The diagnosis and treatment of oral trauma includes the management of dental fractures, luxations and avulsions and the management of jaw fractures and temporomandibular luxations.

Management of dental fractures/luxations and avulsions
The management of fractured teeth falls into the category of endodontic therapy. Endodontic therapy refers to the treatment of the diseased pulp of a tooth. The most common cause of diseased pulp in small animals is a fractured tooth. Any tooth in a dog or cat may be fractured. However, the most frequently fractured teeth in the dog are the canines, incisors and maxillary fourth premolars. The most frequently fractured teeth in cats are the canine teeth.

Dental fractures should be classified on presentation into two groups, fractures with pulpal exposure and fractures without pulpal exposure. A fracture of the enamel surface without exposure of the pulp requires only that the sharp edges of the fracture site be smoothed off followed by application of a dentinal sealer. A fractured tooth with exposed pulp requires endodontic therapy.

Fractured teeth are often noted as an incidental finding on physical examination. However, a series of events may occur in some fractured teeth with exposed pulp which can result in significant clinical presentations. This series of events includes the following conditions: (1) exposed pulp, (2) bacterial pulpitis, (3) pulp necrosis, (4) periapical granuloma, (5) periapical abscess, (6) acute alveolar periodontitis, (7) osteomyelitis, and (8) sepsis.

Radiographic changes associated with endodontic disease include: (1) periapical lysis, (2) apical lysis, (3) large asymmetrical endodontic systems secondary to failure in normal development or endodontic resorption, (4) radiographic loss of tooth structure to the pulp canal such as in severe tooth resorptive lesions or deep dental caries, and (5) secondary destruction of periodontal structures.

Several different endodontic procedures may be utilized to treat endodontically diseased teeth. These techniques include: vital pulpotomy, conventional and surgical endodontic therapy. Whenever pulp disease is present it is important to decide which type of endodontic therapy is most appropriate based on the patient’s age, time of exposure, and the gross anatomic features and vitality of the tooth. The most common and most successful type of endodontic therapy is conventional or nonsurgical endodontic therapy. Occasionally vital pulpotomy with direct pulp capping is recommended and rarely surgical or nonconventional root canal therapy is indicated.

A vital pulpotomy with direct pulp capping is indicated in vital teeth with traumatic pulpal exposure of less than 8 hours. This permissible exposure time may be extended for up to 2 weeks in very young animals with immature teeth. It is also indicated in crown shortening procedures as an alternative to conventional endodontic therapy in the treatment of mature permanent teeth. Ideally, vital techniques such as vital pulpotomy with direct pulp capping should be limited to use in incompletely developed permanent teeth with pulpal exposure. A vital pulpotomy with direct pulp capping in an animal less than 18 months of age will permit the tooth to remain vital at least temporarily so that additional dentin can be formed resulting in an increase in strength of the tooth that has been fractured. Additionally, it can allow the formation of the apex of a very immature tooth. A pulpotomy with direct pulp capping should never be performed in nonvital teeth, when the pulpal exposure is prolonged and in teeth in which the pulp is severely traumatized or grossly contaminated. In fact, it is best to limit vital pulpotomy procedures to immature teeth with recent exposure and teeth requiring crown reduction procedures. The objective of a vital pulpotomy with direct pulp capping is to protect the pulp following pulpal exposure by stimulating formation of tertiary or reparative dentin over the access site with a restorative material. There are several important steps involved in the performance of a vital pulpotomy with direct pulp capping. (1) A preoperative radiograph of the affected tooth and the contralateral tooth is taken. (2) The surface of the tooth is disinfected with 0.2% chlorhexidine solution. (3) An appropriately sized sterile diamond pear-shaped bur on a high-speed handpiece is used to remove the coronal portion of the pulp. (4) The remaining pulp is gently flushed with sterile saline and the blunt ends of paper points that are moistened with sterile saline are used to achieve hemostasis. (5) A layer of MTA (a new pulp capping material) is gently placed over the pulp. (6) An intermediate layer of glass-ionomer is placed over the MTA. (7) A composite material is used to fill the access site.

Postoperative care for animals following a vital pulpotomy with direct pulp capping includes antibiotic therapy for 1 week postoperatively. Owners should be informed that a vital pulpotomy with direct pulp capping may necessitate conventional endodontic therapy in the future if pulpitis and pulp necrosis develops. The patient should be monitored for clinical signs associated with endodontic disease. Oral examination by the owner and veterinarian may reveal problems associated with a failed vital pulpotomy with direct pulp capping including: discolored teeth, soft tissue fistulas, teeth that are painful on percussion or lost restorations. Dental radiographs should be taken at 6 and 12 month intervals postoperatively and then annually during regular dental appointments. Radiographic findings indicative of pulp necrosis include: periapical or apical lysis, failure of symmetrical dentin deposition.
compared to the contralateral normal tooth and endodontic resorption. Radiographic findings consistent with pulpal necrosis necessitate the performance of conventional endodontic therapy or extraction of the affected tooth.

Conventional endodontic therapy or nonsurgical endodontic therapy is performed through the crown of the tooth and is the most frequently performed endodontic therapy. This procedure is indicated whenever there is pulpal death of a tooth secondary to inflammation, infection or trauma. The purpose of root canal therapy is to preserve the function of the tooth while preventing it from causing adverse effects because of its presence. This is achieved by removing the necrotic or infected pulp and filling the pulp canal with an inert material. A properly performed root canal procedure will prevent infection or inflammatory products from extending from the tooth into the tissues that surround the apex of the tooth. There are several basic steps involved in performing conventional endodontic therapy. These steps include: (1) preparation, (2) access, (3) debridement, (4) drying, (5) filling, and (6) restoration.

Dental luxations and avulsions occur infrequently in small animals. Dental luxations can be either in a vertical direction (intrusion or extrusion) or in a lateral direction. A dental avulsion occurs when the tooth is completely extruded from its alveolus. If retention of the tooth is desired it should be replaced into its normal position as soon as possible and stabilized with an interdental splint. Endodontic therapy of the affected tooth is recommended.

Management of jaw fractures/temporomandibular luxations

Prior to correction of jaw fractures the patient must be thoroughly evaluated for other traumatic injuries. Following stabilization of life-threatening injuries jaw fractures can be evaluated under sedation or general anesthesia. The mandible, maxillofacial bones, and temporomandibular joints are palpated both extra- and intraorally for fractures. Radiographs are taken to localize the fracture sites. It is important to assess the full extent of all injuries keeping in mind that multiple fractures may be present. In cases of severe maxillofacial trauma, computed tomography may be helpful in the recognition of all lesions.

The teeth need to be evaluated for periodontal and endodontic disease and their relationship to fracture lines must be determined. Previous reports indicate that pathologic fractures may occur in the mandible of dogs with severe periodontal disease through deep periodontal pockets. These pathologic fractures occur most frequently in the region of the mandibular first molars and canine teeth. Periodontally diseased teeth in a fracture line need to be extracted or hemisected to remove the periodontally affected tooth or root that predisposed the dog to the pathologic fracture. Retention of a periodontally diseased tooth or root in a fracture site inhibits fracture healing. If hemisection is chosen as the method of treatment, the retained root must be treated endodontically. In addition teeth that are fractured with pulpal exposure require endodontic therapy.

Teeth that are not diseased but are located in the fracture site can generally be retained. Prognostic factors of teeth in the fracture site have been reported with fractures extending along the periodontal ligament to the apex having the poorest prognosis. In general it is probably best to retain teeth that significantly contribute to fracture stability as long as severe periodontal disease is not present and the fracture is acute.

Basic principles of jaw fracture management include the following: (1) restoration of occlusion and anatomic reduction of the fracture, (2) neutralization of forces on the fracture line and stable fixation, (3) avoidance of soft tissue entrapment by the fixation technique, (4) avoidance of further dental trauma, (5) proper assessment of tissue viability, (6) removal of diseased teeth within the fracture site, (7) avoidance of excessive elevation of soft tissue from the surface of the bone and covering of exposed bone with soft tissue, and (8) rapid restoration of function. Several techniques for the management of mandibular and maxillary fractures have been described and include: (1) tape muzzles, (2) circumferential wiring, (3) interdental splints, (4) percutaneous skeletal fixation, (5) bone plating, and (6) partial mandibulectomy.

Tape muzzles are an inexpensive, noninvasive technique of aligning and stabilizing jaw fractures. They can be used to temporarily stabilize jaw fractures prior to definitive repair. Tape muzzles can also be utilized as the primary repair technique in minimally displaced stable fractures especially fractures of the mandibular ramus or fractures occurring in young animals in which bone healing occurs rapidly.

Interdental splints are an easy, noninvasive, versatile, and inexpensive technique for repairing jaw fractures. Prior to application of an interdental splint the teeth should be cleaned, polished, acid-etched, rinsed and dried. A self-mixing Bis Acryl-composite material can then be applied to the lingual surface of mandibular teeth or the labial aspect of maxillary teeth in the fabrication of interdental acrylic splints. Interdental splints are removed by sectioning the splint interdentally with a bur and gently removing the splint in segments using extraction forces in a shearing motion to avoid fracturing teeth. Following splint removal the teeth are polished.

Percutaneous skeletal fixation devices may be used to repair jaw fractures. This technique is particularly useful in fractures in which there is significant soft tissue trauma, in severely comminuted fractures and in fractures in which a significant boney defect is present.

Bone plates provide rigid fixation and rapid return to function. However, bone plates can be technically challenging to place without damaging teeth. Significant soft tissue elevation is necessary for the placement of bone plates which may further compromise the blood supply of the fractured bone. It is also difficult to apply a bone plate to a fractured mandible or maxilla without further traumatizing tooth roots or neurovascular structures. It is also difficult to achieve normal postoperative occlusion using plates for jaw
fracture repair because even slight errors in reduction of a fracture particularly in caudal fractures will result in a significant malocclusion with inability of the patient to close the mouth in some cases. Miniplates may be utilized in the repair of mandibular and maxillary fractures. The small size of these implants allows placement close to the alveolar border and the screws may be angled to avoid impingement on tooth roots.

Treatment of temporomandibular luxations includes reduction of the luxation and stabilization of the joint. Either a tape muzzle or other maxillomandibular fixation (MMF) can be used to stabilize TMJ luxations or very caudal mandibular fractures. The intercanine splinting technique (splinting of the maxillary and mandibular canine teeth together bilaterally) can be utilized in the stabilization of the temporomandibular joints until the joint has regained stability. Maxillomandibular fixation (MMF) stabilizes fractures by temporarily connecting the maxillae and mandibles and maintaining occlusion. Less restrictive techniques are preferable because they allow earlier return to function, however MMF techniques are indicated in situations in which alternative techniques do not achieve adequate stabilization and occlusion. Tape muzzles, intercanine bonding, labial reverse suture through buttons, and bignathic encircling and retaining devices (BEARDS)/cerclage sutures are four types of MMF that have been utilized in cats and dogs. MMF can limit a patient’s ability to eat and respire or pant. Maintaining adequate nutrition may be difficult in patients treated with MMF. This complication may be circumvented by a pre-placed feeding tube.

Partial mandibulectomy can be utilized in the management of mandibular fractures when extensive trauma or infection precludes reduction or adequate fixation. Partial mandibulectomy techniques should be limited to cases in which primary fracture repair is likely to fail or cases in which primary fracture repair has resulted in an inability to eat and drink.

Maxillofacial fracture complications can be subdivided into the following categories. Complications in juvenile patients include interference with future growth potential resulting in facial deformities and damage to unerupted permanent teeth. Young patients with maxillofacial trauma should be treated conservatively. Factors that may complicate the treatment of maxillofacial fractures in geriatric patients include concurrent systemic diseases and severe periodontal disease with associated bone loss and an increased risk of pathologic fractures and neoplasia. Geriatric patients also have a higher incidence of postoperative complications such as delayed and nonunions.

Several maxillofacial fracture complications may be related to implants. These potential complications include implant exposure, loosening of implants and migration and implant failure. Several factors can influence the normal healing process following maxillofacial trauma. These factors include the age of the patient, the amount of stability following fixation of the fracture site, bone loss at the fracture site, location of the fracture, integrity of the regional soft tissues, the blood supply at the fracture site, and foreign material in the fracture site. These factors have a significant impact on the potential development of healing complications including an increased incidence in the development of delayed union, non-union, and malunion. The major contributing factor to the development of delayed and nonunion is inadequate fracture stability. Additional factors that may contribute to these complications include: vascular impairment, large fracture gaps, interposed soft tissues, infection, and inappropriate use of skeletal implants. Teeth in the line of the fracture may also delay or prevent healing particularly if the teeth in the fracture site are diseased or loose. Infectious complications that may be associated with maxillofacial trauma include: wound infections, osteomyelitis and bony sequestra. These complications are treated with thorough wound debridement and administration of broad spectrum antibiotics based on culture and sensitivity testing. Malocclusion and various dental pathological conditions may be complicating factors in the management of maxillofacial fractures. Failure to align fracture segments properly during fixation may result in significant malocclusions postoperatively. This may require removal of fixation devices, proper realignment and restabilization. When postoperative traumatic occlusion is limited to one or two pairs of teeth, selective extraction may be elected as an alternative treatment plan.

Dental pathology that may be related to maxillofacial fracture complications include: periodontal, endodontic and iatrogenic conditions. Geriatric small breed dogs with severe periodontal disease may be predisposed to pathologic fractures through circumferential periodontal defects in the region of the mandibular first molars and deep periodontal pockets around the canine teeth. Management of these difficult cases includes extraction of periodontally diseased teeth placement of a cancellous bone graft combined with some type of fixation. Teeth in a fracture line can have a significant effect on fracture healing. The decision to extract or retain a tooth in a fracture line is based on several factors including: timing of fracture repair, the presence of concurrent dental disease, and location of the fracture line in relation to the root. In general, retention of healthy teeth can improve the operator’s ability to achieve anatomic reduction and stabilization of the fracture site. Severely compromised teeth require extraction. Occasionally complications may occur following maxillofacial trauma because of extensive callus formation. Extensive callus formation in the region of the temporomandibular joint or between the zygomatic arch and the coronoid process of the mandible may result in limited or inability to open the mouth. Extensive callus formation may necessitate the performance of one or more surgical procedures including: condylectomy, surgical removal of the zygomatic arch and/or coronoidectomy.

Frequent physical and radiographic evaluations of patients following maxillofacial trauma can help minimize serious postoperative complications and permit early detection of problems. Diligent postoperative care will help minimize postoperative pain and shorten the postoperative recovery period.
References