to the lithotomy position allows simultaneous transabdominal and transpelvic access to organs of the deep pelvis.

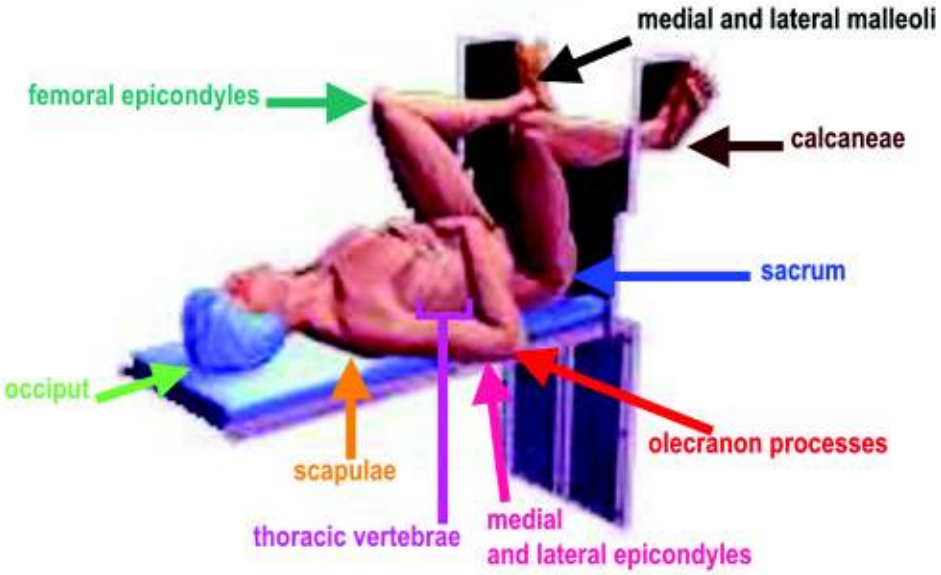
To move a patient into the standard lithotomy position, take the following steps:

1. Begin with the patient in the supine position.
2. Move the patient toward the end of the table, so that the patient's buttocks lie at the edge of the lower table break. (Be sure to provide adequate padding to the sacrum, as pressure to this area will increase when the legs are elevated.)
3. When possible, place the arms on padded armboards at an angle of 90° or less or over the abdomen. (Placing the arms at the patient's sides in the lithotomy position risks a pinching or crushing injury of the fingers when the lower table section is elevated at the end of the procedure. Keeping the arms away from the chest facilitates respiration).
4. Elevate both legs simultaneously and place them at the same height in the chosen support device, maintaining minimal external rotation of the hips.

At the end of the procedure, remove both elevated extremities from their supports, bring the knees together and lower the legs slowly and simultaneously. This will help to prevent torsion to the relaxed spine and allow vessels in the lower extremities to refill slowly, minimizing the risk of a hypotensive episode due to hypovolemia.

Pressure points to be aware of when a patient is in the lithotomy position include: the occiput, the spinous processes of the thoracic vertebrae, medial and lateral epicondyles, olecranon processes, scapulae, sacrum, femoral epicondyles, medial and lateral malleoli and calcaneae. (See Figure 6).

**Figure 6: Pressure points in the lithotomy position**




For the traditional lithotomy position, considerations in adult and pediatric positions are similar. Availability of equipment in the appropriate size for the child will determine whether stirrups or leg holders will be used. Adequate padding of pressure points is particularly important in younger children if the size of the leg supports is not proportionate to the size of the patient.

## *Lateral Decubitus Position*

The lateral decubitus position is usually called simply the "lateral position." As you know, "lateral" means "to the side." "Decubitus" is a Latin word meaning "lying down." In the standard lateral decubitus position (Figure 7), the patient lies on one side. Most often, a 90° angle is established between the patient's back and the surface of the table. The lower leg is flexed to stabilize the torso against ventral tilt, while the upper leg is extended. Padding is placed over bony prominences. A chest pad protects the down-side shoulder without compromising the axilla. A head support maintains the cervical spine in neutral alignment.

**Figure 7: Lateral decubitus position**

The description of a lateral decubitus position always reflects the side of the patient that will rest against the surface of the table. For example, a patient in the left lateral decubitus position is positioned with the left side down, allowing access to the right side of the patient.

The lateral decubitus position has been associated most commonly with thoracotomies for cardiothoracic procedures, but may also be used to advantage for renal, obstetric, gynecologic, neurosurgical and orthopedic operations. Orthopedic surgeons have used the lateral decubitus position extensively for total hip replacement and for open reduction and fixation of hip fractures. Neurosurgeons may request the lateral decubitus position for craniotomies or for laminectomies at any level of the vertebral column.

Variations in the lateral decubitus position include the lateral jackknife position, the kidney position, the Sims position and the combined lateral and supine position.

- In the lateral jackknife position the back-thigh hinge of the tabletop is bent to form an acute angle under the down-side iliac crest. The torso is level and the legs lowered to pull open the up-side intercostal spaces. Because this position reduces pulmonary compliance and therefore functional residual capacity, the lateral jackknife position has fallen into general disuse.
- The kidney position is similar to the lateral jackknife position, but with the transverse elevating bar of the table (the "kidney rest") raised under the downside iliac crest to increase the acuteness of the patient's lateral bend. The long axis of the torso may or may not be level with the floor. This position significantly separates the iliac crest from the lateral costal margin, allowing improved kidney exposure with minimal danger of violating either the pleural or peritoneal cavities.

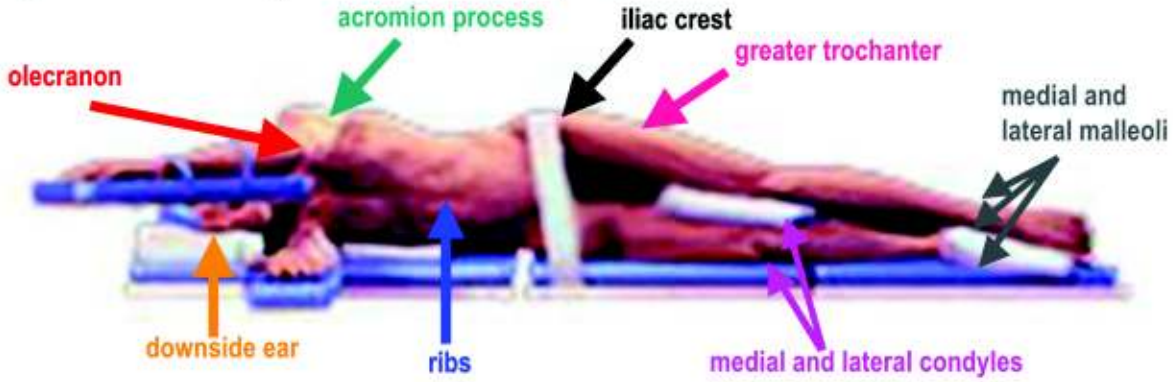
- The Sims position differs from the standard left lateral decubitus position only in that the upper extremity is flexed at the hip and the knee, imparting a measure of stability to the patient to help stabilize ventral tilt and facilitate perineal exposure. It was developed originally for obstetric deliveries and surgical procedures, but now is used most commonly to aid in maintaining a clear airway in an awakening patient.
- A combined lateral decubitus and supine position is used to avoid having to change the patient's position during repair of intracardiac and aortic defects during the same surgical procedure.

A minimum of four people are needed to move the patient into the lateral position. The anesthesia provider is responsible for moving the head. One person stands at the patient's feet, one stands on the left side of the patient and one stands on the right side. To place a patient in the lateral decubitus position, take the following steps:

1. After anesthesia is administered, turn the patient from the supine position to one side, using a rolling action and maintaining spinal alignment at all times.
2. Extend the dependent (lower) arm on an armboard.
3. Use an axillary roll to free the dependent (lower) shoulder from direct lateral pressure and to relieve pressure on the axillary artery and nerve. Proper placement of the axillary roll is just inferior to the axilla, supporting the area of the upper rib cage. An improperly placed roll into the axilla can result in a vascular obstruction of the dependent arm. Check the radial pulse or use pulse oximetry on the dependent arm after the axillary roll is in place to confirm adequate perfusion to the limb.
4. Use pillows, a lateral arm support or a well-padded Mayo stand to support the upper arm. The rule of B's applies to the lower extremities: the bottom leg is bent. That is, the down-side leg will be flexed at the hip.
5. Extend the upper leg and insert a pillow between the legs.
6. Place padding between the knees, ankles and feet.
7. To maintain the patient in this position, sandbags may be placed front and rear, or vacuum-style beanbags may be used. Wide tape fastened to the platform of the OR bed can be used to secure the shoulders, hips and legs.
8. Be sure that the head support is high enough to allow the head to be in a neutral position. Improper height can cause lateral flexion of the neck, which may result in a cervical injury.

Pressure points to be aware of when the patient is in the lateral position are illustrated in Figure 8. They include the downside ear, acromion process, olecranon, ribs, iliac crest, greater trochanter, medial and lateral condyles and medial and lateral malleoli.

**Figure 8: Pressure points in the lateral position**




Most of the considerations addressed in adult patients apply to pediatric patients in the lateral decubitus position. When positioning the head, creation of padding with a cutout for the ear ("donut") is recommended to avoid undue pressure on the auricle. In a larger child, placement of a chest pad under the down-side chest wall just caudad to the axilla is warranted, but chest pads probably are not needed in very small children.

## *Prone (Ventral Decubitus) Position*

In the prone position, the patient lies face-down on the procedure table (See Figure 9). In the classic prone position, the patient rests on the ventral aspects of the torso, with the legs extended and the arms either raised beside the head on padded armboards or retained at the sides of the body. When the arms are raised beside the head, the forearms should be somewhat lower than the torso, but not level with it, to avoid stretching the brachial plexus and its related vascular structures.

**Figure 9: Patient in prone position**

The prone position is used for posterior craniotomies and for spine-related procedures, such as spinal fusions, resections of masses (e.g., lipomas) and repair of dermal defects.

Variations of the prone position include:

- The head-elevated prone position, which is used for cervico-occipital exploration, with a skull clamp to hold the head
- The crouching position (tuck position), in which the thighs are flexed fully on the trunk and the legs fully on the thighs

- The kneeling position, in which the patient's thighs are flexed less acutely on the abdomen, the lower legs at right angles to the thighs and the weight is borne principally on the knees and chest
- The semi-prone position, a variation of the lateral decubitus position in which the patient's torso is allowed to rotate ventral to some degree and is stabilized by suitable padding under its raised edge
- Prone jackknife position, which is used for gluteal or anorectal surgery

In order to move a patient from the supine position on a stretcher to the classic prone position on the procedure table, take the following steps:

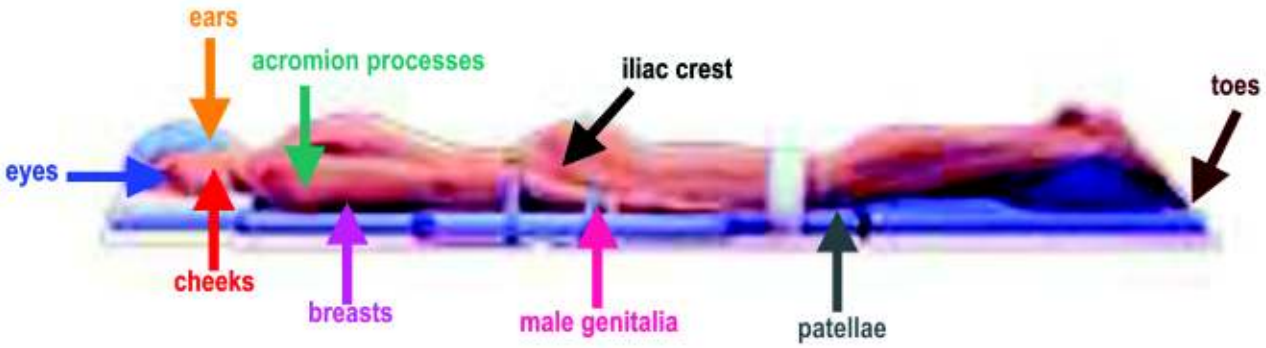
1. Apply anti-embolic or sequential compression stockings.
2. Make sure an adequate number of personnel are available to accomplish this maneuver safely.
3. Ensure that the table and the stretcher are of equal heights and safely locked in position. Note the position of all lines and tubes and place the patient's arms at the sides. To avoid pinching the arm between the stretcher and the table or a possible shoulder dislocation, be sure that the arm that will be the down-side arm is secure.
4. To move the patient into the prone position, use a log roll maneuver. The anesthesia provider coordinates the move and is responsible for the patient's head. Turners turn the patient from the stretcher side and receivers receive the patient on outstretched arms from the opposite side of the table. An additional assistant stands at the patient's feet. Remember to lift, not pull. Lifting will avoid shearing, which can result in tissue injury.
5. Once the patient has been successfully turned, the head will face down in a head support device or will be turned gently laterally to provide airway access. The anesthesia care provider will check alignment of the cervical vertebrae.
6. The arms can remain at the sides, or they can be placed on padded armboards.
7. Use supportive devices to relieve pressure on the abdominal viscera. When lateral chest rolls are used to support the patient, the rolls should provide support from the acromio-clavicular joint to the iliac crest, allowing chest movement and decreasing abdominal pressure. Be careful that the chest roll does not extend beyond the iliac crest, as this would compress the femoral nerve and artery.

Here are a few things to keep in mind:

- Place breasts laterally when positioning females with large breasts
- Allow male genitalia to hang freely with no compression or torsion
- Provide adequate padding, including padding under the knees and support the ankles to prevent plantar flexion of the feet
- Use a padded footboard to maintain the foot in dorsiflexion

Pressure points to be aware of and to protect with adequate padding when a patient is in the prone position are illustrated in Figure 10. They include the: ears, eyes, cheeks, acromion processes, breasts, iliac crests, male genitalia, patellae and toes.

**Figure 10: Pressure points in prone position**




Most of the same preparations and precautions considered for adults apply to children in the prone position, with the weight of the child and equipment-related concerns influencing many of the management decisions. To support a small child, rolls may be placed in a variety of locations. They should permit the neck to be maintained in a neutral position and should assure that the thorax and abdomen are free from compression that would prevent relatively normal ventilation. In a larger child, rolls may be placed in positions similar to an adult.

## INTRAOPERATIVE CONSIDERATIONS

If the procedure requires repositioning of the patient, be sure to reassess the patient after the new position has been achieved. After repositioning or any movement of the patient, procedure table, or devices that attach to the procedure table, the patient should be reassessed for body alignment. Changing position may expose or damage otherwise protected body tissue. This position change may be perceptible or imperceptible and may result from adding or deleting positioning devices, adjusting the procedure table in some manner or moving the patient on the procedure table.

## POSTOPERATIVE ASSESSMENT

The postoperative assessment begins in the OR, as the patient is undraped. Look for anything unusual. Check the patient's skin for reddened areas, which could be a sign of tissue injury. Carefully check areas that were receiving direct pressure as a result of the position.

## DOCUMENTATION

Documentation of patient positioning and positioning-related complications should include, but not be limited to:

- Preoperative assessment
- The patient's intraoperative position
- Type and location of devices used to achieve and maintain position, padding materials and areas of concern
- Names and titles of persons positioning the patient
- Postoperative outcome evaluation

Document all findings in the nurses' notes and advise staff in the postanesthesia care unit (PACU) of any unusual findings or intraoperative circumstances. Follow established hospital policies and procedures for documenting patient care. Documentation provides an accurate picture of the perioperative nursing care administered and the outcomes of care delivered.

## SUMMARY

Proper and safe positioning of the patient for surgery requires teamwork. Working together, the surgical team can incorporate good patient assessment skills, look at potential physiologic effects, check risk areas, determine the patient's status in advance and apply physical assessment skills to achieve the most desirable outcome. Remember: each time the patient enters the operating room, the goal is to create a safe environment, prevent injury and improve patient outcomes.

Learn good interviewing techniques and incorporate them into your preoperative assessment. Spend some time learning about available support and positioning devices. Complete the preoperative planning steps and use your knowledge and experience to create a safe and comfortable position for every patient.

# GLOSSARY

| | |
|---|---|
| **Acromion process** | The lateral extension of the spine of the scapula, projecting over the shoulder joint and forming the highest point of the shoulder. |
| **Assessment** | A continuous activity to collect and document data about the patient's health status. |
| **Axilla** | Armpit; the small hollow underneath the arm, where it joins the body at the shoulder; contains axillary vessels, the brachial plexus of nerves and many lymph nodes and vessels. |
| **Bony prominence** | A protrusion or projection of osseous tissue. |
| **Brachial plexus** | A network of lymphatic vessels, nerves and veins situated partly in the neck and partly in the axilla. |
| **Calcaneus** | Heel bone; the irregular quadrangular bone at the back of the tarsus. |
| **Caudal** | Directed toward the tail; opposite of cephalad. |
| **Cubital tunnel** | The opening between the two heads of the flexor muscle of the wrist, through which the ulnar nerve enters the forearm. |
| **Draw sheet** | A folded sheet placed under a patient in bed so that it may be withdrawn without lifting the patient. |
| **Friction** | Occurs when skin rubs over a rough stationary surface. |
| **Hyperlordosis** | Extremely marked concavity in the curvature of the lumbar spine. |
| **Malleolus** | The rounded protuberance on either side of the ankle joint. |
| **Occiput** | The posterior part of the head. |
| **Olecranon process** | The proximal bony projection of the ulna at the elbow. |

| | |
|---|---|
| **Position** | The disposition of the body and extremities to facilitate the performance of diagnostic or therapeutic procedures. |
| **Positioning device** | Any device or piece of equipment used for positioning the patient and/or providing maximum anatomic exposure. |
| **Pressure ulcer** | Pressure sore; decubitus ulcer; a local defect or excavation of the surface of the skin, which is caused by prolonged pressure in a patient that is allowed to lie still for a long period of time. |
| **Pronation** | Applied to the hand, the act of turning the palm posteriorly (or inferiorly when the forearm is flexed), performed by medial rotation of the forearm. |
| **Prone** | Lying face downward. |
| **Shearing** | Occurs when the patient's skin remains stationary while underlying tissues shift or move, as might occur when the patient is pulled or dragged without support to the skeletal system or when a draw sheet is used. |
| **Supination** | Applied to the hand, the act of turning the palm forward (anteriorly) or upward, performed by lateral rotation of the forearm. |
| **Supine** | Lying with the face upward. |
| **Torsion** | The act or process of twisting; turning or rotating about an axis. |
| **Ventral** | Toward the abdomen. |
| **Viscoelastic** | Both viscous (having a high degree of friction between component molecules as they slide by each other) and elastic (resisting and recovering from stretching, compression or distortion applied by a force). |

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