Use of commercially available foam pipe insulation as a protective device for wounds over the elbow joint area in five dogs

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Case Description—4 large-breed dogs were referred because of nonhealing skin wounds involving the elbow joint area of several weeks to months in duration. One additional large-breed dog was evaluated because of a draining abscess with overlying skin necrosis.

Clinical Findings—Previous attempts at closing each wound over the elbow joint area had been unsuccessful. At the time of hospital admission, open wounds had variable degrees of bacterial contamination and infection.

Treatment and Outcome—Open wounds over the elbow joint area were closed by use of bipedicle advancement flaps or direct suture apposition of opposing sides of the wound. Lengths of pipe insulation were applied to the forelimb in a fashion to prevent contact pressure to the olecranon for a prolonged period (4 to 13 weeks) after surgery. All wounds healed completely. Release incisions (donor areas) healed by second intention within 3 weeks after surgery. One dog developed periostitis of the olecranon, which responded to antimicrobial administration. A second dog developed a skin bacterial infection below the surgical area that was markedly resistant to antimicrobials.

Clinical Relevance—The layered application of commercially available foam pipe insulation provided a simple and economical protective device after closure of problematic skin wounds involving the elbow joint area. Prolonged protection of the olecranon area helped to assure healing was complete and skin coverage was sufficiently stable to reduce the risk of reinjury after removal of the device. Each patient was able to use the involved forelimb during the treatment period. Paired bipedicle advancement flaps (release incisions) were particularly useful for closing small to moderate defects overlying the olecranon in which simple apposition was not feasible. (*J Am Vet Med Assoc* 2011;239:1225–1231)

From October 2007 to September 2009, 5 large-breed dogs were referred to Angell Animal Medical Center with wounds overlying the olecranon area. Wound duration varied from several days to several months. Two former racing Greyhounds (dogs 1 [4-year-old spayed female] and 2 [11-year-old neutered male]) were adopted by the owners with elbow ulcerations. One wound in a German Shepherd Dog (dog 3 [1.6-year-old neutered male]) was the result of dehiscence after removal of a large calcinosis circumscripta lesion with subsequent bacterial infection. One dog was an obese Irish Wolfhound (dog 4 [7.8-year-old spayed female]) that had an abscess over the elbow joint area, resulting in partial necrosis to the skin overlying the caudolateral aspect of the olecranon. A traumatic elbow ulceration in a Golden Retriever (dog 5 [9.8-year-old neutered male]), initially closed with a thoracodorsal axial pattern flap, developed focal necrosis of the terminal flap margin overlapping the olecranon after surgery; subsequent attempts at resolving the wound over a 6-month period were unsuccessful.

Three dogs (dogs 1, 2, and 3) had an ulcer over the olecranon; ulcers were extensively debrided and closed with lateral and medial bipedicled advancement flaps. Release incisions were created in the natural depressions caudal to the lateral and medial epicondylar prominences, followed by dissection deep to the dermis to include underlying subcutaneous tissues, thereby reducing trauma to the cutaneous circulation. Opposing margins of each bipedicled flap were sutured with 3-0 monofilament nylon[a] in a vertical mattress suture pattern that was alternated with a simple interrupted suture pattern. The open release incisions (donor sites) provided adjacent drainage from beneath the apposed flaps (**Figures 1 and 2**). After surgery, topical antibiotic ointment[b] applied to a nonadherent dressing[c] was placed over the surgical area, followed by a thin layer of soft roll cotton,[d] elastic gauze,[e] and a short strip of 1-inch-wide surgical tape.[f]

Initial treatment of dog 4 with a ruptured abscess over the elbow joint area included surgical debridement of necrotic tissue followed by wound lavage. A swab specimen of the abscess cavity was submitted for bacterial culture. A 0.05% chlorhexidene[g]-saline (0.9% NaCl) solution wet-to-dry dressings were applied to the wound and were changed twice daily for 4 days. This was followed by application of a topical dressing and bandage as described for dogs 1 through 3 and changed on a daily basis. With formation of a healthy granu-

Abbreviation

PIPE	Pipe insulation protector for the elbow joint area

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Figure 1—Photograph of a nonhealing dehiscence in the elbow joint area secondary to resection of a large calcinosis cutis lesion in a German Shepherd Dog (dog 3).

lation bed 7 days later, the wound was closed by use of direct apposition with 2-0 monofilament nylon in a vertical mattress suture pattern that alternated with 3-0 monofilament nylon in a simple interrupted suture pattern. A 1/4-inch-wide Penrose drain[h] was inserted into the cavity through a ventral stab incision prior to completion of the surgery. The wound was again covered with the previously described dressing and bandage.

Dog 5 had a chronic nonhealing wound overlying the olecranon for approximately 6 months secondary to necrosis of the terminal portion of a thoracodorsal axial pattern flap used to close the original skin defect. After debridement of the wound, the remaining flap was partially elevated and again advanced over the olecranon. A series of interrupted intradermal sutures were placed with 3-0 absorbable suture material[i] to appose the flap margin to the distal skin margin of the defect. This was followed by placement of alternating 2-0 monofilament nylon in a vertical mattress suture pattern and 3-0 monofilament nylon in a simple interrupted suture pattern as a means to offset mild skin tension at the closure site. A 1/4-inch-wide Penrose drain exited lateral and medial to the flap closure, adjacent to the lateral and medial epicondylar areas. A dressing was applied to the surgical area after surgery as described in patients 1 through 4.

At the time of completion of surgery, the PIPE was applied (**Figure 3**) to manage the wound of each dog. Segments of 1-inch–inner-diameter pipe insulation[j] were cut with scissors; an inner layer was measured for placement below the elbow joint to the metacarpophalangeal

Figure 2—Photographs of release incisions on the medial (left image) and lateral (right image) aspects of the nonhealing wound of the dog in Figure 1. Closure of the defect over the elbow joint involved bilateral bipedicle advancement flaps after the chronic ulcer was resected.

joint, and a second longer outer layer was measured for placement over the uppermost level of the olecranon to the metacarpophalangeal joint. Excessively long hair was trimmed off the forelimb with an electric clipper.

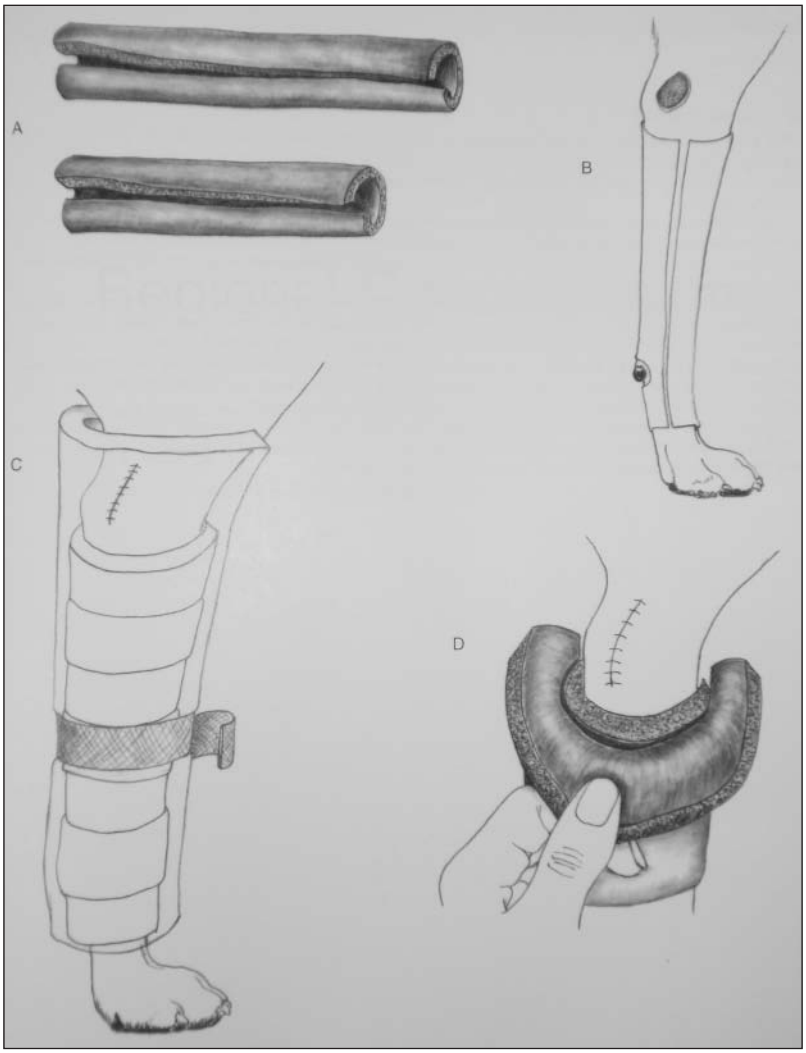

Figure 3—Illustration of the application of the PIPE. A—Preparation of 2 pieces of pipe insulation.[j] The shorter internal piece is made for placement below the flexion surface of the elbow joint area to the metacarpophalangeal joint. The longer outer segment is made to extend from the metacarpophalangeal joint and overlap the entire elbow joint; it is cut to comfortably overlap the entire olecranon, extending approximately 2 to 3 inches (5 to 8 cm) proximally. B—Application of surgical tape[f] to the forelimb. Strips of 2-inch-wide surgical tape are applied to the forelimb in a vertical fashion. For dogs with long hair, removal of the hair is recommended. The parallel strips of tape begin below the flexion surface of the elbow joint area and extend down to the metacarpophalangeal joint. Tape placement over the accessory carpal pad is avoided. This layer of tape forms a friction surface for application of the pipe insulation and elastic tape strips.[k] C—Application of pipe insulation segments. The inner segment is cupped around the extremity. The open split of the insulation is positioned over the cranial surface of the forelimb. A thin plastic strip is removed from the insulation adhesive that covers the split border of the insulation. Strips of elastic tape are used to secure the pipe insulation to the exposed surgical tape overlying the cranial aspect of the forelimb. Contact of the elastic tape with the surgical tape prevents the pipe insulation from slipping. The outer layer of insulation is secured to the exposed surgical tape in a fashion similar to the first layer. Excess tape application over the carpus is avoided to maintain forelimb mobility. D—Overlapping protection provided by the proximal end of the outer layer of the pipe insulation segment. The proximal end of the foam insulation, which forms an overlapping shield for the elbow joint, is temporarily folded down to change dressings. Once released, the foam insulation is able to spring back to its original position for protection. (Adapted from Pavletic MM. Plate 9: pipe insulation protective device. In: Pavletic MM, ed. *Atlas of small animal wound management and reconstructive surgery.* Ames, Iowa: Wiley-Blackwell, 2010;230–231. Reprinted with permission of John Wiley & Sons Inc.)

Strips of 2-inch-wide surgical tape were applied to the length of the forelimb to be subsequently embraced by the inner layer of the insulation. Both pieces of pipe insulation were applied as longitudinally open tubes; they were cupped around the caudal aspect of the leg to assure proper coverage of the surgical site. The open aspect of the pipe insulation ran along the cranial aspect of the forelimb. Segments of adherent elastic tape[k] were wrapped circumferentially around the pipe insulation to secure both the inner and outer layers of insulation to the layer of surgical tape exposed between the longitudinal edges of the pipe insulation segments. An additional, shorter third segment of pipe insulation was applied below the level of the elbow joint in dog 4 (the large overweight Irish Wolfhound) for added protection of the olecranon area.

Following application, the overlapped segment of the outer layer of pipe insulation was temporarily folded down to facilitate application of the wound dressing and thin absorbent bandage layer in the slot provided above the first layer of pipe insulation. The premedicated, nonadherent dressings were applied over the surgical site; 2 or 3 revolutions of soft roll cotton were wrapped around the elbow region, followed by 2 revolutions of self-adherent gauze. One short strip of 1-inch-wide surgical tape was used to secure the cut edge of the gauze; the strip was placed over the lateral surface of this thin bandage, but never over the olecranon area.

The outer cotton-gauze wrap was always placed loosely over the dressing to prevent abrasion or compression over the olecranon area. This bandage layer was always kept narrower than the gap created by the overlapping pipe insulation. Dressings were changed daily over the first week and every other day thereafter until healing was complete. Penrose drains were removed 72 hours after surgery. Follow-up was performed for 6 months after closure of the wound over the elbow joint area.

The entire PIPE was changed every 3 weeks to correct loosening of the layers and offset partial compression and collapse of the foam cells from repeated impact on the material when the dogs reclined on their bedding. The loosening tape foundation was removed manually from the skin and hair; the skin was cleaned with surgical soap and water or with saline solution to remove topical debris. Any slight staining of the skin from the black pipe insulation was largely removed during this cleansing

process. The forelimb was dried with absorbent towels prior to reapplication of the tape foundation and new layers of pipe insulation. The PIPE was used for a total of 6 to 13 weeks in 4 dogs (patients 1, 2, 3, and 5) after wound closure; it was used for 4 weeks in the Wolfhound (patient 4) after closure of the abscess cavity. Owners were instructed to keep the PIPE clean and dry and to inspect the toes for potential swelling after each application.

Dog 1 received amoxicillin with clavulanic acid (10 mg/kg [4.5 mg/lb], PO, q 12 h) after surgery for 1 month. Within a week after antimicrobial treatment was discontinued, unexpected incisional drainage was observed. Radiographic findings revealed periostitis of the olecranon. Antimicrobial treatment was continued for an additional month. Follow-up radiography confirmed resolution of periostitis. Dog 2 empirically received amoxicillin with clavulanic acid (10 mg/kg, PO, q 12 h) after surgery for 6 weeks. In dog 3, *Enterobacter cloacae* was isolated from the infected ulcer before surgery; the organism was susceptible to enrofloxacin. Therefore, dog 3 received enrofloxacin (10 mg/kg, PO, q 12 h) for 4 weeks after surgery. Amoxicillin with clavulanic acid (10 mg/kg, PO, q 12 h) treatment was initiated after surgery in dog 4, pending bacterial culture and antimicrobial susceptibility results. Multiple microorganisms were isolated from the abscess cavity of dog 4 (4 strains of *Escherichia coli*, *Staphylococcus haemolyticus*, and *Streptococcus mutans*); enrofloxacin (10 mg/kg, PO, q 12 h) was administered for 4 weeks and resulted in a successful treatment. Dog 5 received amoxicillin with clavulanic acid (10 mg/kg, PO, q 12h) after surgery over a 6-week period. Within 2 weeks of discontinuing antimicrobial treatment and the removal of the PIPE, the owner noticed development of a small abscess below the original surgical closure. Three highly resistant strains of bacteria were isolated from the abscess (*Staphylococcus aureus*, *Staphylococcus intermedius*, and *Enterococcus faecalis*). On the basis of antimicrobial susceptibility test results, dog 5 was treated with gentamycin (4 mg/kg [1.8 mg/lb], SC, q 12 h) for 5 days, followed by chloramphenicol (25 mg/kg [11.4 mg/lb], PO, q 8 h) and rifampin (5 mg/kg [2.3 mg/lb], PO, q 24 h) over a 10-day period. Because of a poor response to treatment, the owner elected to have the forelimb amputated. The owner of dog 5 indicated she had difficulty preventing her dog from repeatedly crawling beneath her bed onto the oak flooring after removal of the PIPE. How this may have contributed to the problematic bacterial infection that later occurred is unknown.

Each closure healed in these 5 large-breed dogs. The use of release incisions (thereby creating dual bipedicle advancement flaps) in the small depressions caudal to the medial and lateral epicondyles (dogs 1 to 3) created open donor wounds after apposition of each bipedicled flap. Under the basic topical wound care described, these surgical wounds healed remarkably well by second intention within 3 weeks after surgery.

All dogs tolerated use of the PIPE and were able to walk normally. Each owner complied with the use of soft bedding as added protection to the elbow region and were encouraged to continue with its use after final removal of the PIPE. With the exception of dog 5, all elbow joint areas were healed when the owners were contacted 6 months after surgery.

Discussion

Difficulties in closing skin wounds overlying the olecranon in dogs are largely due to this region's susceptibility to repeated impact and compression. This is particularly evident in large-breed dogs, whose body weight can enhance these 2 factors. Wounds in this region may be secondary to external trauma, prolonged compression of the skin with tissue ischemia (pressure sores), bacterial infection and abscessation, or dehiscence secondary to resection of diseased or damaged skin. Debilitated dogs are more prone to pressure-sore formation secondary to prolonged recumbency in a single position. Once pressure sores are formed, long-term resolution can be problematic without optimum nursing care.

Closure techniques for wounds over the elbow joint area include healing by second intention, simple appositional closure of the wound, local skin flaps, axial pattern flaps, myocutaneous flaps, distant direct flaps, and skin grafts.[1] Each option has advantages and disadvantages. Healing by second intention, for example, can be prolonged or futile; should healing occur, the epithelialized scar may lack the long-term durability required during daily activities, especially in larger dogs. Direct apposition requires sufficient skin laxity to offset postoperative tension or distraction forces. Closure of wounds under moderate tension over the olecranon will increase the probability of wound dehiscence, especially with active motion of the elbow joint region. Tension-relieving techniques may be useful under these circumstances. Simple local skin flap techniques can effectively close problematic wounds unsuitable for simple appositional closure. Local flaps are comparatively easy to perform, providing full-thickness skin coverage with a variable amount of subcutaneous tissue to provide some cushion between the olecranon and the flap's overlying dermal surface. Axial pattern flaps (in particular the thoracodorsal axial pattern flap) and myocutaneous flaps (including the latissimus dorsi or cutaneous trunci myocutaneous flaps) are normally reserved for the larger problematic wounds over the elbow joint area. The underlying subcutaneous tissues or muscle layer of these large flaps can provide a thicker cushion of tissue over the olecranon, adding protection against direct impact forces over this bony prominence. Distant direct flaps can be used for wound closure but are more labor-intensive to execute, requiring prolonged immobilization of the affected forelimb to the trunk of the patient during the healing and transfer process. Skin grafts, devoid of an underlying subcutaneous layer during their preparation, usually lack the durability required for permanent wound closure over the elbow prominence of larger dogs.[1]

Successful closure of these cutaneous defects normally includes a variable period protecting the area from external disruptive forces. A variety of external protective techniques, commercially available protective devices, and bedding materials have been advocat-

ed to both prevent trauma to the elbow joint region and promote the closure of problematic skin wounds. They include external splints and spica bandages, Schroeder-Thomas splints, braces to prevent elbow joint flexion, doughnut rings (comprised of cotton or short segments of pipe insulation), and soft bedding, including sheepskin and foam mattresses.[1–6] Soft bedding is usually used as a form of supplemental protection of the olecranon area, rather than a primary method of managing wounds over the elbow joint area. Soft bedding, however, is a useful adjunct in preventing reinjury to healed wounds over the elbow joint area. Wound care includes keeping the incision clean and dry as well as managing any bacterial infection involving this region. In open wound care, changes in dressings are largely dictated by the products used, presence or absence of bacterial infection, state of the wound, and volume of discharge.[1–5]

Each of the current protective devices noted has its own advantages and limitations. The elbow joint area is not ideally suited to doughnut rings, the use of which in protecting bony prominences (for management and prevention of pressure sores) is questionable.[1] While circular rings of padding (doughnut rings) can help protect a bony prominence from impact and compressive forces, the ring itself redistributes pressure on the peripheral skin essential to the healing process.[1] Securing a padded ring also has its own set of challenges. A reported variation of the doughnut ring technique was the use of a short segment of pipe insulation with a central hole created to protect a flap after closure of an olecranon wound. The length of insulation provided a surface for tape application over the elbow joint area.[7]

Rigid splints and braces have the undesirable effect of impairing use of the affected forelimb as they minimize motion and incisional tension postoperatively. These patients normally have difficulty elevating the extended forelimb during ambulation: in most cases, the patient will simply drag the immobilized forelimb as it walks. Maneuvering through doorways, up or down stairs, and around household furniture can be difficult. As a result, owners usually need to lift and assist their dog to stand and walk to a variable degree. This can be problematic for many owners of heavy dogs. Prolonged forelimb immobilization, in turn, promotes muscle atrophy and negatively affects circulation to the immobilized extremity. Schroeder-Thomas splints and reinforced spica braces do require periodic reassessment and adjustment during their application. Long-term use and replacement of these external splints, combined with local wound care through an access window in the bandage, can be labor-intensive and cumulatively expensive.[1]

Collagen deposition occurs during the proliferative phase of healing.[1,4] During healing over a bony prominence, collagen deposition forms between the surface of the bony prominence and the skin used to cover the recipient wound bed. During this proliferative phase (day 5 to approx 17 to 20 days),[1,6] skin can be initially affixed to the olecranon until collagen remodeling is initiated during the maturation phase of healing (day 17 to 20 to anywhere from 1 to 2 years).[1,6] Initial collagen deposited in the wound and resorbed as new collagen is remodeled in a more superior basket weave design.[1] This remodeling process likely accounts for the skin's improved ability to shift over this bony prominence to a variable degree over time.

The author believes that skin used to cover the olecranon is especially susceptible during this proliferative phase of healing: impact or prolonged compression of the relatively immobile skin increases the possibility of focal skin necrosis. Moreover, the blood supply to the skin, in the early stages of healing, may be marginal. Prolonged protection of the elbow region into the maturation phase of healing may be of special importance in the large dogs. It is the author's opinion that prolonged protection is advisable until inflammation subsides and collagen remodeling is initiated. Skin sutures are normally removed during the proliferative phase of wound healing. However, this may not be the ideal time to abandon protection of the elbow region.

Normal skin will shift to a variable degree when pressed with the index finger tangentially. In some cases, the skin is initially immobile as a result of early connective tissue deposition between the underlying periosteum of the olecranon and dermal and subcutaneous tissues. This skin, affixed to the prominence, cannot shift to any degree and is susceptible to compressive trauma without prolonged external protection as described. During the maturation phase of healing, collagen remodeling occurs. The skin will begin to resume its natural mobile relationship with the underlying tissues. Prolonged protection also allows for the regional circulation to improve during the remodeling of the collagen matrix.

As noted, protection of the surgical areas was maintained into the maturation phase of wound healing. In these patients, the final decision to discontinue the use of the PIPE was determined by the visual resolution of inflammation at the surgical area, the return to the natural mobility of the skin covering the olecranon, and the presence of early hair growth. In general, the author would suggest the use of the PIPE for a minimum of 6 weeks postoperatively to protect surgical closures directly overlying the olecranon.

The author has found the use of dual bipedicle advancement flaps to be a valuable technique for closure of small to moderate problematic ulcers overlying the olecranon, as observed in dogs 1 to 3. Closure options in dogs 4 and 5 were dictated by the local availability of sufficient skin to facilitate direct or linear closure of these 2 wounds. Technically, it is undesirable to close a wound overlying a bony prominence with the incision directly over this structure.[1] The scar that forms after incision is clearly weaker than intact skin. In the management of pressure sores in humans, it is preferable for the body of the flap to envelope the bony prominence, leaving the suture line along its perimeter.[1] Despite this, the bipedicle flap closure was sufficiently durable to resist breakdown from the daily activities of these dogs. There may be merit to the parallel relationship of the bipedicle flaps and the linear skin tension over the olecranon. Hair growth over time can provide additional protection to the skin used to resurface the area.

The skin of Greyhounds is recognizably thinner than the skin of several other canine breeds, and a more cautionary approach is taken by the author when man-

aging wounds of this breed, especially over the elbow joint area. A relative lack of subcutaneous fat may also contribute to the skin's susceptibility to compressive trauma. Despite this, each of the Greyhounds of the present study did well.

Pipe insulation is used by plumbers and homeowners to insulate water pipes from freezing. There are a few varieties available at hardware stores. Black plastic foam pipe insulation[j] is a soft, light, flexible foam with a linear split to facilitate its application around a pipe. The split edges have a self-adherent adhesive, allowing the insulation to completely encase a pipe upon application. Pipe insulation comes in economical 6-foot lengths to cover copper pipes of 1/2-, 3/4-, and 1-inch diameters. Insulation lengths used to encase 3/4- and 1-inch pipes are the most appropriate sizes for medium to large dogs. With a cost of approximately $1/foot, pipe insulation is cheap and economical to apply. This very light and flexible material enables the dog to use the forelimb unimpeded, comfortably, and with a foam density suitable for protecting the olecranon area as described.

Applying the pipe insulation from the elbow joint to the metacarpophalangeal joints as described provided a long surface area to secure this device, thereby preventing its displacement. Moreover, when the dog is recumbent, the pressure exerted by the weight of the patient against the floor or bedding is better distributed over the length of the pipe insulation below the olecranon, especially to the shorter inner segment of insulation. The outer layer provides added elevation of the olecranon from the floor and bedding when the dogs recline. Overlapping the olecranon with the second insulation strip provides a foam shield to the surgical area while creating an open slot for the application and security of a dressing and light bandage. It is critical that the bandage be thinner than the slot or gap provided: thick bandages would actually focus pressure on the olecranon when the patient reclines. It is also important to apply the cast padding and outer gauze wrap loosely, avoiding any stretching of the materials during their application. This minimizes the risk that the bandage material will bind and rub the skin overlying the olecranon. In giant breeds, it may be advisable to apply an outer tertiary layer of foam insulation, approximating the length of the first foam layer. This can provide added elevation of the olecranon from the floor or bedding during recumbency. When protecting wounds lateral to the olecranon, the pipe insulation can be rotated on the forelimb for optimal protection of the area prior to application of the elastic adhesive bands.

As discussed, both spica splints and the Schroeder-Thomas splints provide relatively effective immobilization of the elbow joint, but with the unfortunate loss of forelimb usage. Their use could be considered, at least initially, if there is substantial skin tension on the incision after wound closure. After incisional healing, the PIPE could be used to replace the splint when prolonged protection of the olecranon area is indicated. In the 5 dogs of the present study, tension after wound closure was not excessive. The bipedicle flap closure, in particular, may be useful for the olecranon since the length of the flap and incision created by conjoining the opposing flap borders are parallel to the lines of tension generated in the area.

Bacterial culture of swab specimens from the deeper layer of chronic wounds and radiographic evaluation of the olecranon are prudent to assess the area for periostitis and select the most appropriate treatment with antimicrobials. In dog 1, wound drainage from the incision line could have been mistaken for problematic healing of the soft tissues rather than the actual cause, which was an unresolved periostitis. The decision of the owner of dog 5 to have the dog's forelimb amputated underscores the difficulties associated with the management of a highly resistant bacterial infection. The cumulative expenses from the inception of the ulcer finally prompted the owner to resolve this problematic elbow joint area by forelimb amputation.

Veterinarians should exercise caution when considering the surgical removal of diseased skin overlying the olecranon area. Postoperative dehiscence can result in a problematic wound that can be frustrating to resolve. It would be prudent to consult with a surgeon experienced with this rather problematic area before undertaking major surgical procedures involving the substantial loss of skin. The thick protective skin callus seen in many dogs is best preserved whenever possible.

In conclusion, closure of wounds overlying the olecranon area can be a rather daunting task. The bipedicle advancement flap technique can be useful in the closure of small to moderate wounds overlying the olecranon, when simple appositional techniques cannot be effectively used. The PIPE as described in the report of this study can provide a useful means of protecting the elbow joint area for several weeks after wound closure. Prolonged protection provides time for collagen remodeling to occur and circulation to the overlying cutaneous coverage to improve. This economical, lightweight, and highly flexible material enables the dog to use the forelimb unimpeded while providing an effective barrier to external trauma for prolonged periods. If immediate postoperative tension is a concern, short-term immobilization of the elbow joint area can be followed by application of the PIPE for long-term support as healing progresses. Dressing and bandage changes are easy for the dog owner to perform after basic instructions regarding their proper application. The slot provided by the overlapping inner layers of insulation creates a convenient niche for their application while providing a barrier to maintain the position of the dressing and soft cotton wrap over the surgical site.

a. Monosof, Tyco Healthcare Group LP, Norwalk, Conn.
b. Triple antibiotic ointment, G&W Laboratories Inc, South Plainfield, NJ.
c. Adaptic, Johnson & Johnson, Skipton, North Yorkshire, England.
d. Specialist cast padding, BSN Medical, Hamburg, Germany.
e. Conforming stretch gauze, Webster Veterinary Supply, Sterling, Mass.
f. Zonas porous tape, Johnson & Johnson, Skillman, NJ.
g. Dermachlor solution, Butler Animal Health Supply, Dublin, Ohio.
h. Latex Penrose tubing, Argyle, Tyco Healthcare Group, Mansfield, Mass.
i. PDS II, Ethicon, Somerville, NJ.
j. Armacell Self-Seal pipe insulation, Home Depot, Atlanta, Ga.
k. Elasticon elastic tape, Johnson & Johnson, Skillman, NJ.

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