Fractures and Dislocations of the Mandible

D. M. Nunamaker

- Fractures of the Mandible
  - Methods of Fixation
  - Types of Fractures

- Mandibular Osteomyelitis

- Dislocation of the Temporal Mandibular Joint

- Mandibular Amputation

Fractures of the mandible are very common in the dog and cat. Dislocations are uncommon but may occur by themselves or in combination with fractures of the mandible and maxilla. The often dramatic and pathetic appearance of an animal with a severe mandibular fracture on presentation should not prevent a thorough examination of the entire patient. Occasionally giant breed dogs may have unilateral or bilateral radial and ulnar fractures that will need attention. Other fractures or soft tissue trauma may be life-threatening as well. Establishment of a patent airway may be necessary in some dogs following head trauma, even some time after admission, hence close observation of the patient is necessary.

FRACTURES OF THE MANDIBLE

On admission the diagnosis of fractured mandible is usually evident. Drooping of the jaw, asymmetry, and/or blood-covered hair coat may all be present. Definitive diagnosis is usually performed by careful palpation and radiography, most often under general anesthesia. Simple symphyseal or unilateral shaft fractures can be diagnosed with the patient awake. Careful correlation between physical findings and radiographic interpretations must be made in every case.

The treatment goal with mandibular fractures is normal function with perfect dental occlusion. Normal occlusion is sometimes very difficult to achieve and warrants special attention. Often during internal or external skeletal fixation, the introduction of an endotracheal tube and/or esophageal stethoscope will prevent closure of the mouth sufficient to check for normal occlusion. This can be a major problem when dealing with comminuted fractures in which reduction might be imperfect because of loss of bone stock. In such cases, the endotracheal tube can be introduced through a sublingual skin incision similar in placement to an incision for a pharyngotomy tube, thereby allowing closure of the jaw to check occlusion. The ease of this procedure and the little attendant risk make it extremely useful. Following surgery the tube is removed and the wound sutured. The technique has none of the drawbacks that occur with a tracheostomy in the dog.

When applying internal fixation to jaw fractures, it must be remembered that most if not all mandibular fractures are open fractures. The relative resistance to infection makes jaw fractures amenable to treatment with internal fixation despite their open nature. Whenever possible, intraoral approaches are made with the implants, especially plates and screws, covered by the mucosa. Incisions through the skin will provide communication to the fracture site, which can become a problem resulting in a draining lesion. I have experienced a lower incidence of complications using intraoral approaches. Surgical preparation is done as with any sterile procedure, although no pretense is made that the surgical procedure is done in a sterile fashion. Mucosa is closed over implants where possible. Exposed implants are always removed following bone healing.
METHODS OF FIXATION

EXTERNAL FIXATION

Simple undisplaced or easily reducible fractures of the mandible may be stabilized using a muzzle to control excursion of the jaw as long as there are canine teeth present to control occlusion. (13) Muzzles are usually made of tape and include an encircling band around the mandible and maxilla with an attached band connecting both sides that goes behind the ears. Elizabethan collars must sometimes be used to prevent the animal from removing the muzzle. Usually after the muzzle has been in place for several days the collar can be removed. Certain animals may resent the muzzle and remove it in spite of all efforts to the contrary. Care should be taken when using a muzzle to prevent the development of rub sores. The muzzle is placed so that the dog can open its mouth enough to eat soft gruel with its tongue.

Muzzles can be used in any animal in whom occlusion of canine teeth is adequate to align the fracture fragments. They are often used as an adjunct to other forms of internal fixation to spare the internal fixation unnecessary loading.

INTERNAL FIXATION

ORTHOPAEDIC WIRE FIXATION

Wire fixation is one of the most commonly used methods of dealing with mandibular fractures. These wires are used as cerclage devices, sutures, interdental wires, or as tension band wires. The wires may be used with Steinmann pins, Kirschner wires, or bone screws.

Cerclage wiring can be used for symphyseal fractures or long oblique fractures of the horizontal ramus. Transverse fractures are often wired using common suture techniques. This is usually the least effective use of internal fixation but may be successful when combined with a tape muzzle. Tension band wiring over the dental arcade is an efficient use of wire for internal fixation when indicated and can be combined with other fixation appliances such as screws (Fig. 18-1).

PIN FIXATION

Steinmann pins and Kirschner wires can be used for intramedullary fixation for horizontal body fractures of the mandible. Although practical theoretically, problems with intramedullary pin fixation arise because of the location of the marrow space that will allow malalignment with imperfect reduction and inadequate stability. The large space occupied by the roots of the canine teeth often makes insertion of the pins for rostral fractures of the mandible impossible. Intramedullary pins are usually used in combination with wire fixation in jaw fractures. The vertical ramus is a large thin plate of bone with only a minimal space for intramedullary pins. Rotation can be controlled in the ramus by inserting two pins in this narrow medullary space.

FIG. 18-1 A tension band wire is drawn over the dental arcade and combined with a lag screw (A,B). A similar case in which three interfragmentary screws and a tension band wire were used is seen postoperatively (C). Healing of the fracture is documented (D,E), and the implants are seen at the time of their removal approximately 2 months following initial stabilization (F).

PLATE AND SCREW FIXATION

The use of plates and screws for mandibular fractures gives versatility to fracture reduction and stability. Where feasible, plates can be used to maintain perfect anatomical reduction and stability of the fracture site with normal occlusion. Special plating equipment is available for use in mandibular fractures which although expensive can make practical the reconstruction of difficult fractures of the mandible as well as fractures of the pelvis (Fig. 18-2).
SKELETAL TRANSFIXATION
External skeletal transfixation has been described for fractures of the mandible and maxilla.\(^\text{(1,7)}\) The use of Kirschner splints as a method of stabilization is well known. (See Chapter 16). For many years we have employed external skeletal transfixation using long cortical bone screws or pins for fixation and making sidebars from wire-reinforced acrylic (Fig. 18-3). This method allows more versatility with a less encumbered apparatus. The use of cortical screws instead of smooth pins seems to allow the fixation to remain stable for longer periods of time. The relative thinness of the body and ramus of the mandible allows a greater purchase by the screws than is achieved with smooth pins. Wrapping wire around the screw heads and then connecting the screws in the other fracture fragment acts as a scaffold on which the acrylic can be used. The dental acrylic is usually poured into a trough made of aluminum foil that is preplaced around the wire scaffold. The fracture site can be manipulated until the acrylic dries (usually about 5 minutes). Even when the Kirschner splint is used, acrylic can be molded around the couplings to help prevent loosening. Combinations of the Kirschner apparatus with acrylic bridges are useful in difficult cases (Fig. 18-4).

FIG. 18-2 Special mandibular reduction forceps with compression rolls are available as part of the ASIF instrumentation (A). These clamps are applied to the mandible fragments using temporary screws. Following attachment (B) to this three-part fracture of the mandible, reduction is accomplished by squeezing the clamp and adjusting the compression rolls to trap (C) and compress (D) the third fragment. Following reduction, a mandible plate is applied to compress the stabilized fracture Note the transverse direction of the inner DCP holes to help stabilize the third fragment without placing any screws in it (E). Following placement of all the screws (F), the forceps are removed and the fracture is fixed and stabilized. Occlusion is perfect and the stability is excellent (G).

FIG. 18-3 (A) A fracture of the midbody of the mandible shows four screws with an acrylic bridge for fixation. A typical patient wearing the acrylic frame.

FIG. 18-4 This old toy poodle presented with a bilateral rostral fracture of the mandible just caudal to the canines associated with a symphyseal separation. The dog had four canine teeth and two molars in its mouth. Since bone stock was so poor in the mandible, cerclage wires were used to grasp the rostral fragments, which were used as the reinforcement for an acrylic bridge connected to two screws in each vertical ramus (A,B). The dog at the time of implant removal several months later (C).
ACRYLICS

Acrylics can be used in mandibular fractures in the form of easily made splints for use in the oral cavity by wiring into place. These can be either elaborate stone castings or single manipulations of partially cured acrylic to mold to the jaw. The splints are generally wired to the teeth or around the mandible. Although useful in theory, I have had problems with intraoral splints entrapping food and debris, thereby producing mucosal damage and foul-smelling breath. I have, however, used acrylic successfully in combination with intra-arcade wires or tape muzzles on the dental arcade to stabilize the mouth in a partially open position while still maintaining a stable reduction of the mandible. (1) Here the acrylic must bridge the fracture site or be combined with other internal fixation. Acrylic has also been used under plate fixations to allow good bone-plate contact that is necessary for stability when contouring of the palate is impossible (Fig. 18-5).

The specific handling of fractures of the mandible may tax the creativity of the surgeon. The wide variety in size and shape of the mandibles of different breeds will not always allow the same fracture to be treated in the same manner. Some fractures of the dog and cat can be treated in a similar manner. If differences exist, they will be pointed out below.

TYPES OF FRACTURES

SYMPHYSEAL SEPARATIONS

Symphyseal separations are very common in the cat and may present with hard palate separation, usually following high rise injuries (falls) or vehicular injuries. The lesion is common in the dog as well. Although many methods of treatment have been described in the literature, the description that follows can be used successfully in all species and is the treatment of choice.

Following the manipulative reduction of the symphysis, a single 6 inch to 8 inch long, 18- to 22-gauge stainless steel wire is introduced behind the canine tooth lateral to the horizontal ramus through the mucosa and out through the skin on the midline ventral to the mandible (Fig. 18-6). The other end of the wire is introduced in a similar manner and the wires are twisted as they exit the skin. Reduction of the fracture is obtained while the wire is tightened. The wire is cut off, leaving approximately three twists. It is usually allowed to remain in place for 12 weeks. Removal can be accomplished with a wire cutter by snipping the wire between the canine teeth and pulling it out ventrally; anesthesia is not necessary. No other figure-of-eight wires or pins are needed or desirable in this type of fracture.

Fractures rostral to the first premolar caudal to the canine tooth are common and are often difficult to stabilize. Intramedullary pins, if used, will usually distort the jaw and are difficult to insert. Plates have been used in this area as an uncovered splint (see Fig. 18-5), and tension band wires can be used over the interdental space. (2) Normal occlusion is achieved, and often a muzzle is worn to protect the relatively weak fixation. Combinations of small Kirschner wire and...
cerclage wires may also be used here, as well as acrylic splints.

FRACTURES OF THE BODY OF THE MANDIBLE
Fractures of the body of the mandible are handled readily by a number of methods including external skeletal fixation, plates and screws, and intramedullary pins. Fractures of the horizontal ramus often occur next to the root of an adjacent tooth, and care must be taken to ensure that there is enough bone on both sides of the fracture to allow bone-to-bone union. Bone will not heal to an adjacent tooth, and nonunion will result. Sometimes the bared tooth must be extracted and the fracture stabilized with a cancellous bone graft in the old alveolus to ensure fracture healing. Occasionally, if the tooth is necessary, an effort is made to raise the periosteum around the tooth and a bone graft is applied under the mucosa. Whenever cancellous bone grafting is used in the jaw, the mucosa must be closed over the graft to prevent it from being swallowed or washed away (Fig. 18-7).

Fractures of the angle of the jaw and vertical ramus are best handled with plates using an oral approach or external skeletal fixation. Since the vertical ramus of the jaw is so thin, screws are used as the half-pins, thereby creating more stability. Fractures through the mandibular notch in the cat have been reported to be approached laterally and stabilized with wire suture techniques.

MANDIBULAR OSTEOMYELITIS
Serious infection of the jaw is uncommon, but when it occurs it can be a severe complication. Infection starts most often with a tooth problem that is not attended to properly. The treatment, as with any chronic infection, involves removal of that bone. Fractures occur with infection, and the successful treatment of these fractures necessitates sequestrectomy and stabilization (Fig. 18-8). Bone grafting may be necessary, usually at a later date after healthy soft tissues have covered the fracture fragments.

DISLOCATION OF THE TEMPOROMANDIBULAR JOINT
Dislocation of the mandible may occur with or without additional fractures. Simple dislocation can be assumed when an animal presents with a stable mandible that will not close or is fixed in a nonocclusal position. The diagnosis is confirmed radiographically. Ventrodorsal and lateral radiographs of the dog can demonstrate the abnormality. In the cat, ventrodorsal and lateral oblique radiographs are required; in the latter, the mandibular ramus must be rotated dorsally 20° to project the temporomandibular joint satisfactorily.
Luxations, whether rostral or caudal, can be difficult to treat. The reduction process can be frustrating and time-consuming, with final reduction being accomplished easily or not at all. Remember that reduction is always accomplished on the last try. The process of reduction involves the use of an obstacle (stick or pipe) placed on the occlusal surface of the second molar and manipulation of the mandible using the obstacle as a fulcrum combined with traction to pull or push the condyle into the temporomandibular joint.

Fractures of the temporomandibular joint can occur with dislocation in the dog. Instability of the temporomandibular joint may cause problems of clicking or catching of the coronoid process of the mandible on the zygomatic arch. When this occurs, the animal may be unable to close its mouth, a condition that is both painful and frustrating. Manipulative reduction can allow normal closure of the mouth, but any wide excursion such as a yawn may repeat the syndrome. Surgical correction of the problem has been undertaken by removing that part of the zygomatic arch that interferes or removing the coronoid process of the mandible to alleviate this interference. The problem has been reported in bassett hounds without associated fracture.

In the cat, temporomandibular joint trauma has been described by Ticer and associates(11) and has been separated into six entities: rostral luxation, caudal luxation with fracture of the retroarticular process, fracture of the mandibular fossa, fracture of the zygomatic process of the temporal bone, fracture of the condyloid process of the mandible, and fracture through the base of the condyloid process. Treatment of temporal mandibular joint injuries in the cat is by wire fixation or closed reduction and muzzle fixation(5) Surprisingly functional results can be expected from apparently serious injuries to the temporomandibular joint in the cat.

MANDIBULAR AMPUTATION
Rostral mandibulectomy has been used as a treatment for oral neoplasia in the dog (6,12) and cat (6). It would appear from experience that the mandible is not necessary to preserve life in the dog. Massive resections are not even cosmetically displeasing, since the lips of the dog cover the deficient mandible. Only when the animal is panting is the deficit seen by the casual observer.

The procedure is carried out using a transverse skin incision caudal to the lesion. The mandible is drilled for placement of a screw in lag fashion between the rami. An amputation saw is used just caudal to the the skin incision and amputation of the rostral portion of the mandible is achieved. One or two lag screws are used to stabilize the remaining mandible, and the skin is closed over the stump. Two extra skin sutures are placed between the new mandibular angle of the jaw, and the skin is secured to prevent degloving of the skin upon completion (Fig. 18-9). The results of mandibulectomies have been documented,(6) and the procedure can give good long-lasting results when used before metastatic spread of disease.

FIG. 18-9 An ameloblastoma (acanthomatus type) is seen on the rostral mandible of this 12-year-old cocker spaniel (A). A transverse osteotomy removed the mass (B). A screw is used in lag fashion to stabilize the jaw (C). The immediate post-operative effect (D) is contrasted to the follow up examination several months later (E). The dog was followed for an additional 4 years and could pick up a ball and eat without problems. No loosening of the internal fixation occurred, and it was not removed.

Hemimandibulectomy or partial hemimandibulectomy has been described by Withrow and Holmberg for the treatment of oral neoplasia(14) They state that instability of the jaw was not a problem following resection. Screw fixation in this series did not utilize the lag principle and was a failure. The ability of the dog to maintain function without stability is remarkable, however, and should not be overlooked when nonunion of difficult mandibular fractures occurs. Removal of unstable implants has in several cases allowed the dog to function adequately.

REFERENCES

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