Bandages - an Overview
When applying cast padding, conforming gauze, or casting material, one often has a choice among various widths of material (2, 3, and 4 inch). The wider the roll, the more material is applied with each encircling wrap and the fewer the rolls needed to achieve an appropriate thickness of material. However, wider tapes make it more difficult to maintain the limb in a functional position because the material does not course as evenly over partially flexed joints. As a result, wider rolls tend to straighten underlying joints more than narrower rolls, which can be wrapped more anatomically along limb contours.
Generally, the smaller and thinner the limb, the narrower is the roll of material. As a rule of thumb, bandages for cats and small dogs are best applied with 2-inch-wide material. Three-inch material is used for midsized dogs (25 to 50 pounds), and 4-inch material is reserved for only the largest breeds.

THORACIC LIMB SLINGS
Slings are general-purpose bandages designed to prevent weight bearing or maintain a protective orientation for the limb. Slings usually afford significant mobility to the incorporated limb and should therefore be reserved for injuries requiring minimal stability.
It is important to remember that slings are prone to bandage-related complications. Elastic fabric is often adhered directly onto the skin, since slings are usually constructed with little to no padding. Skin underlying the tape can be irritated directly by the adhesive or by excessive pressure from material wrapped too tightly. These complications may be prevented by applying a protective layer of padding and conforming gauze underneath the elastic tape wherever it must encircle the limb. Pressure-related cutaneous injury can also be minimized by incorporating pleats in the elastic tape. Pleats can separate with tension, providing more "give" than tape that is applied circumferentially. In this way, pleats act as safety valves if excessive tension is used during sling application or if the incorporated limb swells significantly after application.

Carpal Flexion Sling
The carpal flexion sling prevents weight bearing but provides free mobility to the proximal limb. The carpus is partially or fully flexed and taped into position with elastic adhesive tape. The tape is applied circumferentially around the dorsal aspect of the paw and distal radius, with little to no tension. Swelling of the paw can occur if the tape is applied too tightly or if the carpus is forced into maximum flexion. Cast padding and conforming gauze underneath the tape help prevent skin irritation caused by direct contact with the adhesive, but slippage is more common.
Indications for the carpal flexion sling include stable forelimb injuries that would benefit from temporary protection from weight-bearing forces. Typically, this includes postoperative protection of repaired forelimb fractures or luxations. The carpal flexion sling is also used to protect repairs of the accessory carpal bone or flexor tendons, which can be subjected to disruptive forces when the carpus extends.

Velpeau Sling
The Velpeau sling prevents weight bearing and provides some stability to the proximal limb. Two or three layers of padding are placed circumferentially around the torso and limb while it is held partially flexed and adducted against the ventrolateral chest. The layers should be wrapped in front of and behind the contralateral brachium to prevent cranial slippage of the incorporated
The Velpeau sling can occasionally be used as the primary mode of therapy for proximal limb connective tissue injuries and fractures. Bicipital bursitis and traumatically induced medial shoulder luxation can be rested effectively with this sling. Sufficient stability can also be provided for minimally displaced, intrinsically stable fractures of the scapula and humerus. Most often the Velpeau sling is used adjunctively to protect tenuous repair of a fractured scapula or humerus or to protect repair of medial shoulder luxation. By adducting the distal limb, the sling forces the humeral head laterally within the joint, thereby reducing stresses to any imbrication or tendon transfer performed on the medial aspect. For lateral shoulder luxation, a spice splint should be used as primary or adjunctive therapy.
THORACIC LIMB PADDED AND SPLINTED BANDAGES

Padded Bandage
The padded bandage (modified Robert Jones) is a general purpose application with numerous indications for injuries distal to the elbow. Padded bandages are constructed with contact, padding, compressive, and outer layers and permit weight bearing but provide minimal stability. For injuries distal to the carpus, the proximal end of the bandage should extend up to the middle or proximal one-third of the radius (half limb). For injuries to the carpus or antebrachium, the bandage should extend up to the middle or proximal one-third of the humerus (full limb). Proximally the bandage should not end at the level of a joint (i.e., carpus or elbow). Distally, the digital pads and claws of digits three and four should protrude from the end of the bandage.

Application. The specific techniques used to apply the various bandage layers are described earlier in this chapter. In brief, the stirrups are applied firmly to the hair on the lateral and medial aspects of the distal limb. Distally, the ends of the stirrups are adhered to each other or to a tongue depressor so that they extend at least 10 cm distal to the digits. Using cast padding or roll cotton, the padding layer is applied distally to proximally with about 50% overlap wrapping cranially to caudally around the medial aspect of the limb and caudally to cranially around the lateral aspect, to minimize external rotation (supination). The padding is continued up to the anticipated proximal end of the bandage and torn. Additional layers are applied in a similar manner until the appropriate thickness is obtained. Usually, 1 to 2 cm of cotton cast padding (five to seven layers) is adequate. Two or three additional layers of padding are applied to the most proximal and distal ends of the bandage to provide added protection in these locations. With the limb cupped in one hand, conforming gauze is applied evenly and snugly with the other. The conforming gauze should be spiraled proximally in the same direction as the underlying padding. Two or three layers of conforming gauze are usually adequate. The compressive layer should compact all but the most proximal 1.5 to 2.0 cm of padding; direct contact with the skin should be avoided. The stirrups are separated, reflected proximally with tension, and held in place with a circumferential loop of adhesive tape. Finally, elastic tape is applied to protect the underlying layers. Direct contact between the outer layer and skin should be avoided.

Padded bandages are applied so that digits three and four protrude from the distal end to facilitate examination. However, injuries to the digits or pads may require the entire paw be incorporated within the bandage. In this case, special care is taken to ensure that the compressive layer is not applied too tightly since the digits cannot be examined for signs of swelling.

Indications. Padded bandages are used primarily or adjunctively for the treatment of relatively superficial injuries that do not need significant additional stability (see Indications for External Support). The most common examples include open wounds, primary or delayed wound closures, and surgical incisions. The specific benefits of these bandages have been discussed in detail. Most importantly, they can minimize swelling of traumatized limbs, absorb exudate, and protect, debride, and medicate underlying wounds.

Robert Jones Bandage
The Robert Jones bandage (R-J bandage) is a variation of the padded bandage with a much thicker padding layer. As with padded bandages, the R-J bandage is constructed with contact, padding, compressive, and outer layers and is indicated for injuries distal to the elbow. The proximal aspect of the R-J bandage usually extends as high up on the limb as possible (full limb). The R-J bandage provides more stability than a padded bandage because of its added thickness; however, its extremely bulky size is unwieldy and restricts ambulation.

Application. Application of the R-J bandage is performed similar to that of the padded bandage except for the padding and compressive layers. Much thicker padding (4 to 8 cm) is applied using rolled cotton instead of cast padding. Usually, three to five layers of cotton roll are wrapped as snugly as possible to achieve the desired thickness. The compressive layer is then applied, as tightly as possible, with conforming gauze. The thicker padding and tightly applied compressive layer
afford increased stability without contributing to vascular occlusion. The stirrups and outer layer are fashioned identical to the padded bandage.

**Indications.** The major advantages of the R-J bandage include its increased stability over padded bandages and its tremendous absorbent capacity. However, if the padding layer becomes too thick or the compressive layer is not applied tightly enough, stability is diminished because axially located cotton adjacent to the limb is not adequately compacted (see Biomechanics). Additionally, the bandage's bulk, which limits mobility and requires a significant investment in bandaging material, makes repeated application impractical. Therefore, the R-J bandage is usually used as a temporary "field dressing" for fractures or wounds distal to the elbow until definitive repair, splinting, or casting can be performed.

**Splinted Bandage**

The splinted bandage is a support bandage for injuries distal to the elbow that permits weight bearing and provides moderate stability. The bandage is constructed with contact, padding, compressive, splint, and outer layers. For injuries distal to the carpus, the proximal aspect of the bandage should extend up to the middle or proximal one-third of the radius (half limb). For injuries to the carpus or antebrachium, the bandage should extend up to the middle or proximal one-third of the humerus (full limb). The proximal aspect of the bandage should not end at the level of a joint (i.e., carpus or elbow), and only the pads and claws of digits three and four should protrude distally.

**Application.** The specific techniques used to apply the bandage layers are described earlier in this chapter. In brief, the first three layers, including the stirrups and padding and compressive layers, are applied identical to those of the padded bandage, as described earlier. Moldable splintage, such as a metal rod (3/8”, 1/4 or 5/16 inch), thermally sensitive plastic, or casting tape, is then contoured to the bandage's lateral aspect. At the carpus, 10-15 degrees of flexion and 10-15 degrees of medial deviation (varus) may be incorporated into the splint to minimize the carpal hyperextension often seen after bandage removal. A functional position for the elbow joint should also be maintained with full-limb splints. The splint layer is then applied laterally, superficial to the compressive layer, and is bound to the bandage with additional layers of conforming gauze. These additional layers of conforming gauze should be applied evenly, spiraling in the same direction and with similar tension to that of the underlying compressive layer. The stirrups are then reflected, and the outer layer is applied routinely.

Spoon splints are a special form of splintage material that are prefabricated out of plastic or aluminum. They are best used to protect injuries distal to midshaft radius. Unlike the other splint materials, they are placed on the bandages caudal aspect and extend distally, past the paw, to contact the ground during weight bearing. Proximally, they should not extend past the olecranon. If needed, the splints can be hacksawed or cut with heavy shears to the appropriate length. With a radial, carpal, or metacarpal injury, the padded bandage underlying a spoon splint may be applied with digits three and four protruding. If the digits or pads are injured, the entire paw is often incorporated. In this case, care must be taken that the compressive layer is not applied too tightly, since the digits cannot be examined for evidence of swelling.

**Indications.** Splinted bandages are usually used primarily or adjunctively for the treatment of injuries that require significant additional stability. The most common examples include luxations, fractures, and postoperative protection of tenuous orthopedic repairs. For open wounds, splinted bandages provide all the benefits of padded bandages and increased stability.

**Spica Splint**

The spica splint is a special form of splinted bandage for injuries of the proximal limb, including the elbow, humerus, shoulder, and scapula. It permits weight bearing and limited ambulation and provides moderate stability. The bandage is constructed with contact, padding, compressive, splint, and outer layers. Stability to the proximal limb is afforded because the bandage and splint span the entire limb and incorporate the thorax. As with the other padded and splinted bandages, only the pads and claws of digits three and four should protrude from the bandage distally.
**Application.** The specific techniques used to apply the bandage layers are described earlier in this chapter. In brief, the stirrups and padding, compressive, and splint layers are applied similar to those of the splinted bandage except that the entire limb and thorax are incorporated. The padding layer is applied as high proximally on the limb as possible and is then continued circumferentially around the thorax, cranial and caudal to the contralateral limb. Conforming gauze is applied similarly, using caution to extend no closer than 1.5 to 2 cm from the padding’s edge. Care must also be used when applying tension to material wrapped around the thorax. Respiration can be compromised if the conforming gauze or outer layer material is applied too tightly. This is especially true in patients with preexisting thoracic trauma, such as hemothorax, pneumothorax, or pulmonary contusion. Moldable splintage is then contoured to the lateral aspect of the limb and thorax, maintaining a functional position for the elbow and shoulder. To provide optimal stability, the splint material should extend from the most distal aspect of the bandage to at least the dorsal midline of the thorax. The splint layer is then bound to the bandage with additional layers of conforming gauze. The additional conforming gauze should be applied evenly, with similar tension to that of the underlying compressive layer. The stirrups are then reflected, and the outer layer is applied.

**Indications.** Spica splints are used primarily or adjunctively for the treatment of injuries to the elbow, humerus, shoulder, and scapula that require additional stability. The most common indications include elbow luxation; lateral shoulder luxation; and minimally displaced, intrinsically stable fractures of the humerus or scapula. Additionally, spica splints are often used to protect tenuous orthopedic repair of these associated bones and joints postoperatively. The spica splint is not a frequently applied bandage, even though indications for its use are common. The increased bandaging material required to incorporate the chest makes this splint relatively expensive to apply. Also, the splint's bulkiness and significant restriction of the elbow and shoulder severely limit patient ambulation.

**PELVIC LIMB**

**Ehmer Sling**

**Application.** The classical Ehmer sling prevents weight bearing of the pelvic limb by maintaining the tarsus and stifle in partial flexion. Elastic adhesive tape is carefully pleated around the metatarsus with the material directed proximally and the adhesive surface laterally. The stifle and tarsus are flexed, and the material is directed proximally and medial to the thigh. The material is brought over the thigh, as proximally as possible, and is directed distally over the limb’s lateral aspect back toward the pleat. This circumferential loop is continued planter to the metatarsus and medial to the limb. After the material is brought over the thigh again, it is directed caudodistally, medial to the tarsus. The material is twisted 180 degrees and directed laterally, along the planter aspect of the metatarsus at the level of the initial pleat. The roll is then directed cranioproximally medial to the thigh and again twisted 180 degrees. This figure-eight application is continued for one or two complete revolutions.

The modified Ehmer sling, as with the classical version, prevents weight bearing of the pelvic limb but also maintains the hip joint flexed, abducted, and internally rotated. The bandage is applied similar to the classical version except that an additional revolution of tape is applied. After the material is brought caudodistally medial to the tarsus, and twisted, it is directed over the planter aspect of the calcaneus, tarsus, and proximal metatarsus. The material is then directed cranioproximally with significant tension and is incorporated into a caudal abdominal belly band constructed of elastic adhesive tape. Additional strips, connecting metatarsus to torso, may be needed to support the limb as desired.

With both versions of the Ehmer sling, the band crossing over the proximal aspect of the thigh has a tendency to slip forward over the stifle, causing the bandage to unwrap. This often occurs in long-haired dogs, with the tape adhering to long mobile hair rather than firmly attaching to the limb. Looping around the thigh as proximally as possible and clipping or shaving the upper limb help prevent this problem.
Finally protection in the form of cast padding and conforming gauze is often placed around the tarsus, metatarsus, and distal tibia to prevent sores caused by the irritation or excessive pressure from elastic tape.

**Indications.** Traditionally, the Ehmer sling is used to maintain the femoral head within the acetabulum after open or closed reduction of a craniodorsal coxofemoral luxation. However, the classical Ehmer does not cross the hip joint and cannot effectively restrict the hip’s orientation or mobility. Alternately the modified Ehmer, by suspending the metatarsus from the torso, forces the hip into flexion, abduction, and internal rotation, which are the optimal orientations to maintain reduction after a craniodorsal luxation.

### Pelvic Limb Sling

**Application.** The pelvic limb sling (Robinson sling) prevents weight bearing by maintaining the tarsus, stifle, and hip in partial flexion. Two- to three-inch elastic or nonelastic adhesive tape is unrolled to an amount at least equal to the distance from the lumbar dorsal midline to the affected limb’s metatarsus. The proximal end of the tape is held at the level of the dorsal midline and the roll is directed distally, positioning the tape medial to the limb with the adhesive surface directed laterally. The tape is wrapped around the planter aspect of the metatarsus and then attached to itself proximally forming a pleat. The material is further tmrolled, doubling back on itself to the dorsal midline, attaching adhesive surface to adhesive surface. The paw is raised 5 to 8 cm off the ground by drawing the doubled material up proximally and incorporating it into a caudal abdominal belly band made of elastic adhesive tape. The pleat and doubled material can be further secured to the limb with additional encircling strips of tape. Additionally, the metatarsus can be cushioned from the pleat with a thin underlying layer of padding and conforming gauze.

**Indications.** Most often the pelvic limb sling is used adjunctively to protect tenuous fracture repair of the tibia or femur or repair of stifle luxation. The sling is an attractive alternative to support bandages if minimal stability is needed. By maintaining the pelvic limb only a few inches off the ground, the sling protects the affected limb from the normal forces of weight bearing while maintaining a functional position and allowing significant freedom of movement.

### 90/90 Flexion Sling

**Application.** The 90-90 flexion sling is a variation of the classical Ehmer and prevents weight bearing of the pelvic limb by maintaining both the tarsus and stifle in approximately 90 degrees of flexion. With the tarsus and stifle flexed to 90 degrees, elastic adhesive tape is simply wrapped circumferentially around the thigh and metatarsus. This differs from the Ehmer sling, where the material is then passed distally around the caudomedial aspect of the tarsus in a figure-eight fashion. Additionally, tape can be applied circumferentially at the level of the distal tibia to help prevent slippage of the proximal and distal loops.

**Indications.** The 90-90 flexion sling has been described as a prophylactic maneuver to prevent quadriceps contracture after complicated femur fracture repair in young dogs. Patients at high risk for quadriceps contracture are defined as immature patients (especially under 9 months) with considerable contracture comminution and soft tissue injury. It is recommended that the sling be maintained for no longer than 10 days.

### Hobbles

**Application.** Hobbles are designed to permit weight bearing but prevent abduction of the pelvic limbs. Elastic tape is applied circumferentially around the hind limbs, taking care to maintain a between-limb distance similar to that of the standing position. When applying tape to each limb, it is better to form pleats than to apply the tape circumferentially. Cast padding and conforming gauze can be applied underneath the elastic tape, if desired. Additional tape placed around the pleat on the medial aspect of both limbs can help prevent premature pleat separation and distal slippage. Tarsal hobbles are positioned just proximal or just distal to the tarsus, at the level of the distal tibia or midmetatarsus. Stifle hobbles are positioned just proximal to the patellae, at the level of the distal femur. An additional strip of tape coursing over the pelvic dorsum and connecting the lateralmost aspects of the stifle hobbles is often necessary to prevent distal slippage.
Indications. Indications for hobbles include caudoventral coxofemoral luxation, pelvic trauma, and pelvic limb restraint. Caudoventral coxofemoral luxation must be handled differently than the more typical craniodorsal luxation. Although craniodorsal luxation is usually associated with diffuse capsular tears, caudoventral luxation is often associated with focal tearing of only the ventral joint capsule. Dorsocranially, the capsule is usually intact and provides excellent intraarticular stability once reduction is achieved. However, severe abduction of the hip forces the femoral head ventrally, toward the area of weakened capsule. Hobbles can very effectively limit this severe abduction and prevent reluxation. Patients with multiple pelvic injuries often have difficulty maintaining the hind limbs adducted. When walking, pelvic limbs can suddenly abduct, especially on slippery floors, causing the animal to fall and further injure itself. Hobbles are useful in providing support to patients with this tendency. Finally, hobbles can be used as a restraint device for animals that injuriously scratch themselves with the pelvic limbs. Bandages, wounds, incisions, or pruritic skin can be protected from self-induced trauma. with these restraint devices. Tarsal and stifle hobbles perform similar functions; however, each has its own unique advantages. Some patients recovering from caudoventral coxofemoral luxation can still manage to abduct the hip at the level of the stifle.