EMPHASIS:
In several previous articles, we have discussed stabilization of comminuted long bone fractures using external skeletal fixation. In such cases, interfragmentary fixation is often difficult and may cause devitalization of the fragments; buttress plating may not give sufficient support. External fixation is an excellent choice for this type of fracture. The tibia is particularly suited to this technique, due to the ease of placing a type II (full pin) fixator.

In this paper, we will discuss external skeletal fixation of tibial fractures.

PREOPERATIVE DIAGNOSIS:
1. Complete physical examination.

AXIOM: Identify all other orthopedic injuries.

AXIOM: Be sure to document that there are no neurologic deficits on the involved limb.


3. Radiographic examination:
   a). Two view radiographs of the tibia.
   b). Two view radiographs of the thorax and abdomen, in cases where blunt trauma is suspected.

Figure 1: This schematic drawing depicts a dorsal view of a right comminuted tibial and fibular fracture. The hypodermic needle delineates the proximal aspect of the distal segment. The leg is badly swollen. The leg is suspended and stretched to normal length before rigid fixation.

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PREOPERATIVE CARE:

1. Indwelling cephalic catheter.
2. Intravenous anesthetic induction protocol (Ketamine/Valium, Propofol, etc.)
3. Endotracheal intubation and inflate cuff.
4. Isofluorane inhalant anesthesia to effect.
5. Lead II ECG and pulse oximetry monitoring during prep and surgery.
6. Clip and prepare the limb circumferentially.
7. Cefalexin 20 mg/kg IV immediately preoperatively.

8. The leg may be suspended, to assist in aligning the fracture ends.

SURGICAL TECHNIQUE:

1. Make a stab incision at the first pin entry site.
2. Drive the pin through the near and far cortices.
3. Make a stab incision to allow the pin tip to exit the skin.
4. Drive the pin further, so that the central threads engage both cortices and the pin end is far enough from the leg to permit attachment of the connecting bar (See Figure 2).
5. Repeat the above steps for all subsequent pins.

AXIOM: By creating a full-pin external fixator (i.e. with a connecting bar on the medial and lateral side of the limb), stability is increased and the risk of implant loosening is reduced, compared to a half-pin configuration.

AXIOM: Low-speed power insertion of the pins is advised; high speed power causes more thermal necrosis at the pin entry site, while hand-chuck placement results in slightly looser pin stability.

AXIOM: If possible, 3 or even 4 pins should be placed in each fracture end, for better stability.

AXIOM: The pins should be placed no closer to the fracture line than a distance equal to half the bone diameter.

AXIOM: If clamps and connecting bars are to be used, it is important that all pins be placed in the same plane. Commercially available aiming devices can be used to facilitate this. This is not necessary if methylmethacrylate is used. For smaller patients, we find that using methacrylate to link the pins is the easiest method.

AXIOM: The pins should be spaced over the entire length of the fragment, rather than close together (See Figure 3).

AXIOM: Central-threaded pins will resist pull-out better than smooth pins. However, if 3 to 4 pins are placed in each end of the tibia, even smooth pins will generally not loosen.

AXIOM: Particularly if smooth pins are used, the pins should be placed at angles relative to each other. If they are parallel, the risk of implant pull-out is increased.

6. With the leg held in full extension and anatomic alignment, apply methylmethacrylate to create a rigid connecting bar on each side (See Figure 4).
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DANGER:
Keep the methacrylate at least 1 cm away from the skin level (2 cm in larger patients); otherwise post-op swelling may press the skin against the methacrylate (or connecting bar/clamps) resulting in pressure sores.

POSTOPERATIVE CARE:
1. Postoperative 2-view radiographs of the tibia.
2. Postoperative antibiotic therapy (Cephalexin 20 mg/kg PO TID for 5 days).
3. Pain management using oral, injectable, or transdermal analgesics.
4. Strict confinement during the next 8 weeks.
5. Recheck 14 days postoperatively.

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Figure 3: This schematic drawing depicts: A) Proper placement of pins over the full length of the bony segment with divergent angles. B) Improper placement of pins. They are too close together, they do not cover the entire segment of bone, and they do not have divergent angles.

Figure 4: These schematic drawings depict the advantage of using two vise grip pliers to bend the pins. A) When bending the pin, the use of two vise grip pliers prevents a leverage force being exerted at the bone-in interface. B) When only one plier is used to bend the pin, a slight leverage force is exerted at the bone-pin interface that may cause a fissure fracture. C) The pins have been bent and the methylmethacrylate has been applied giving rigid fixation.

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6. Postoperative radiographs at 4 to 6 week intervals until the fracture is healed.

7. Implant removal once there is radiographic evidence of bone union.

PROGNOSIS:
Optimistic, with the great majority of patients returning to excellent weight bearing.

AUTHOR’S NOTE
If you have any questions concerning this paper, additional references, surgical supplies or sources of products mentioned or used in this protocol, please FAX us at 1-310-479-8976. We will answer your questions promptly.

Coming Attractions
Lip avulsion in dogs and cats may occur secondary to bite wound trauma, or occasionally by automobile trauma. Most or all of the lower lip and ventral mandibular skin becomes detached from the mandibles. Although this injury has a garish and disfiguring appearance, the prognosis with proper surgical repair is actually quite optimistic.

Next month, we shall outline our protocol for surgical repair of lip avulsions.

See you then!

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