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MANDIBULAR FRACTURES – ASSESSMENT AND TREATMENT
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Mandibular fractures in companion animals usually occur secondary to trauma, but pathologic processes (neoplasia, metabolic bone disease, and infection) and overzealous tooth extraction can also lead to bone disruption. Although any breed and species can be affected and various fracture configurations exist, symphyseal fractures occur more frequently in cats and mandibular body fractures occur more frequently in dogs.1,2

Nearly all mandibular fractures are open/contaminated fractures due to their location and a lack of adequate soft tissue coverage of the bone in the oral cavity.2 Failure to properly assess and treat these fractures can have undesirable consequences for the animal in regard to overall jaw function and healing. Caudal malalignment of 2-3 mm may prevent closure of the rostral portion of the mouth by a full cm.3 A variety of repair techniques exist and the one chosen depends on the location and configuration of the fracture.

Initial assessment of a traumatized animal should focus on the patient’s well being as a whole. The cardiovascular, neurologic, and respiratory systems are assessed first and life-threatening disturbances treated prior to fracture management. When fractures of the face and jaw are involved, airway management is of particular concern since disruption of the airway can be a sequel of displaced bone fragments and soft-tissue swelling. An emergency tracheotomy may be necessary in some cases. Thoracic and abdominal radiographs will aid assessment of other injuries the animal might have sustained.

Assessment of facial trauma is done after initial patient stabilization. These assessments are difficult without sedation since animals are often painful and distraught. Many animals will require general anesthesia for complete evaluation. The animal is assessed for facial asymmetry, ocular abnormalities, loss of bone continuity, lacerations/avulsions, hemorrhagic nasal/oral discharge, drooling, inability to open/close the mouth, dental malocclusion, fractured teeth, disruption of oral soft-tissues, and/or palatal defects. Radiographs under general anesthesia are taken if abnormalities are present. Lateral, ventrodorsal, oblique, and open mouth radiographic views should be assessed to evaluate the full extent of trauma. Dental radiography can be helpful under some circumstances to better visualize tooth roots and fracture lines, but care must be taken to when using dental radiography alone since injuries can be missed due to the small size of the film and focusing of the radiographic beam. Overlapping bone and soft tissues of the skull make radiographic image interpretation difficult, especially when dealing with caudal fractures of mandible. Computed tomography with image reconstruction may be helpful for identifying facial trauma where conventional techniques fall short.

Anesthetizing animals with mandible trauma should be done with care. Opening the jaw for intubation can be hindered by displaced and mobile fracture fragments and temporomandibular joint instability. Additionally, oropharyngeal trauma can impede visualization of the larynx. Patient induction and gaining airway control should be rapid. Fast acting, intravenous induction agents are ideal. Oral intubation is initially performed. However, for fracture repair, passing the tube through a pharyngotomy incision will be necessary in many instances since orotracheal intubation will interfere with evaluation of dental occlusion during surgery. A reinforced endotracheal tube will help prevent tube kinking and loss of a patent airway while the animal is under anesthesia.

After the animal is anesthetized and completely assessed preparation for repair is done. If implants are to be placed, the skin overlying the fractured area is clipped and aseptically prepared for surgery while the eyes are protected with a sterile ocular lubricant. The oral cavity is also rinsed with a dilute antiseptic solution. Such as 0.05% chorhexidine or 1.0% povidone-iodine. If an open fracture is present, antibiotics are initiated at the time of presentation and continued until the soft-tissue wounds are healed to reduce the risk of infection associated complications. Due to the variety of bacteria found in the oral cavity, a broad spectrum agent should be used. Ampicillin with sublactam (10-20 mg/kg or 4.5-9 mg/lb), second/third generation cephalosporins, and Cefazolin (22 mg/kg or 10 mg/lb) have been used empirically. The antibiotics are given intravenously to prevent unnecessary pain to the animal with oral manipulation during administration and to establish good tissue levels. Perioperative antibiotics are used if implants are placed or if contamination is expected, but these are discontinued within 24 hours of surgery unless further therapy is warranted due to oral soft-tissue injury or infection. Perioperative antibiotics should be given intravenously. Oral antibiotic therapy can be initiated after fracture repair if continued therapy is warranted due to the presence of soft-tissue damage or active infection. Amoxicillin with clavulanic acid is a good empirical choice (10-20 mg/kg or 4.5-9 mg/lb P.O. BID), but treatment of active infections should be based on culture and bacterial sensitivity patterns. If internal fixation is used, intraoral surgical approaches are avoided to minimize contamination and further soft-tissue damage. The mandibular symphysis is often approached both oral and percutaneously, the mandibular body is typically approached ventrally through the skin, and the temporomandibular joint is approached laterally. It is not recommended to remove teeth at the fracture line unless they are loose or damaged, as this can complicate surgical repair and teeth along the fracture line often remain viable unless loose or damaged.4 Oral soft-tissues that were damaged from the trauma or surgical stabilization are repaired after fracture stabilization to prevent further damage to them during fracture manipulation unless the fracture repair technique chosen will prevent access to them.

The goal of mandibular fracture repair is to restore normal jaw function while maintaining dentition and appearance. For this to happen, normal dental occlusion must be reestablished. When deciding on a repair technique, it should be remembered that fracture fixation on the tension surface of the bone will maximize implant strength. For the mandible, this is the alveolar surface of the bone. However, placing implants on this surface is likely to result in damage to tooth roots and neurovascular structures. Hence, implants are often placed on the compressive surface, putting them at a mechanical disadvantage. Although it would be in the surgeon’s best interest to avoid this situation, as long as the implants are placed using appropriate technique, a clinical problem is unlikely to result even though the implants are not in the optimum position on the bone. A variety of management techniques exist for mandibular fracture repair and there are advantages and disadvantages for each technique. The rest of this paper will examine some of these techniques and provide recommendations for their use.
Muzzle fixation is commonly used to stabilize mandibular fractures. Advantages of this technique are ease of application and minimal cost. Indications for muzzle fixation include minimally displaced mandibular body fractures (commminated fractures, if one sided), fractures of the caudal mandible (ramus), and fixation for fractures in dogs with excellent healing potential and minimal fracture displacement (young animals). It is sometimes a necessary technique in cases with poor bone quality and tooth loss when other forms of fixation have failed. A tape muzzle can be made or a fabric muzzle can be used. For tape application, waterproof tape is used. The tape is first placed around the muzzle with the sticky side of the tape facing away from the dog. This is covered with a second piece of tape so that the sticky sides are stuck together. The process is continued by attaching another piece of tape, sticky side out, from the right, lateral aspect of the dog’s muzzle to the round strip of tape initially placed on the muzzle of the dog, passing the tape around the back of the head ventral to the ears, and then finally passing it to the left side of the dog’s muzzle where the tape is once again attached to the lateral aspect of the initially placed tape on the muzzle (basically, the piece of tape placed around the muzzle is attached to a piece of tape that goes around the back of the head). The sticky side of the tape is once again covered with another layer. Proper muzzle placement allows the mouth to be opened wide enough for the animal to eat gruel and drink water while maintaining interlock of the canine teeth for appropriate dental occlusion. This is usually an opening of about 0.5 to 1.0 cm. It is important to make sure that proper occlusion is obtained when the muzzle is applied. Disadvantages of the muzzle technique include lack of rigid fracture immobilization, potential for prolonged healing, dermatitis, premature dislodgement by the animal, possible overheating of the animal, and possible aspiration pneumonia. The muzzle technique can not be used on cats or brachycephalic dogs. An Elizabethan collar will be necessary in dogs that have difficulty adjusting to the presence of the muzzle.

Dental bonding is used to immobilize a mandibular fracture by bonding the upper and lower canine teeth together. It provides more rigid fixation than the muzzle technique and has fewer potential complications. Dental bonding is inexpensive, fast, does not damage the teeth, can be used in cats and brachycephalic dogs, and does not predispose to dermatitis. However, it does require intact canine teeth, over heating can still occur, and aspiration pneumonia is still a potential. Dental bonding may not work well for extreme rostral mandibular fractures since a high degree of motion can still occur from movement at the temporomandibular joint and the bonding may have to be replaced in some animals due to early dislodgement of the cement.1

To bond the teeth, the teeth are cleaned, pumiced, and etched with phosphoric acid. Proper dental occlusion is obtained and a cold curing acrylic is applied to the upper and lower canine teeth bilaterally. The teeth can be bonded directly together (alone or with bonding splints); however, dental tubes or syringes cut into small tubes provide better seating of the acrylic around the teeth. The tube is cut the appropriate length and placed over the upper and lower canines (this is done bilaterally). The fracture is reduced and dental occlusion is achieved with the tubes in place. This requires that the canine teeth be placed in the proper position and that some dental interlock is allowed. When the fracture is reduced and good alignment is achieved, the tubes are filled with a cold curing acrylic. The fracture is held in alignment with the appropriate dental occlusion until the acrylic is cured. The mouth should be bonded in a position that still allows the animal to lick gruel and drink water (0.5 to 1 cm opening). An e-collar may be necessary if the animal is pawing at the fixation.

External fixators are frequently used in the management of mandible fractures. They work well for most fractures of the mandibular body, but are difficult to place for bilateral rostral fractures since adequate bone stock is lacking in the rostral mandible. Lack of bone stock near the ramus makes fracture fixation there difficult as well. External fixators are versatile, fairly inexpensive, well tolerated by the animal, allow management of severe soft-tissue injuries, and maintain normal jaw function during healing. Fixator pins may not hold well in bone of poor quality and inappropriately placed pins can damage tooth roots and neurovascular structures. Additionally, pins must be placed away from the alveolar surface, which places the fixation in a mechanically inferior position. External fixator placement follows similar rules to their application on long bone fractures. At least two bicortical pins are placed per fracture fragment and positive-profile threaded pins are preferred. Pins should be placed below the mandibular canal in the mandible to avoid the neurovascular supply and tooth roots. It is important to remember that the mandibular canal is not medullary bone and contains important structures. If the pins are placed in the same plane, traditional connecting bars can be used to maintain fracture reduction. More frequently, acrylic systems are used because of their versatility and the ability to easily connect pins on both sides of the jaw by curving around the front of the mouth with the acrylic. This technique is advantageous in cases of rostral, unilateral fractures since pins can be placed in the caudal fracture fragment on the fractured side and in the mandibular body on the opposite side without having to put them in the rostral aspect of the mandible since there is little bone available in that area.

Bone plating can also used for fracture repair. Plating is especially useful when bone loss has occurred and for ramus fractures, but it is typically more expensive and time consuming compared to some of the other repair techniques. Bone plates and screws must be applied away from tooth roots and neurovascular structures. As for external fixators, this requires that plates be placed on the compression side of the bone. The stout nature of compression plates often makes up for this disadvantage when applied in this area. Miniplates can be placed closer to the tension side of the bone than traditional compression plates since the screws are small and the plates can be contoured three-dimensionally.5 However, these plates are weaker than compression plates. Reconstruction plates are easily contoured and work well for fractures in this area as well.

A minimum of six cortices should be engaged with screws on each side of the fracture, but this is not always possible due to lack of available bone. Implant infection requiring plate removal is a possibility.

Interdental wiring stabilizes fracture fragments using the tension band principle. Wiring techniques are applied to the alveolar surface placing them in an optimal biomechanical position. The technique calls for passing orthopedic wire around and between teeth secure enough to hold the fractured bone in position during healing. Interdental wiring can be used alone or adjunctively with other forms of fixation to add strength to the repair (especially those techniques that require fixation to be placed on the compression side of the bone). The two teeth immediately rostral and caudal to the fracture should be intact and included in the wiring. Although inexpensive and easy to apply, dental wire can be easily dislodged by the patient. To
help prevent dislodgement, acrylic can be added to the wire. The teeth can also be notched to help hold the wire in place. Interdental wiring is indicated for simple fractures of the mandible. It is contraindicated for comminuted fractures or when bone loss is apparent. Although jaw function is preserved during the healing process, the wire may interfere with dental occlusion, especially if acrylic is added. If necessary, these wiring techniques can be modified to lock the jaw closed. Alternative alimentation is necessary in these cases.

Interfragmentary wiring involves placement of orthopedic wire between bone fragments. The wire is used to “suture” the bone fragments together in an interrupted pattern. Holes are drilled 5-10 mm from the fracture site on both sides of the fracture. The wire can be placed on the tension side of the bone as long as holes are drilled away from tooth roots and neurovascular structures. The wires are passed through the drill holes, and then they are tightened. Ideally, at least two wire sutures per a bone fragment are placed. This technique should only be used when all the bone fragments can be anatomically realigned. Interfragmentary wiring requires little equipment and is economical, but can also be time consuming. Additionally, the wire may fracture out of weak/thin bone. Interfragmentary wiring is most useful for fractures of the maxilla and not the mandible. It is not routinely used for mandibular fractures since it is difficult to maintain fracture alignment, avoid tooth roots and neurovascular structures, place the appropriate number of wires, and obtain good stability.

Intraoral splints also provide stability for fractures of the mandible and can be used on a variety of fracture types. They are best suited for fractures without comminution or missing bone fragments. Basically, a cold curing acrylic is molded around the teeth after fracture reduction to lock the bones in position. The teeth provide a surface for locking the acrylic securely to the mandible while the bone heals. If cold curing acrylics are not available, a mold of the animal’s mouth can be made and then a splint using bone cement is formed from the mold. The splint is then wired to the teeth. Alternatively, the exothermic curing acrylic can be applied directly to the oral cavity in layers rather than in bulk to avoid some of the heat damage that might occur during cement curing. Splint rods can also be used for intraoral splinting. The rod is molded to the shape of the mandible and is wired to the teeth or directly to the bone for stability. External fixator pins can be incorporated into oral splints rostrally to avoid placing them in an area that is lacking bone stock.

Various other techniques are also available for oral fracture management. Partial mandibullectomy is avoided if possible since mandibular drift can occur, but it is a viable alternative for complicated cases in which other techniques have failed. Cerclage wire is acceptable for stabilization of mandibular symphyseal separation that occurs commonly in cats. The wire is placed behind the canine teeth and secured under the jaw. Cortical or vascular bone grafts may also be used to span mandibular defects. 6,7 Conservative management of mandibular condyloid fractures consisting of a soft food diet and rest is an acceptable way to deal with fractures in that area. 8 Complications of mandibular fracture repair include continued malocclusion, osteomyelitis, non-union, degenerative joint disease, and implant failure. Overall, the prognosis is good with fractures healing within 3-6 weeks. Proper alimentation must be maintained in the post-operative period. A pharyngostomy tube may be necessary in some patients to provide nutrition, but most animals can still be maintained with oral alimentation. Animals should be fed a soft diet or gruel and should be kept away from hard toys/treats until the fracture is healed. Healing should be assessed radiographically before fixation is removed.

REFERENCES