Figure 30-1  Human skeleton.
Figure 30-2  Highlighted in pink: The axial skeleton comprises the skull, spine, ribs, and sternum. The extremities comprise the appendicular skeleton.
Figure 30-3  Bones of the axial skeleton.
Figure 30-4  Bones of the appendicular skeleton.
Figure 30-5  Bones are classified by shape.
Figure 30-6a  (A) Open fracture and dislocation to the ankle. (B) X-ray of same injury. (© Edward T. Dickinson, MD)
Figure 30-6b  (A) Open fracture and dislocation to the ankle. (B) X-ray of same injury. (© Edward T. Dickinson, MD)
Figure 30-7a  (A) The muscular system.
Figure 30-7b  (B) Three types of muscle.
Figure 30-8  Tendons tie muscle to bone. Ligaments tie bone to bone.
Figure 30-9  Bones bleed. In fact, there may be considerable blood loss, even from an uncomplicated closed fracture.
Figure 30-10a  (A) Open fracture. (B) Closed fracture. (© Edward T. Dickinson, MD)
Figure 30-10b  (A) Open fracture. (B) Closed fracture. (© Edward T. Dickinson, MD)
Figure 30-11  Comminuted fracture.
Figure 30-12  Greenstick fracture.
Figure 30-13a  (A) A closed angulated fracture. (B) An X-ray of the same fracture. (© Edward T. Dickinson, MD)
Figure 30-13b  (A) A closed angulated fracture. (B) An X-ray of the same fracture. (© Edward T. Dickinson, MD)
Figure 30-14  A right shoulder dislocation. (© Edward T. Dickinson, MD)
Figure 30-15  Aligning an extremity.
Figure 30-16  Splints and accessories for musculoskeletal injuries.
Scan 30-1  **Immobilizing a Long Bone**  FIRST TAKE STANDARD PRECAUTIONS (1) Manually stabilize the injured limb.
Scan 30-1 (continued) Immobilizing a Long Bone  FIRST TAKE STANDARD PRECAUTIONS  (2) Assess distal circulation, sensation, and motor function (CSM).
Scan 30-1 (continued)  **Immobilizing a Long Bone**  FIRST TAKE STANDARD PRECAUTIONS  (3) Measure the splint. It should extend several inches beyond the joints above and below the injury.
Scan 30-1 (continued)  Immobilizing a Long Bone  FIRST TAKE STANDARD PRECAUTIONS  (4) Apply the splint and immobilize the joints above and below the injury.
Scan 30-1 (continued)  Immobilizing a Long Bone  FIRST TAKE STANDARD PRECAUTIONS  (5) Secure the entire injured extremity.
Scan 30-1 (continued)  **Immobilizing a Long Bone**  FIRST TAKE STANDARD PRECAUTIONS  (6a) Secure the foot in the position of function. . .
Scan 30-1 (continued)  Immobilizing a Long Bone  FIRST TAKE STANDARD PRECAUTIONS  (6b) . . . Or, if splinting an arm, secure the hand in the position of function. This is the position the hand would be in if the patient were holding a palm-sized ball. A roll of bandage can be placed in the patient's hand to help maintain the position of function.
Scan 30-1 (continued)  Immobilizing a Long Bone

FIRST TAKE STANDARD PRECAUTIONS  (7) Reassess distal CSM.
Scan 30-2  Immobilizing a Joint  FIRST TAKE STANDARD PRECAUTIONS  (1) Manually stabilize the injured limb, in this case an injured elbow.
Scan 30-2 (continued)  Immobilizing a Joint  FIRST TAKE STANDARD PRECAUTIONS  (2) Assess distal pulse, motor function, and sensation (CSM).
Scan 30-2 (continued)  Immobilizing a Joint  FIRST TAKE STANDARD PRECAUTIONS  (3) Select the proper splint material. Immobilize the site of injury and bones above and below.
Scan 30-2 (continued)   Immobilizing a Joint   FIRST TAKE STANDARD PRECAUTIONS   (4) Secure the splint.
Scan 30-2 (continued)  Immobilizing a Joint  FIRST TAKE STANDARD PRECAUTIONS  (5) Reassess distal CSM.
Scan 30-3 Applying a Vacuum Splint  FIRST TAKE STANDARD PRECAUTIONS  (1) Stabilize the extremity and check distal circulation, sensation, and motor function (CSM).
Scan 30-3 (continued) Applying a Vacuum Splint  FIRST TAKE STANDARD PRECAUTIONS  (2) Apply the splint to the extremity and secure it with the straps.
Scan 30-3 (continued)  Applying a Vacuum Splint  FIRST TAKE STANDARD PRECAUTIONS  (3) Remove the air from the splint with the pump provided by the manufacturer.
Scan 30-3 (continued)  Applying a Vacuum Splint  FIRST TAKE STANDARD PRECAUTIONS  (4) Reassess distal CSM.
Figure 30-17a  (A) Blood at the meatus of the penis is a sign of a pelvic fracture. (B) A pelvic wrap can help to stabilize a fractured pelvis. Shown here is a commercial pelvic binding device placed on a severely injured patient with an open pelvic fracture. (© Edward T. Dickinson, MD)
Figure 30-17b  (A) Blood at the meatus of the penis is a sign of a pelvic fracture. (B) A pelvic wrap can help to stabilize a fractured pelvis. Shown here is a commercial pelvic binding device placed on a severely injured patient with an open pelvic fracture. (© Edward T. Dickinson, MD)
Figure 30-18a  (A) For a pelvic wrap, lay a sheet, folded flat, approximately 10 inches wide onto the backboard. (B) Bring the sides of the sheet together. (C) Tie the sheet firmly without overcompression to complete the pelvic wrap.
Figure 30-18b  (A) For a pelvic wrap, lay a sheet, folded flat, approximately 10 inches wide onto the backboard. (B) Bring the sides of the sheet together. (C) Tie the sheet firmly without overcompression to complete the pelvic wrap.
Figure 30-18c  (A) For a pelvic wrap, lay a sheet, folded flat, approximately 10 inches wide onto the backboard. (B) Bring the sides of the sheet together. (C) Tie the sheet firmly without overcompression to complete the pelvic wrap.
Figure 30-19  A right posterior hip dislocation from dashboard impact. (© Edward T. Dickinson, MD)
Figure 30-20a  For a patient with a hip or pelvic injury, (A) bind the legs together or (B) splint with a padded long board. Apply an anti-shock garment, if local protocols indicate.
Figure 30-b  For a patient with a hip or pelvic injury, (A) bind the legs together or (B) splint with a padded long board. Apply an anti-shock garment, if local protocols indicate.
Figure 30-21  An air splint may be used for a lower leg injury.
Figure 30-22  A pillow splint may be used for an injured ankle.
Scan 30-4  Applying a Sling and Swathe  (1) Prepare the sling by folding cloth into a triangle.
Scan 30-4 (continued)  Applying a Sling and Swathe  (2a) Position the sling over the top of the patient's chest as shown. Fold the injured arm across his chest.
Scan 30-4 (continued) Applying a Sling and Swathe  

(2b) . . . If the patient cannot hold his arm, have someone assist him until you tie the sling.
Scan 30-4 (continued) Applying a Sling and Swathe  (3) Extend one point of the triangle beyond the elbow on the injured side. Take the bottom point and bring it up over the patient's arm. Then take it over the top of the injured shoulder.
Scan 30-4 (continued)  Applying a Sling and Swathe  (4) If appropriate, draw up the ends of the sling so that the patient's hand is about 4 inches above the elbow.
Scan 30-4 (continued)  Applying a Sling and Swathe  (5) Tie the two ends of the sling together, making sure that the knot does not press against the back of the patient's neck. Pad with bulky dressings. (If spine injury is possible, pin the ends to the patient's clothing. Do not tie them around the neck.)
Scan 30-4 (continued) Applying a Sling and Swathe  (6) Check to be sure you have left the patient’s fingertips exposed. Then assess distal circulation, sensation, and motor function (CSM). If the pulse has been lost, take off the sling and repeat the procedure. Then check again.
Scan 30-4 (continued)  Applying a Sling and Swathe  (7a) To form a pocket for the patient's elbow, take hold of the point of material at the elbow and fold it forward, pinning it to the front of the sling. Or . . .
Scan 30-4 (continued)  Applying a Sling and Swathe  (7b) . . . If you do not have a pin, twist the excess material and tie a knot in the point.
Scan 30-4 (continued)  **Applying a Sling and Swathe**  (8) Form a swathe from a second piece of material. Tie it around the chest and the injured arm, over the sling. Do not place it over the patient's arm on the uninjured side.
Scan 30-4 (continued) Applying a Sling and Swathe  (9) Reassess distal circulation, sensation, and motor function (CSM). Treat for shock, and provide high-concentration oxygen. Take vital signs. Perform detailed assessments and reassessments as appropriate.
Scan 30-5  Splinting an Injured Humerus  VARIATION ONE: Apply a sling and swathe. If you have only enough material for a swathe, bind the patient’s upper arm to her body, taking great care not to cut off circulation to the forearm.
Scan 30-5 (continued)  Splinting an Injured Humerus  VARIATION TWO: If you have only a narrow or short length of material to use as a sling, apply it so that it supports the wrist only.
Scan 30-6  Splinting Arm and Elbow Injuries  SIGNS: The elbow is a joint and not a bone. It is composed of the distal humerus and the proximal ulna and radius, which form a hinge joint. You will have to decide if the injury is truly to the elbow. The location of deformity and tenderness will direct you to the injury site.
Scan 30-6 (continued)  Splinting Arm and Elbow Injuries  ELBOW IN OR RETURNED TO THE BENT POSITION
(1) Move the limb only if necessary for splinting or if the pulse is absent. Stop if you meet resistance or significantly increase the pain.
Scan 30-6 (continued)  Splinting Arm and Elbow Injuries  ELBOW IN OR RETURNED TO THE BENT POSITION

(2) Use a padded board splint that will extend 2 to 6 inches beyond the arm and wrist when placed diagonally.
Scan 30-6 (continued)  Splinting Arm and Elbow Injuries  ELBOW IN OR RETURNED TO THE BENT POSITION
(3) Place the splint so it is just proximal to the elbow and wrist. Use cravats to secure it to the forearm, then the arm.
Scan 30-6 (continued)  Splinting Arm and Elbow Injuries  ELBOW IN OR RETURNED TO THE BENT POSITION
(4) A wrist sling can be applied to support the limb. Keep the elbow exposed. Apply a swathe, if possible.
Scan 30-6 (continued)  Splinting Arm and Elbow Injuries  ELBOW IN A STRAIGHT POSITION  (1) Assess distal circulation, sensation, and motor function (CSM).
Scan 30-6 (continued) Splinting Arm and Elbow Injuries  

ELBOW IN A STRAIGHT POSITION  

(2) Use a padded board splint that extends from under the armpit to a point past the fingertips. Pad the armpit.
Scan 30-6 (continued)  Splinting Arm and Elbow Injuries  ELBOW IN A STRAIGHT POSITION  (3) Place a roll of bandages in the patient's hand to help maintain the position of function. Place the padded side of the board against the medial side of the limb. Pad all voids.
Scan 30-6 (continued) Splinting Arm and Elbow Injuries

ELBOW IN A STRAIGHT POSITION

(4) Secure the splint. Leave the patient's fingertips exposed.
Scan 30-6 (continued)  Splinting Arm and Elbow Injuries  ELBOW IN A STRAIGHT POSITION  (5) Place pads between the patient’s side and the splint.
Scan 30-6 (continued)  Splinting Arm and Elbow Injuries   ELBOW IN A STRAIGHT POSITION   (6) Secure the splinted limb to the body with two cravats. Avoid placing the cravats over the suspected injury site. Reassess the distal circulation, sensation, and motor function (CSM).
Scan 30-7  Splinting Forearm, Wrist, and Hand  SIGNS:
• Forearm. Deformity and tenderness. If only one bone is broken, deformity may be minor or absent.
• Wrist. Deformity and tenderness.
• Hand. Deformity and pain. Dislocated fingers are obvious.
Scan 30-7 (continued)  **Splinting Forearm, Wrist, and Hand**  CARE: Injuries occurring to the forearm, wrist, or hand can be splinted using a padded rigid splint that extends from the elbow past the fingertips. The patient’s elbow, forearm, wrist, and hand all need the support of the splint. Tension must be provided throughout the splinting. A roll of bandages should be placed in the patient’s hand to ensure the position of function. After rigid splinting, apply a sling and swathe.
Scan 30-7 (continued)  Splinting Forearm, Wrist, and Hand   ALTERNATIVE CARE: Injuries to the hand and wrist can be cared for with soft splinting by placing a roll of bandages in the hand to maintain the position of function, then tying the forearm, wrist, and hand into the fold of one pillow or between two pillows. An injured finger can be taped to an adjacent uninjured finger or splinted with a tongue depressor. Some emergency department physicians prefer that care be limited to a wrap of soft bandages. Do not try to “pop” dislocated fingers back into place.
Scan 30-7 (continued)  Splinting Forearm, Wrist, and Hand  ALTERNATIVE CARE: Injuries to the hand and wrist can be cared for with soft splinting by placing a roll of bandages in the hand to maintain the position of function, then tying the forearm, wrist, and hand into the fold of one pillow or between two pillows. An injured finger can be taped to an adjacent uninjured finger or splinted with a tongue depressor. Some emergency department physicians prefer that care be limited to a wrap of soft bandages. Do not try to “pop” dislocated fingers back into place.
Scan 30-8  Applying an Air Splint  (1) Check distal circulation, sensation, and motor function (CSM). Grasp the hand of the patient’s injured limb as though you were going to shake hands and apply steady tension.
Scan 30-8 (continued)  Applying an Air Splint  (2) While you support her arm, your partner gently slides the splint over your hand and onto the patient's injured limb. The lower edge of the splint should be just above her knuckles. Make sure the splint is free of wrinkles.
Scan 30-8 (continued) Applying an Air Splint  (3) Continue to support the arm while your partner inflates the splint by mouth to a point where you can make a slight dent in the plastic when you press it with your thumb. NOTE: Air-inflated splints may leak. When applied in cold weather, an inflatable splint will expand when the patient is moved to a warmer place. Variations in pressure also occur if the patient is moved to a different altitude. Frequently monitor the pressure in the splint with your fingertip. Air-inflated splints may stick to the patient's skin in hot weather.
Scan 30-8 (continued)  Applying an Air Splint  (4) Continue to assess distal circulation, sensation, and motor function (CSM).
Scan 30-9  Applying a Bipolar Traction Splint  (1) Take Standard Precautions.
Scan 30-9 (continued)  Applying a Bipolar Traction Splint  (2) Manually stabilize the injured leg.
Scan 30-9 (continued)  Applying a Bipolar Traction Splint  (3) Assess circulation, sensation, and motor function (CSM).
Scan 30-9 (continued)  Applying a Bipolar Traction Splint  

(4) Adjust the splint to the proper length and position it next to the injured leg.
Scan 30-9 (continued)  Applying a Bipolar Traction Splint  (5) Apply the ischial securing device.
Scan 30-9 (continued)  Applying a Bipolar Traction Splint  (6) Apply an ankle hitch.
Scan 30-9 (continued)  Applying a Bipolar Traction Splint  (7) Apply manual traction.
Scan 30-9 (continued)  Applying a Bipolar Traction Splint  (8) Secure support straps, as appropriate.
Scan 30-9 (continued) Applying a Bipolar Traction Splint  

(9) Reevaluate the ischial securing device.
Scan 30-9 (continued)  Applying a Bipolar Traction Splint  (10) Reassess CSM function.
(11) Secure the patient's torso to the long board to immobilize the hips.
(12) Secure the splint to the long board to prevent movement of the splint.
Scan 30-10 Applying the Sager Traction Splint  (1) Place the splint medially.
Scan 30-10 (continued)  Applying the Sager Traction Splint  (2) The length of the splint should be from groin to 4 inches below the heel. Unlock the clasp to extend the splint.
Scan 30-10 (continued)  Applying the Sager Traction Splint  (3) Secure the thigh strap.
Scan 30-10 (continued)  Applying the Sager Traction Splint

(4) Wrap the ankle harness above the ankle (malleoli) and secure it under the heel.
Scan 30-10 (continued) Applying the Sager Traction Splint  

(5) Release the lock and extend the splint to achieve the desired traction (in pounds on the pulley wheel).
Scan 30-10 (continued)  Applying the Sager Traction Splint  (6) Secure the straps at the thigh, lower thigh and knee, and lower leg. Strap the ankles and feet together. Secure the patient to the spine board.
Scan 30-11  Two-Splint Method—Bent Knee  (1) Assess distal CSM.
Scan 30-11 (continued)  Two-Splint Method—Bent Knee  (2) Stabilize the knee above and below the injury site.
Scan 30-11 (continued)  Two-Splint Method—Bent Knee  (3) Place the padded side of the splints next to the injured extremity. Note that they should be equal in length and extend 6 to 12 inches beyond the mid-thigh and mid-calf.
Scan 30-11 (continued)  Two-Splint Method—Bent Knee  (4) Place a cravat through the knee void and tie the boards together.
Scan 30-11 (continued)  Two-Splint Method—Bent Knee  (5) Using a figure-eight configuration, secure one cravat to the ankle and the boards, and the second cravat to the thigh and the boards. Reassess distal CSM.
Scan 30-12 One-Splint Method—Straight Knee  (1) Assess distal CSM.
Scan 30-12 (continued)  One-Splint Method—Straight Knee  (2) Stabilize. The padded board splint should extend from the buttocks to 4 inches beyond the heel.
Scan 30-12 (continued)  One-Splint Method—Straight Knee  (3) Maintain stabilization and lift the limb.
Scan 30-12 (continued) One-Splint Method—Straight Knee

(4) Place the splint along the posterior of the limb.
Scan 30-12 (continued)  One-Splint Method—Straight Knee  (5) Pad the voids.
Scan 30-12 (continued)  One-Splint Method—Straight Knee  (6) Use a 6-inch roller bandage or cravats to secure the injured leg to the splint.
Scan 30-12 (continued)  One-Splint Method—Straight Knee  (7) Place the folded blanket between the patient's legs, groin to feet.
Scan 30-12 (continued)  One-Splint Method—Straight Knee  (8) Tie the patient's thighs, calves, and ankles together. Do not tie the knot over the injured area.
Scan 30-12 (continued)  One-Splint Method—Straight Knee  (9) Reassess the distal CSM.
Scan 30-12 (continued)  **One-Splint Method—Straight Knee**  (10) Provide emergency care for shock, and continue to administer high-concentration oxygen.
Scan 30-12 (continued)  One-Splint Method—Straight Knee  (11) Monitor distal pulse and vital signs.
Scan 30-13  Two-Splint Method—Straight Knee  (1) Stabilize the injured limb, and assess distal CSM.
Scan 30-13 (continued)  Two-Splint Method—Straight Knee  (2) Measure the padded board splints, medial from groin, lateral from iliac crest, both to 4 inches beyond the foot.
Scan 30-13 (continued)  Two-Splint Method—Straight Knee  (3) Position the splints.
Scan 30-13 (continued)  Two-Splint Method—Straight Knee  (4) Pad the groin.
Scan 30-13 (continued)  Two-Splint Method—Straight Knee  (5) Secure the splints at the thigh, above and below the knee, and at mid-calf. Pad all voids.
Scan 30-13 (continued)  Two-Splint Method—Straight Knee  (6) Cross and tie two cravats at the ankle or hitch the ankle. Reassess distal CSM, care for shock, and provide high-concentration oxygen.
Scan 30-14  Two-Splint Method—Leg Injuries  (1) Assess the distal CSM. Measure the splints. They should extend above the knee and below the ankle.
Scan 30-14 (continued) Two-Splint Method—Leg Injuries   (2) Apply manual traction (tension) on the leg, then place one splint medially and one laterally. Padding is toward the leg.
Scan 30-14 (continued)  Two-Splint Method—Leg Injuries  (3) Secure the splints, padding the voids.
Scan 30-14 (continued) Two-Splint Method—Leg Injuries  (4) Reassess distal CSM.
Scan 30-14 (continued) Two-Splint Method—Leg Injuries  (5) Provide emergency care for shock, and administer high-concentration oxygen. Transport on a long spine board.
Scan 30-15  One-Splint Method—Leg Injuries  (1) Assess distal CSM. Measure the splint.
Scan 30-15 (continued)  One-Splint Method—Leg Injuries  (2) Lift the limb off the ground.
Scan 30-15 (continued)  One-Splint Method—Leg Injuries  (3) Apply manual traction (tension).
Scan 30-15 (continued)  One-Splint Method—Leg Injuries  (4) Secure the splint to the injured leg.
Scan 30-15 (continued) One-Splint Method—Leg Injuries  (5) Reassess distal CSM.
Scan 30-15 (continued)  One-Splint Method—Leg Injuries  (6) Care for shock, and continue to administer high-concentration oxygen. Package the patient and prepare to transport.