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EMERGENCY MEDICINE/CRITICAL CARE

Definitive Treatment of Limb Fractures With Splints or Casts

Ross Palmer, DVM, MS, DACVS
Clara S. S. Goh, BVSc, MS, DACVS-SA, ACVS Founding Fellow—Surgical Oncology
Colorado State University College of Veterinary Medicine & Biomedical Sciences

Dramatic technologic advances in fracture fixation offer veterinarians a wider array of surgical fixation systems than ever before; however, a definitive treatment role remains for splints and casts for selected fractures. As a profession, veterinarians must preserve their knowledge and skills in the "art" of effective utilization of splints and casts for these fractures, referred to in this article as *coaptation*. The keys to successful use of coaptation as a definitive fracture treatment are case selection, the techniques of fracture reduction and cast application, and proper post-application care and monitoring.

CASE SELECTION

TABLE 1 summarizes important mechanical and biologic factors when considering coaptation for the definitive treatment of long bone fractures.

Indications

Depending on the fracture configuration and location, the fracture zone may experience any of 5 disruptive forces: bending, rotation, compression, shear, and tension. Properly applied splints and casts are capable of providing some resistance to bending forces and somewhat less resistance to rotational forces. Since they are not capable of resisting compression, shear, or tensile forces, they are unsuitable for treatment of fractures for which these disruptive forces are significant. In brief, coaptation is best used for treatment of fractures distal to the elbow/stifle that are subjected only to moderate bending and mild rotational forces.

Incomplete ("greenstick") fractures in the crus or antebrachium; fractures with an intact adjacent bone, such as tibial fracture with an intact fibula (**FIGURE 1**); and fractures of 1 or 2 of the 4 metacarpal/metatarsal bones tend to be the best candidates for cast/splint treatment. An intact bone adjacent to a fractured bone functions as an internal anatomic splint. Incomplete fractures and preservation of an intact adjacent bone are most common in animals aged <6 months owing to the relatively compliant nature of their collagen-rich bone compared with the more

COAPTATION, PART 2 The authors discuss splinting/casting for definitive treatment of selected fractures. Coaptation for temporary first aid immobilization was addressed in the November/December 2019 issue.

mineral-rich bone of adult animals. Some transverse fractures in which >50% reduction can be achieved in both orthogonal radiographic views may also be candidates for casting; the restored bony column should be capable of resisting axial collapse while the cast resists bending and rotational forces.

CONTRAINDICATIONS

Coaptation should never be used for definitive treatment of fractures proximal to the elbow/stifle, as it is not possible to span the joint above the fracture; thus, disruptive bending forces cannot be controlled. It is not recommended for fracture configurations in which the bone itself is incapable of resisting axial compression; these include complete oblique or spiral fractures, comminuted fractures, and transverse fractures in which <50% reduction is present in one or more orthogonal radiographic views. Coaptation is unsuitable for treatment of fractures at the insertion site of muscle-tendon units, due to the strong tensile forces acting on them; these so-called traction apophyses include the tibial tuberosity, tuber calcis, and olecranon.

Coaptation is prone to complication and should be avoided in scenarios where mechanical overloading is a concern; this includes animals with multi-limb dysfunction and pets in which activity restriction is unlikely due to patient temperament and/or anticipated client noncompliance. Cast/splint application should also be avoided in fracture scenarios in which delayed healing is predictable, regardless of mechanical factors, as the risk of complications with coaptation increases with treatment duration.

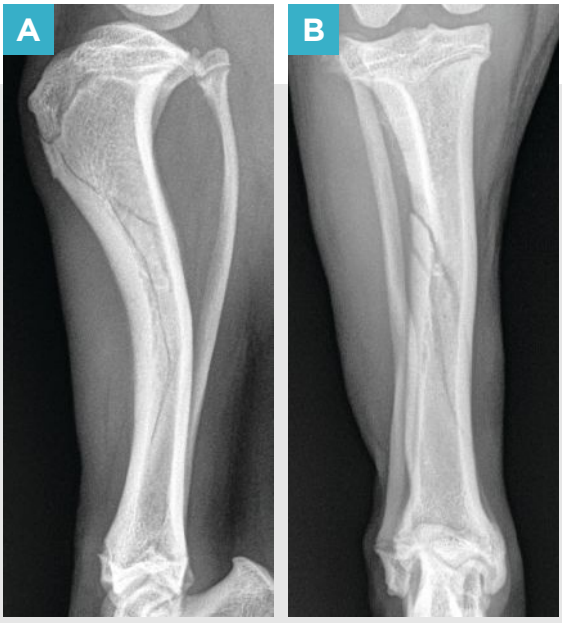

FIGURE 1. Incomplete tibial fracture with an intact fibula in a growing dog may be an ideal case for coaptation.

Before anesthesia and attempted fracture reduction, owners should be informed that surgical treatment will be recommended (and may involve referral) if >50% reduction of a transverse fracture cannot be achieved in both orthogonal radiographic views. If the owner refuses surgical treatment despite inadequate fracture reduction, clarify that coaptation is their choice but is not the recommended treatment.

Complication Factors

Soft tissue complications can be mild, moderate, or severe. Total soft tissue complication rates can be as high as 63% of cases, and the cost of treating them can be up to 121% of the original procedure cost.[1,2] Since the likelihood of soft tissue complications increases with treatment duration, coaptation may not be the best treatment when the estimated healing time exceeds 4 to 6 weeks; this may include animals older than a young adult (age ≥3 years), patients with moderate/severe regional soft tissue injury (including open fractures), and anatomic regions with poor regional blood supply to bone.

Poor vascular density of the distal radius/ulna in small breeds of dogs may contribute to the reported 75% rate of nonunion and malalignment in such fractures treated with coaptation.[3,4] Therefore, even when >50% reduction of transverse fractures of the distal radius/ulna is achievable, coaptation is *not* the treatment of choice in these patients. Articular fractures require rigid fixation and maintenance of perfect anatomic reduction in order to maximize restoration of limb function; coaptation is *not* recommended for treatment of these fractures because of its inability to satisfy these treatment requirements. Additionally, the thin skin and bony prominences of sighthound breeds make them particularly prone to soft tissue complications.

Additional Considerations for Growing Animals

Rapidly healing fractures are most suitable for cast/splint treatment, and fracture healing is most rapid in young, healthy animals with only minor disruption of regional soft tissue health. However, casting duration

TABLE 1 Coaptation Indications and Contraindications

INDICATIONS	CONTRAINDICATIONS
Fracture distal to elbow/stifle	Fracture proximal to elbow/stifle
Fracture configuration can resist compression ■ Incomplete (greenstick) ■ Intact adjacent bone (anatomic splint) ■ >50% reduction of transverse fracture	Fracture cannot resist compression ■ Complete oblique or comminuted fracture ■ <50% reduction of transverse fracture
Overloading of fracture not anticipated ■ Single injury (normal function in other 3 limbs) ■ Docile patient temperament (exercise restriction is probable) ■ Owner compliance anticipated	Overloading of fracture is a concern ■ Multiple dysfunctional limbs ■ Active patient temperament (exercise restriction is a concern) ■ Owner compliance is questionable
Rapid bone healing anticipated ■ Young, systemically healthy animal ■ Minimal/mild regional soft tissue injury	Rapid bone healing less likely ■ Older than young adult ■ Moderate to severe regional tissue injury ■ Poor regional blood supply to bone ■ Toy breed, distal radius/ulna
	Fracture at traction apophyses (e.g., tibial tuberosity, olecranon, tuber calcis)
	Articular fracture
	Animals with very thin skin and profound bony prominences (e.g., sighthounds)

should be kept to a minimum in animals aged <6 months due to the bones of young animals shaping and developing in response to the forces placed on them. Casts do not permit normal physiological weight-bearing forces in the limb and can therefore interfere with normal bony shaping and development, leading to issues such as patellar luxation (due to shallow trochlear groove development) and hip dysplasia (due to poor development of acetabular depth).

Casts should be molded such that normal limb contours are preserved. Cast application with the limb held in firm traction is a common error that causes the limb to be too extended; it is especially important to avoid this in the hindlimbs of growing animals.

CLOSED FRACTURE REDUCTION TECHNIQUES FOR USE WITH COAPTATION

Greenstick fractures and fractures with an intact adjacent bone are often minimally displaced and may not require specific reduction techniques. In contrast, complete transverse fractures are frequently displaced with angulation and may be overridden. If significant soft tissue swelling is present, initial temporary immobilization with a Robert Jones bandage for the first 24 hours can facilitate fracture reduction and improve subsequent cast conformation. When the configuration and displacement of the fracture require closed reduction, general anesthesia is typically required. While limb traction via suspension of the limb (to the point of gentle regional trunk elevation) can help fatigue the patient's muscles and stretch regional periosteum/soft callus, it is seldom sufficient, by itself, to permit adequate fracture reduction. For a step-by-step description of coaptation for temporary first aid immobilization, including placement of a Robert Jones bandage, please see part 1 of this article at todaysveterinarypractice.com/temporary-immobilization-of-limb-fractures.

When angulation is present, the periosteum is often completely disrupted on the convex side of the angulated limb, but it may be preserved on the concave side of the limb. Frequently, the direction of angulation is caused by muscular dominance on the concave side; for example, valgus angulation of complete tibia/fibula fractures is common because the muscles on the tibia's lateral side are dominant (**FIGURE 2**).

Lateral muscle spasm and lateral bridging periosteal sleeve prevent pure longitudinal limb traction from achieving fracture alignment. Tension in these lateral

bridging tissues can, first, be relaxed by exaggerating the angulation toward the concave side, often to 90° or more ("*you must make the fracture worse before you make it better*"). The fractured bone ends can then be manipulated until they come in contact with one another. The cortical contact of the fractured ends at the concave margin serves as a hinge about which slow, progressive, 4-point bending using the bone segments as levers to stretch the contracted soft tissues gradually restores bony alignment (**FIGURE 2**).

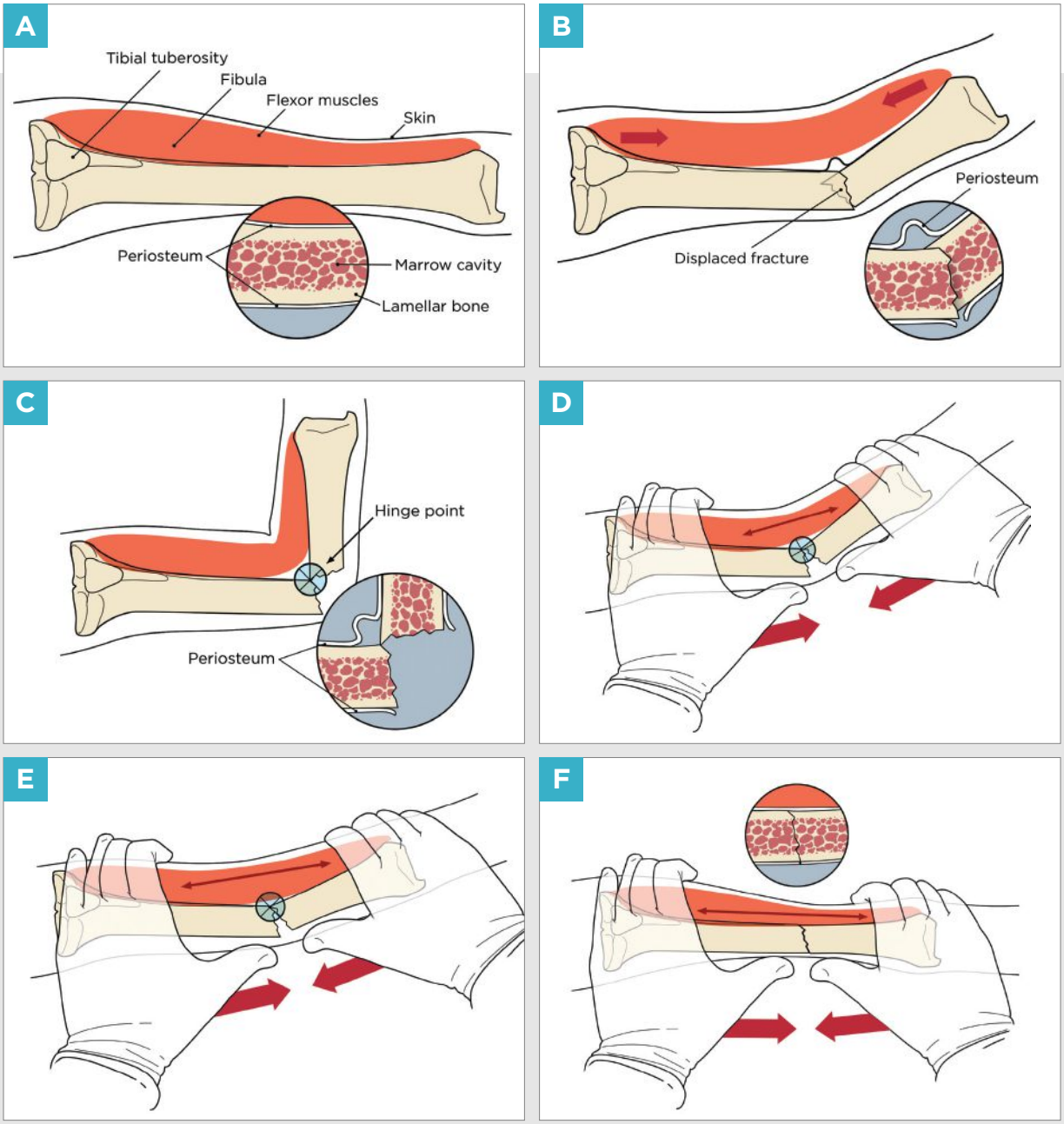

FIGURE 2. (A) Normal relationship of muscle and intact bone in canine lower leg (cranial view). **(B)** In the case of fracture, bony angulation is often in the direction of muscular dominance. Taut musculature and intact periosteum on the concave side of the angulation must be overcome to accomplish fracture reduction and alignment. **(C)** Increasing the bony angulation to relax the tension in the soft tissues allows the fracture ends to be brought into contact with each other. **(D)** The cortical contact of the fractured ends at the concave surface works as a hinge about which steady 4-point bending in the direction of the arrows can be used to slowly improve angulation as the musculature is stretched. **(E)** The 4-point bending process is continued slowly to progressively restore fracture reduction until **(F)** bony alignment is achieved.

Kip Carter (6)

CAST APPLICATION TECHNIQUE FOR DEFINITIVE FRACTURE TREATMENT

The patient is typically under general anesthesia if closed reduction techniques are used; sedation may be feasible in instances of incomplete fracture or fracture with intact adjacent bone because these fractures are inherently more stable and often well reduced, and the patient is typically more comfortable.

At least one assistant is necessary to support the limb. For relatively unstable complete fractures, one assistant may be required for limb support and another for traction on the stirrups and bandaging assistance. Most fractures tend to deviate toward valgus angulation because the fracture zone is mistakenly allowed to sag medially while upward tension is mistakenly applied to the stirrups. The assistant must be trained to always support the fracture zone and avoid upward deviation of the distal limb segment throughout the casting process.

The following step-by-step description assumes that a cast is being applied to a relatively unstable complete fracture that has been reduced as illustrated in **FIGURE 2**. (Supplies needed for the cast application are listed in **BOX 1**.)

Step 1: Patient Position and Interdigital Padding

Position the patient in lateral recumbency with the affected limb upward. Apply a strip of cast padding from the dorsal surface of the metacarpus/metatarsus through each interdigital space to the palmar/plantar surface of the metacarpus/metatarsus. An assistant should maintain the position of these strips.

Step 2: Applying Tape Stirrups

Apply 1-inch porous white tape strips to the medial and lateral surface limb surfaces from the carpus/tarsus to the digits, extending approximately twice this adherent length distal to the digits. Fold over the distal ends of the tape stirrups to create nonadherent tape tabs; a tongue depressor may be placed between the strips of tape if desired (**FIGURE 3**).

Step 3: Applying Stockinette Liner

Cut stockinette of appropriate diameter (it can be stretched to accommodate the maximal diameter of the upper segment of the casted limb) to approximately 1.5 times the estimated cast length. Roll the stockinette into a doughnut shape and slide it over the tape stirrups. Unroll the stockinette such that several inches extend distal to the paw and there is redundant material proximally as it is pulled high into the axilla/inguinal

BOX 1 Casting Supplies

- 1″ porous white adhesive tape (1 roll)
- Tongue depressor
- 2″–4″ cast padding (3–4 rolls)
- 2″–4″ roll gauze (2–3 rolls)
- 2″–4″ fiberglass casting tape
- Exam gloves for operator and 1 assistant
- Sink or basin filled with room-temperature water
- 2–3 rolls of self-adherent elastic wrap, such as Vetrap (3m.com)
- 2″ elastic tape, such as Elastikon (jnjsportsmed.com)
- Cast cutting saw or similar oscillating action saw
- Plastic bag/surgical sleeve/impervious bootie
- Stockinette of appropriate diameter for the casted limb segment

FIGURE 3. Proper application of tape for stirrups.

There is little risk of getting the cast padding layer too tight because the material will tear if too much tension is applied.

region. Pull the proximal cuff of the stockinette taut and as high as possible on the limb medially, cranially, laterally, and caudally; it can be held in this position by an assistant or with towel clamps or skin staples (in an anesthetized patient; **FIGURE 4**). Eventually, this liner will help create a cuff of soft padding over the ends of the cast to prevent skin irritation.

Step 4: Padding Bony Prominences

Pad bony prominences such as the tuber calcis and olecranon by applying "doughnuts" made of stockinette or folded layers of cast padding such that the prominence is protected within the doughnut hole (**FIGURE 5**). Padding these prominences appropriately is important, since the cast will likely be worn for several weeks.

Step 5: Applying Cast Padding

Hold the cotton or synthetic polypropylene cast padding roll as if holding a snail by its shell. Wrap the free end of the padding roll (the gooey snail body) around the distal limb, starting at the nail beds of central digits 3 and 4. Holding the roll in this orientation (versus holding the snail shell upside down) allows for maximal control of the tension of application. Apply the padding snugly, with roughly 50% overlap of each successive layer (**FIGURE 6**). Extend the cast padding as far proximally up the limb as possible, being sure to leave the tensioned proximal stockinette cuff exposed (**FIGURE 7**).

There is little risk of getting the cast padding layer too tight because the material will tear if too much tension is applied. Some products (Specialist Cast Padding, bsnmedical.com) have a micropleated texture; these should be tensioned until the pleated structure is flattened. Regardless of the material used, use care to avoid getting wrinkles in this layer.

A minimum of 2 layers of cast padding is needed, but avoid excessive padding, which can foster inadequate fracture immobilization and cast loosening. The toe region of the bandage often needs to be built up slightly because it is difficult to abruptly taper the shape of the fiberglass cast in this region; cast padding at the level of the toes can be folded longitudinally to halve its width and double its thickness over the toes (**FIGURE 8**).

Step 6: Applying the Roll Gauze Layer

Apply roll gauze snugly from distal to proximal, using care to have approximately 50% overlap of each circumferential wrap. Apply even tension to the gauze roll to avoid creating any constricting bands, and take care not to pull this layer too tightly. This layer should

FIGURE 4. Stockinette pulled taut by an assistant.

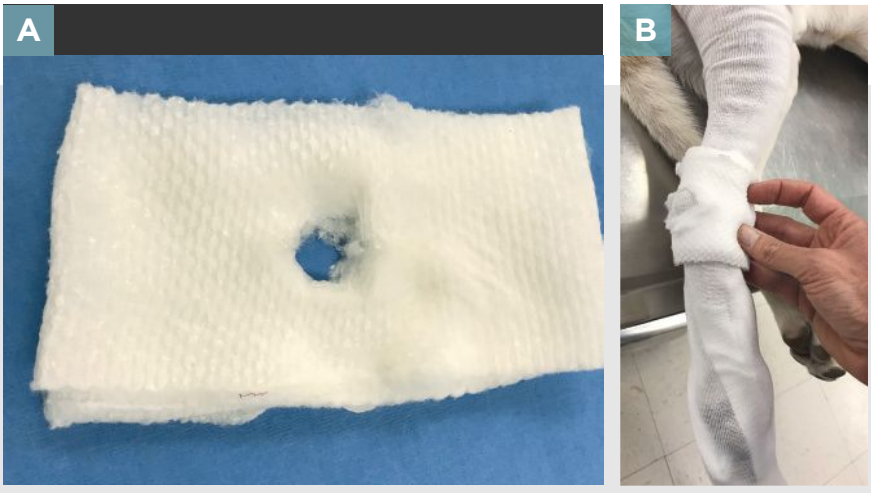

FIGURE 5. (A) Padding "doughnut" for bony prominence. **(B)** Padding in place.

extend to the proximal and distal margins of the underlying cotton roll. Two or 3 layers should be sufficient (**FIGURE 9**).

Step 7: Applying a Nonadherent Layer (optional)

Various materials can minimize adhesion of the fiberglass casting tape to the underlying soft bandage layers to make future cast removal easier. Plastic self-adherent kitchen wraps have been recommended, but they do not breathe and, therefore, require removal immediately after the cast has set. This removal process requires bivalving the cast and temporary cast removal. It is more efficient to use a breathable material (e.g., VetRap, 3m.com) that does not require immediate removal after the cast has set (**FIGURE 10**). Since this material is elastic, care must be taken to avoid pplying it too tightly.

Step 8: Applying Fiberglass Casting Tape

To foster normal limb use, it is important, especially in growing animals, that the limb be casted in a normal standing posture. Normal limb use fosters normal shaping of the skeleton as it develops. Excessive tension on the stirrups during casting often leads to limbs being casted in full extension; this should be avoided. Fiberglass casting tape is available in 2-inch, 3-inch, and 4-inch width rolls; wider rolls improve cast strength, but roll width should be appropriate for the size of the patient.

Open, activate, and squeeze the excess water from the first roll of casting tape (**BOX 2**). Again, hold the roll as if holding a snail by its shell and start the first layer at the nail beds of the center digits. Reinforce the distal end of the cast with several layers, as it will get the most wear (**FIGURE 11**). Then apply the tape with 50% overlap of each successive layer (**FIGURE 12**). Apply the tape in firm contact with the underlying layers, but do not pull too tightly, because this layer cannot stretch once the cast has hardened and could restrict blood and lymphatic flow. When approaching the more heavily muscled proximal limb, some mild increase in casting tape tension is appropriate to compress the muscles and conform the cast to the limb.

The top margin of the fiberglass cast should reach the axilla/inguinal region, but should leave a 1-cm cuff of cast padding extending beyond the upper cast edge. The upper margin of the cast can be reinforced slightly before beginning to wrap back down the cast. A second (and possibly third) roll of casting tape, applied as described above, is often required to achieve an

FIGURE 6. Application of the first cast padding layer. Note the assistant supporting the fracture zone to avoid valgus deviation and the normal standing contour of the limb.

FIGURE 7. Completed cast padding layer.

FIGURE 8. Extra cast padding at the toes to simplify cast shaping.

BOX 2 Handling Fiberglass Tape

Fiberglass casting tape rolls are provided in sealed packaging to prevent exposure to air and moisture. They should feel soft and compliant inside their packaging. Firm or hardened rolls may have been spoiled by exposure to air, moisture, or temperature extremes and should not be used as they may not set properly.

Before handling fiberglass casting tape, the operator and assistant should both don examination gloves to protect their fingers from the resin on the tape. To use a roll, first submerge and soak it in a basin of room-temperature water to thoroughly activate it; then gently squeeze it to expel excess water.

appropriate cast thickness. Two layers of 50% overlap (4 layers in cross-section) is appropriate for most small and medium-sized dogs; 3 layers of 50% overlap (6 layers in cross-section) is appropriate for most larger dogs (**FIGURE 13**).

Any shaping of the cast should be done with the palms and base of the hands rather than fingers to avoid focal cast indentations that may lead to cast sores in the underlying tissues. When room-temperature water is used, the cast will begin to harden within about 5 minutes. While the casting tape is setting, pull the proximal cuff of stockinette down over the cast's proximal margin to subtly roll its edge outward; then pull a short cuff of cast padding over the rolled edge to further protect the delicate tissues of the region (**FIGURE 14**).

Step 9: Bivalving the Cast

Once the cast has hardened, a cast-cutting saw can be used to cut the cast lengthwise into 2 halves; cranial and caudal cuts yield lateral and medial half-shells (**FIGURE 15**). While this does compromise some of the cast's mechanical integrity, the effect is nominal when this technique is properly performed and should not make the difference between clinical success and failure in properly selected cases. Bivalving simplifies future cast changes and will be greatly appreciated if future cast care is provided by a veterinarian who does not have access to a cast-cutting saw.

A properly formed cast should be in close apposition with the underlying layers and should be of uniform thickness except for its reinforced distal end (**FIGURE 16**). After bivalving the cast, apply circumferential strips of adhesive tape along the length of the cast to hold the half-shells together, followed by a reinforcing gauze layer.

FIGURE 9. Completed roll gauze layer.

FIGURE 10. Completed nonadherent layer.

FIGURE 11. Extra fiberglass tape at the toes to resist wear.

Step 10: Applying Stirrups and Outer Layers

Separate the tape stirrups and twist each one so that the adhesive surface is against the gauze wrap. The middle 2 toes should be visible through the end of the bandage.

Step 11: Applying the Outer (Protective) Layer

Apply short strips of elastic adhesive wrap (i.e., Elastikon [Johnson & Johnson, jnjsportsmed.com]) to reinforce the distal end of the cast/bandage. Next, apply Vetrap (3M Company, vetwraps.com) from distal to proximal, using care to have roughly 50% overlap of each successive layer. The tension of this outer layer is not particularly critical, as the underlying cast prevents this layer from compressing the limb.

After the cast is complete, an impervious layer, such as a plastic bag or protective bootie, can be used to protect it from getting wet (e.g., water bowl spill, urine, puddles) while the patient is still in the hospital or after discharge.

POSTAPPLICATION RADIOGRAPHY

Obtain radiographs after cast application. Because the casting materials are relatively radiolucent, radiographs can be screened to assess fracture reduction and alignment of adjacent joints.

In most instances, follow-up radiographs will be scheduled at the earliest estimated healing time. While this may be as late as 6 or more weeks in young adult animals, it should often be much sooner for skeletally-immature animals. As a rule of thumb, for animals younger than 6 months of age, patient age in months represents a suitable estimate of the weeks required for fracture healing. For example, a 3-month-old puppy would likely be healed by 3 weeks. A combination of palpable circumferential soft callus formation and radiographic evidence of bony callus bridging in 3 of the 4 bony surfaces (medial, lateral, cranial, and caudal) is typically sufficient for cast removal (**FIGURE 17**).

POSTAPPLICATION CARE

The pet owner should evaluate the cast daily for signs of toe swelling, wet bandaging layers, foul odor, or acute onset of focal chewing or irritation with the cast. Owners should be informed that these observations are indications for an immediate veterinary evaluation and probable cast change. These problems seldom improve without treatment and often worsen rapidly to the point of catastrophic implications, including limb loss. A purpose-specific protective boot (MediPaw, medivetproducts.com; or similar product) should be donned temporarily before the patient walks on wet surfaces (e.g., wet grass, snow, kennel runs for elimination purposes).

FIGURE 12. Proper application of fiberglass casting tape.

FIGURE 13. Completed fiberglass tape layer.

FIGURE 14. Upper cuff protecting the inguinal region.

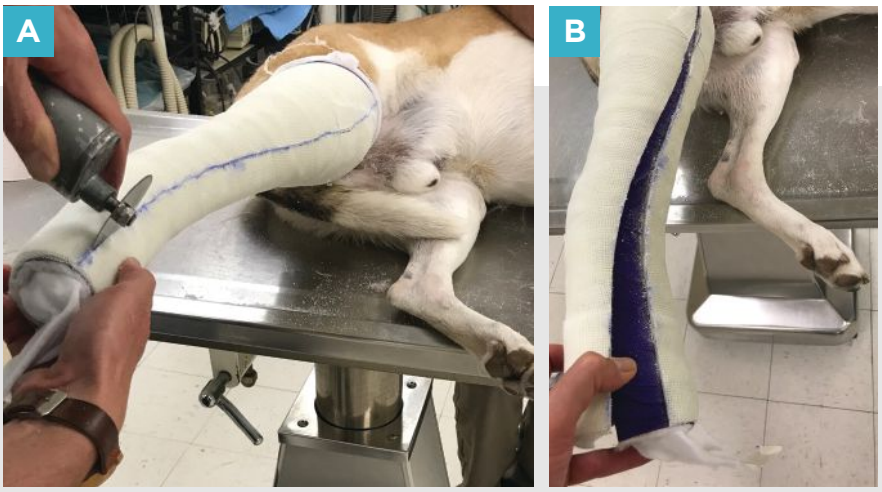

FIGURE 15. Bivalving the cast.

FIGURE 16. Properly formed cast showing uniform thickness.

In the absence of owner-observed problems, veterinary reevaluation is indicated 24 to 48 hours after application and every 5 to 7 days thereafter. During weekly rechecks, the patient is assessed clinically and, if indicated, radiographically to determine if cast change or removal is indicated.

Unlike many of the more routine bandage changes conducted in veterinary practice, cast changes typically require heavy sedation or general anesthesia to minimize the likelihood of loss of fracture reduction, especially for complete fractures without an intact adjacent bone. When replacing a cast, do not strip the old tape stirrups from the skin, as this contributes to skin irritation. Instead, cut the stirrups at the level of the digits, then apply the new stirrups directly over the old ones. The bivalved half-shells of the cast can be reused if they are in good condition and can be

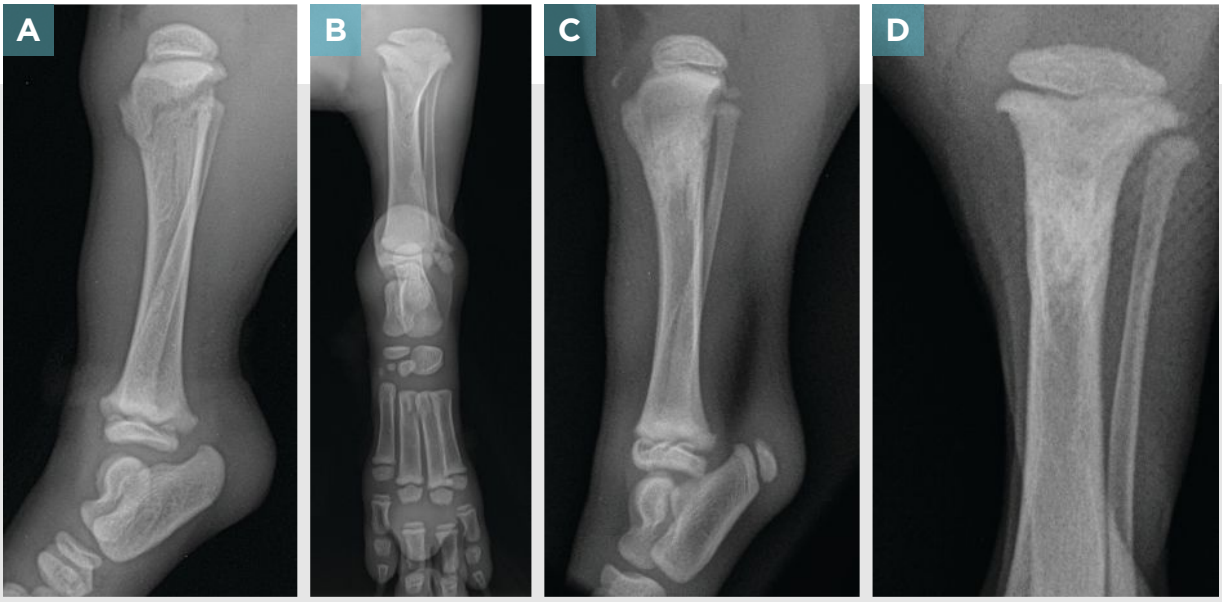

FIGURE 17. (A and B) Pretreatment radiographs in an 8-week-old puppy show an incomplete proximal tibial fracture with an intact fibula. The soft, collagen-rich bone is more compliant than adult bone and normal shaping occurs in response to the normal forces of weightbearing. Limb immobilization should follow normal contours of the standing limb position and the duration of immobilization should be kept to a minimum to avoid iatrogenic skeletal abnormalities such as patellar luxation and hip dysplasia. **(C and D)** Radiographs 2.5 weeks after injury show a healed and completely remodeled fracture.

properly conformed to the underlying layers of the new bandage. If in doubt, replace the casting layer. TVP

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Ross Palmer

Dr. Palmer is currently a professor of orthopedic surgery at Colorado State University; half of his career was in private specialty practice as a staff surgeon and as a practice owner. He has been an invited speaker at conferences around the world and is the founder of Complete Course on External Skeletal Fixation, which has been educating veterinarians for 25 years. The author of dozens of journal articles, book chapters, and veterinary educational videobooks, he also is the president of the Veterinary Orthopedic Society. Dr. Palmer's clinical work is focused on traumatology, minimally invasive surgery, limb deformity correction, and conditions of the knee. His research is directed toward disease and injury of the canine/human knee, cartilage repair, and development of novel devices for human orthopedic health care.

Clara S. S. Goh

Dr. Goh earned her veterinary degree at Sydney University, Australia. She completed her postgraduate specialty training (rotating internship, surgical residency, and surgical oncology fellowship) at Colorado State University, where she currently holds a faculty position in small animal orthopedic surgery. Her clinical and research interests include cruciate disease, hip dysplasia, and minimally invasive surgery (arthroscopy). Dr. Goh has been an invited speaker and instructor at numerous conferences and surgical labs throughout the United States, supporting continuing education of veterinarians from around the world. She is also the current small animal surgery program chair for the North American Veterinary Community (NAVC).

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CONTINUING EDUCATION

Definitive Treatment of Limb Fractures With Splints or Casts

TOPIC OVERVIEW

This article describes the indications for definitive treatment of limb fractures with splints or casts and provides step-by-step application techniques for casting as well as recommendations for postapplication care and monitoring.

LEARNING OBJECTIVES

Upon completion of this article, readers should be able to:

1. List common indications and contraindications for definitive treatment of limb fractures with splints or casts
2. Describe the application technique for cast immobilization of limb fractures
3. Develop a posttreatment care and monitoring plan for a given patient

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1. **Which disruptive forces is a cast capable of resisting?**
   a. Compression and tension
   b. Compression and bending
   c. Rotation and bending
   d. Shear and tension

2. **Which of the following is/are an example(s) of a fracture configuration for which a cast may be appropriate (check all that apply)?**
   a. Incomplete ("greenstick") fracture
   b. Complete oblique fracture
   c. Fracture with an intact adjacent bone
   d. Comminuted fracture

3. **Which of the following is/are an example(s) of a fracture for which a cast may be suitable as a definitive treatment (check all that apply)?**
   a. Complete transverse fracture in a young, healthy, docile pet; >50% reduction is evident on both of 2 orthogonal radiographic views
   b. Well-reduced articular fracture
   c. Fracture of a traction apophysis (e.g., tuber calcis, tibial tuberosity)
   d. Complete transverse fracture in an elderly, fractious pet; >50% reduction is evident on both of 2 orthogonal radiographic views

4. **For which of the following would a cast not be the recommended treatment (check all that apply)?**
   a. Complete transverse fracture, <50% reduction is evident on 1 radiographic view
   b. Complete fracture in an active amputee patient
   c. Complete transverse fracture of the distal radius/ulna in a toy-breed dog
   d. Complete fracture in an elderly, fractious dog

5. **Which of the following statements regarding closed fracture reduction is correct (check all that apply)?**
   a. Closed reduction efforts may not be necessary when there is an intact adjacent bone.
   b. Reduction can usually be achieved via firm traction alone.
   c. It is often necessary to first exaggerate the fracture angulation to bring fractured bone ends in contact with each other.
   d. If the fractured ends can be brought into contact, bone segments may be used as levers to stretch the tissue on the concave side of the angulated limb segment.

6. **Which of the following statements regarding cast application is correct (check all that apply)?**
   a. Padding of bony prominences and interdigital spaces is important with casts because they are typically worn for weeks.
   b. Strips of cast padding can be placed between the digits for interdigital padding before placement of the tape stirrups.
   c. Upward traction on the tape stirrups and failure to support the fracture zone can lead to valgus malunion.
   d. A stockinette liner is helpful to prevent cast irritation.

7. **Which of the following statements regarding cast application is correct (check all that apply)?**
   a. A stockinette liner should be pulled taut by an assistant (or towel clamps/skin staples in an anesthetized patient) to prevent wrinkles.
   b. Cuffs of stockinette should extend proximal and distal to the fiberglass cast.

c. Padding of bony prominences can be performed on top of the stockinette layer.
d. Cast padding should be applied as thickly as possible to avoid cast sores.

8. **Which of the following statements regarding cast application is correct (check all that apply)?**
   a. Extreme caution should be used to avoid pulling the cast padding layer too tight.
   b. The orientation of the cast padding roll is of little consequence with regard to the ability to control the tension of application.
   c. The layer of roll gauze should be pulled as tightly as possible even if it causes constricting bands to form.
   d. A nonadherent layer between the gauze layer and the fiberglass casting tape may simplify future cast removal/bivalving efforts.

9. **Which of the following statements regarding cast application is correct (check all that apply)?**
   a. Fiberglass casting tape that feels hardened in its sealed packaging may have been spoiled by exposure to air, moisture, or temperature extremes and may not set properly.
   b. A trained assistant should support the fracture zone and hold the limb in a standing posture throughout cast application.
   c. It is not necessary to don examination gloves when handling fiberglass casting tape.
   d. The distal end of the cast should be slightly reinforced as it will experience the most wear.

10. **Which of the following statements regarding cast application is correct (check all that apply)?**
    a. Fiberglass casting tape should be pulled as tightly as possible during application.
    b. A single layer of 50% overlapped casting tape is sufficient for most dogs.
    c. Fiberglass casting tape should extend roughly 1 cm proximal to the underlying soft bandage materials.
    d. Pulling the proximal cuff of stockinette over the cast before it hardens will round its edge and create a protective cuff.

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