CANINE ORTHOPEDIC DEVICES

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Orthopedic devices can be used to supplement or replace surgical treatment of cranial cruciate ligament (CCL) insufficiency, shoulder injury, carpal and tarsal injury, hip luxation, and limb salvage with prosthetics.

Although use of orthopedic devices, including custom orthotics, braces, neoprene slings, support wraps, and prosthetics, often leads to a successful outcome, the expected outcome as well as objective and subjective outcome measurements should be discussed with the owner prior to device placement.

CRANIAL CRUCIATE LIGAMENT INSUFFICIENCY

CCL insufficiency is the most common cause of hindlimb lameness in dogs. Numerous surgical treatment options exist, but surgery is not always a possibility. Concurrent medical problems, financial concerns, or staging procedures for bilateral CCL insufficiency are all reasons for either forgoing or delaying surgical treatment.

Recently, the use of canine stifle braces has emerged as a potential therapeutic approach to managing CCL insufficiency. Studies are under way investigating whether braces are truly able to stabilize the stifle and eliminate cranial tibial thrust and internal rotation.

Human Knee Braces

Knee braces are used in human medicine to:
• Enhance proprioception/joint position sense
• Permit the injured limb to relax
• Reduce fatigue in the injured limb
• Provide some mechanical protection against impact
• Slow movement down to allow muscles time to react and control motion.

Categories of knee braces in human medicine include the following:
• Prophylactic braces prevent or reduce severity of knee injuries in contact sports.
• Functional braces provide stability for unstable knees.
• Rehabilitative braces allow protected and controlled motion during the rehabilitation of injured knees.
• Patellofemoral braces improve patellar tracking and relieve anterior pain.

Of these braces, only functional knee braces are used in veterinary medicine.

Indications

The most common indication for a canine stifle brace is CCL insufficiency, but these braces are also used for postoperative support for medial or lateral collateral ligament instability, postoperative support for patellar tendon rupture, and caudal cruciate ligament insufficiency.

Stifle braces are not intended as first-line treatment for canine CCL rupture. Preliminary reports suggest that custom-made stifle braces stabilize the stifle; however, surgery should be considered the gold standard treatment.

When deciding whether a patient would benefit from a stifle brace prior, or as an alternative, to surgery, carefully consider the following factors:
• Dog’s activity level
• Owner’s expectations
• Owner’s willingness to comply with necessary care.
• Age should never be the sole reason for
recommending against surgery. For example, an overweight 13-year-old Labrador retriever, with an acute CCL rupture, that spends most of the day recumbent and only goes outside to eliminate may be a better candidate for a stifle brace than a 13-year-old Labrador retriever in good body condition that goes on daily runs and hikes. The more active dog is better served by surgical treatment.

Types
Although numerous stifle braces are available for veterinary use, in our experience custom-made, hinged braces are the most effective. Proper construction is imperative to create a comfortable and functional brace (see Constructing a Custom Canine Stifle Brace).

While braces that are not custom-made are more affordable and easily acquired, they do not support the stifle or eliminate instability. Furthermore, if the brace is not designed to fit a specific patient, rubbing of the skin against the brace can lead to skin wounds (see Fitting & Using Custom Stifle Braces).

Mechanics
In theory, custom-made, functional hinged stifle braces remove the strain on the CCL, allowing the stifle joint to function normally and the patient to perform normal activities of daily living, which should reduce muscle atrophy.

The brace provides a set path of motion for the tibia under the femur by locking onto the long bones of the leg and preventing excessive cranial-caudal movements. Unfortunately, data proving this in veterinary medicine are lacking; furthermore, the theory of why functional hinged stifle braces work can only be applied to custom-made braces.

Constructing a Custom Canine Stifle Brace
The most important step when constructing a custom stifle brace is taking a proper cast mold of the affected limb.
- Using soft fiberglass casting, cast the limb from mid thigh to just proximal to the paw (Figure 1, page 117).
- A normal, standing angle at the stifle (approximately 130°) must be reflected in the cast as accurately as possible.
- The standing angle is most easily accomplished by either applying the cast:
  » While the patient is standing
  » With patient in lateral recumbency and the limb in a neutral position.

Once the cast is made, send it to an orthotist, who will:
1. Pour the cast with plaster of Paris to create a positive model of the affected limb (Figure 2).
2. Modify the mold to accommodate for bony prominences and sensitive areas as well as sculpt it to fit the affected limb.
3. Heat and vacuum-form foam and high-temperature thermoplastic around the mold in varying layers/designs to create the most functional custom product (Figure 3).
MEDIAL SHOULDER INSTABILITY

Medial shoulder instability is a common cause of forelimb lameness in dogs. Diagnostics and treatment options have been well documented (Figure 6).5-7 However, postoperative rehabilitation programs and nonsurgical treatment options are not well described. Depending on the severity of the instability, conservative treatment using a rehabilitation therapy program or surgical intervention followed by rehabilitation therapy may be considered.

Indications

Some surgeons and rehabilitation therapists use a commercially available neoprene shoulder stabilization system to protect the shoulder during the rehabilitation period. No published studies have compared recovery with and without a shoulder support system following medial shoulder instability surgery. However, thousands of arthroscopic procedures to address medial shoulder instability have been performed at our institution, and use of a stabilization system is considered the standard of care following arthroscopic or open medial shoulder instability repair.

Types

The shoulder stabilization system consists of removable, breathable neoprene/polyester sleeves that are placed over the shoulders of the patient and attached securely via Velcro to each forelimb.
One- or 2-inch double-sided Velcro strips serve as a hobble strap to prevent abduction of the forelimbs (Figure 7). Other shoulder stabilization devices include the shoulder spica stabilization vest (Figure 8) and Velpeau sling (Figure 9).

Mechanics
The shoulder stabilization system, which can be applied following arthroscopy while the patient is under anesthesia, limits abduction, flexion, and extension of the shoulder but allows for full weight bearing. Patients are able to bear weight immediately and adapt quickly to the device. A shoulder stabilization device can be worn continually for several months with minimal irritation and can be removed and reapplied easily for rehabilitation therapy.

CARPAL & TARSAL INJURIES
Indications
Carpal and tarsal devices have been used with both humans and dogs with hyperextension injuries, sprains and strains, and Achilles tendon disruption. Orthotic devices can be used for both nonsurgical management and to enhance postoperative management of these conditions.

FIGURE 7. A shoulder stabilization system consists of removable, breathable neoprene/polyester sleeves that are placed over the shoulders of the patient and attached securely with Velcro to each forelimb. One- or 2-inch double-sided Velcro strips serve as a hobble strap to prevent abduction of the limbs.

FIGURE 8. Patient wearing shoulder spica stabilization vest.


FIGURE 10. Neoprene carpal support wrap with thermoplastic for additional support.

FIGURE 11. Patient that sustained a bilateral Achilles tendon rupture secondary to trauma wearing bilateral controlled, range-of-motion, hinged tarsal braces.
Types
Device options include:
• Support wraps, with or without thermoplastic (Figure 10)
• Custom braces
• Hinged braces (Figure 11).

Mechanics
Depending on the injury and recommended treatment plan, many of these devices can be designed to allow dynamization of the tissues over the recovery period, which gradually increases forces on the tendons and stimulates healing. Patients can also be transitioned to a less cumbersome device during the recovery period to support healing.

Fitting
When the device arrives, schedule a fitting appointment, following the same parameters as for CCL braces (see Fitting & Using Custom Stifle).

Braces; Figure 12). In addition, wraps and braces used for the carpus and tarsus need to be snug to be effective, but not so tight that the toes swell. If the toes swell, the brace should be removed for a few hours until the swelling resolves. Massaging the toes helps the swelling subside. If excessive sweating is noted, talc powder may be used to help keep the skin and device dry.

HIP LUXATION
Ehmer slings are commonly used in dogs to protect the hip following conservative or surgical treatment of coxofemoral luxation.4 Ehmer slings are not easily removed and reapplied, limiting the ability to perform rehabilitation therapy. In addition, Ehmer slings commonly cause secondary skin irritation and abrasions.

An alternative is the vest with Ehmer sling, a custom form-fitting sling that allows for proper positioning and immobilization, while enabling access for rehabilitation therapy (Figure 13). This sling is manufactured using a fabric that is stretchable, breathable, antimicrobial, and bactericidal.
Indications
Neoplasia and severe trauma are common reasons for amputation; however, giant breeds or dogs with concurrent orthopedic disease may respond poorly to amputation.3 Forelimb (Figure 14, page 121) and hindlimb (Figure 15) prostheses offer an alternative to full-limb amputation. To be a candidate for a prosthetic, a partial limb amputation must be performed (see Prosthesis Success).

Types
Multiple types of prosthetics are available for veterinary use. Every external prosthesis requires some type of suspension system to keep it from falling off the residual limb. Suspension systems may include:
- Self-suspension of the socket, which makes use of the anatomic shape of the residual limb (knee disarticulation) (Figure 16)
- Suction suspension, which includes the use of an appropriate suction socket design of a gel suspension liner (Figure 17)
- Suspension devices or harnesses, such as belts, cuffs, wedges, straps, and sleeves.

Osseointegrated prosthetics have also become available recently for use in dogs. Osseointegration involves threading the prosthesis onto a titanium bolt, which is implanted into the bone of the residual limb and protrudes through the skin. Use of these devices is still currently under investigation.3,9

Construction
Similar to braces, the most important step when constructing a prosthesis is making a proper cast mold of the affected limb (see Constructing a Custom Canine Stifle Brace). In addition, padded sockets are often needed to create a more intimate fitting device.

Prosthesis Success
A recent study in humans showed that the level of amputation is a critical factor in prosthesis success. Patients in this study had better outcomes when the amputation was performed distal to the carpus or tarsus.3 However, this is not always practical. Ideally, the elbow and tarsus should be spared.

Surgical technique is also thought to have a significant impact on the success of prostheses.3 Correct incision placement, proper soft tissue technique, and meticulous management of nerve and vascular structures are vital to achieving a successful outcome.3 Thus, consultation with a small animal veterinary surgeon is recommended. However, both surgeons and general practitioners are instrumental in the postoperative management of the patient outfitted with a prosthetic.
The shank and feet are created from aluminum, steel, carbon fiber, or wood, depending on the size and activity level of the animal. A “rocker bottom” foot is very commonly used to mimic the normal gait cycle (see Figure 14). The shank/foot is aligned under the weight line and abducted 5° for contralateral limb clearance. A toe out of about 5° to 7° is also added for stability and to allow for lateral movement.

Fitting
When the prosthesis arrives, schedule a fitting appointment to show the client how to put on and remove the device. The device should be kept snug because a loose fit will result in friction and skin irritation.

Prosthetic devices should be worn in short, increasing increments in order to build up a tolerance to them. Both the length of the break-in period and the time of each increment depends on the patient's diagnosis. For best results, it is recommended to place the prosthesis on the patient for only 30 minutes the first day, increasing by 30 minutes each day.

A short, but variable, period of time is often required before the patient accepts and becomes accustomed to the device. To help facilitate acceptance, the device should be associated with positive reinforcement.

Follow-Up
A re-evaluation appointment is recommended 2 weeks after the fitting appointment to ensure that there are no problems or concerns. It is not uncommon to see minor problems within the first few weeks.

Either the veterinarian or orthotist, depending on the needed modifications, can easily adapt the prosthesis to relieve any areas of irritation. It is also important to inspect the device regularly for any cracks or tears. Padding and Velcro can be replaced at re-evaluation appointments as needed.

Care
1. Cleaning: It is important to keep both the orthosis/prosthesis and the skin in contact with the device clean; this reduces the risk for contact dermatitis or other skin conditions. The device should be cleaned regularly using a 1:1 mix of

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>TYPE OF DEVICE</th>
<th>MANUFACTURERS (Partial List)</th>
<th>AVERAGE COST (Prices May Vary by Manufacturer)</th>
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<tr>
<td>Cranial cruciate ligament insufficiency</td>
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<td></td>
<td></td>
<td>Hero (goherogo.com)</td>
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<td>Medial shoulder instability</td>
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<td>DogLeggs (doglegs.com)</td>
<td>$200–$300</td>
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<td>Shoulder spica stabilization vest</td>
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<td></td>
<td>Velpeau sling</td>
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<td>Carpal and tarsal injuries</td>
<td>Support wrap (+/- thermoplastics)</td>
<td>Prefabricated orthotics:</td>
<td>Prefabricated orthotics:</td>
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<td>Hip luxation</td>
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<td>Limb salvage</td>
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<td>Ortho Pets (orthopets.com)</td>
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water and alcohol and a clean towel. The device should be towel dried or allowed to dry at room temperature. Hair dryers and clothes dryers should not be used.

2. **Dampness:** Cotton socks are often used to help with excessive sweating and to keep the device clean. A wet brace or cotton stockinet should never be placed on the patient in order to prevent rub sores. Some devices can be worn in the water, but this should be clarified with the orthotist first.

3. **Skin:** It is of extreme importance that the patient's skin is inspected thoroughly after every use, especially during the break-in period. Skin redness that does not disappear within 20 minutes or evidence of skin breakdown is a sign of excessive pressure.

   Instruct the client to discontinue use of the device for a full day if irritation or skin breakdown is noted. Clients should also note any unusual marks on the skin, blisters, or excessive wearing of the device. If any of these conditions present themselves, use of the device should be discontinued and the client should contact the veterinarian immediately.

**IN SUMMARY**

Although many orthopedic devices are available (Table, page 123), it is important to note that they alone are not always the silver bullet; rehabilitation is usually required in addition to device use.

- Proper fit and appropriate use of the device are equally important to achieving a successful outcome.
- Re-evaluating each patient after fitting a device ensures that the patient is comfortable and the device is effective.
- Frequent device adjustments may be needed within the first 2 to 4 weeks if the patient is having difficulty with the device. Depending on the adjustment required, this may be performed by the owner, the veterinarian overseeing the device or prosthetic, or the orthotist.
- Owner compliance is very important when using any of these devices. Owners should be properly educated on applying and using the device properly.

CCL = cranial cruciate ligament
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References