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UPPER AND LOWER JAW FRACTURES MANAGEMENT IN DOG AND CAT

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Abstract

Car accidents, bites trauma or high-rise syndrome are the main causes of mandible and maxilla fractures in dogs and cats. This article presents the surgical approaches for the treatment of different types of fractures resulting from traumatic maxillofacial and mandibular injuries. Maxillary or mandibular body fractures are the most common oral fractures seen in dogs. In cats, fractures of the mandibular ramus are less common than those of the symphysis. The surgical technique must be adapted to each case according to the complexity of the fracture. The assessment of the integrity of the soft tissues and their eventual surgical restoration is performed intraoperatively. Postoperative recovery must be correlated with the degree of trauma to the adjacent soft tissues. Osteomyelitis and delayed union are common complications in the upper and lower jaw fracture repair process in dogs and cats.

Key words*: maxillary, mandibular, fracture, dog, cat.*

INTRODUCTION

Mandible and maxillary fractures in dogs and cats occur due to trauma caused by blows, road accidents, falls from heights, and aggressive confrontations between animals.

In cats, mandibular fractures represent 16% (Woodbridge, 2013) of the total fractures in this species, and within these, the most frequently affected are the intermandibular symphysis and the hard palate, followed by the mandibular body, condyle and coronoid process caused by falls from height, road accidents, aggressive interaction with other individuals of the same or different species (dogs).

In dogs, head fractures are more common in the cranial vault (Batle et al., 2020) and jaw (De Paolo et al., 2020). Most patients are young, with fractures resulting from road accidents, bites, aggression, and horse strikes (Arzi et al., 2015). Pathological mandibular fractures caused by periodontal disease can occur in older small and toy breed dogs (Harasen, 2008).

Animals with traumatic skull fractures located only in the facial region (mandible and maxilla) did not show nervous signs (Batle et al., 2020)

The maxillofacial complex in the dog is the most prominent part of the skull, making it vulnerable to severe injuries.

The term “maxillofacial” refers to structures involving the incisors, palatine, zygomatic, lacrimal, frontal, and nasal bones, as well as the jawbone itself. This anatomical region is located between strong craniofacial bony structures: the cranial base, mandible, nasal cavities, and paranasal sinuses (Legendre, 2005).

In dogs, in maxillofacial trauma, regardless of aetiology, there are often multiple bone fractures (Verstraete et al., 2020)

Mandibular fractures are more common due to the location exposed to possible mechanical trauma, due to the presence of a thin compact of the mandibular bone as well as the poor coverage with soft tissue (muscular, adipose, subcutaneous, cutaneous) (Stoian, 2009).

This type of fractures is often complicated by dental fractures, lacerations of the oral mucosa, and wounds of the tongue.

The character and temperament of the animal contribute greatly to the occurrence of fractures, with young animals being more exposed to traumatic fractures, and old animals to pathological fractures (Stoian, 2009).

MATERIALS AND METHODS

Medical data of patients presented for surgical consultation in the clinic of the Faculty of

Veterinary Medicine in Bucharest and the "Prof. Dr. Alin Bârțoiu" University Veterinary Emergency Hospital during 2020-2024.
All patients underwent a complete clinical examination, ophthalmological examination, neurological examination, dental examination, radiological examination, computed tomography, biochemical blood examination, CBC, general inhalation anaesthesia, specific surgical protocol for oral and maxillofacial surgery. Postoperatively, the patients remained hospitalized under supervision. Antibiotics, analgesics, anti-inflammatories were administered for 7-10 days. The animals were re-evaluated postoperatively at different time intervals.

RESULTS AND DISCUSSIONS

Most traumatic mandibular and/or maxillary fractures present dramatic clinical symptoms with haemorrhagic hypersalivation, epistaxis (Figure 1), difficulty chewing, pain when opening the oral cavity, oedema, crepitation on palpation, anisognathia (asymmetric occlusion), dislocation or luxation of teeth, skin wounds, oral mucosa or tongue. Halitosis (induced by fermentation and putrefaction phenomena) is a clinical sign of an old fracture. These changes are often discovered only during clinical inspection (under general anaesthesia) of the oral cavity (Stoian, 2009).

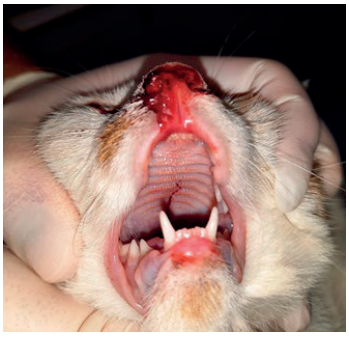

Figure 1. Head trauma: bilateral epistaxis, cleft palate, feline, European breed (original Mocanu)

After the patient is stabilized, an extraoral examination is performed to assess facial symmetry, dental occlusion, the ability to open and close the oral cavity, oral and nasal bleeding, signs of instability and discomfort. The clinical examination involves a complete examination (Clarke & Caiafa, 2014), which consists of inspecting and palpating the entire head. Upon inspection, the presence of oedema, hematomas and lacerations can be detected at the level of the skin adjacent to the mandible or maxilla. Facial asymmetry is a clinical sign usually present in the case of maxillary or mandibular fractures. Palpation is performed with both hands, from the lower edge of the mandible, the maxillary area to the nasal bones, the suborbital region, the temporomandibular joint (Bubenik, 2005). Thus, areas of bone discontinuity, the gap of bone fragments, bone crepitations due to the mobility of bone fragments and painful points are highlighted, due to the pain generated by the traumatic focus (Zacher et al., 2013). In cats that have fallen from the floor, the intermandibular symphysis and the palatal region (cleft palate) are checked. Patients who have suffered head trauma may present multiple maxillofacial lesions; therefore, it is recommended to perform a computed tomography scan. Due to the pain generated by the traumatic focus, the intra -oral examination is recommended to be performed under general anaesthesia. The integrity of the oral mucosa, tongue, teeth, hard palate is monitored. Any changes in the oral occlusion are checked (Kleftouri et al., 2017). In order to accurately establish the diagnosis, the location and extent of the fracture, as well as to choose the technique for immobilization and fixation of the fracture, an initial imaging (radiological) examination is necessary. In polytraumatized patients, in addition to skull radiographs, it is recommended to perform additional radiological images of the rib cage (Woodbridge et al., 2013). The standard views used in radiological imaging for maxillary and mandibular fractures are: latero-lateral, dorso-ventral or ventro-dorsal projection if oblique views at various angles are indicated. The temporomandibular joint is best shown on radiographs when using the lateral, slightly oblique view with the oral cavity partially (slightly) open (Stoian, 2009). Interpretation of radiological films, especially of the caudal cranial region and sinus cavities, is often difficult due to the location and overlapping of bone structures. The use of computed tomography (Figure 2) can be of great use for choosing the most appropriate therapy and

method of stabilizing the fracture, especially in the case of complex fractures (Stoian, 2009). Cats presenting symphyseal (Figure 3) or parasymphyseal fractures usually have other mandibular and/or skull fractures, therefore computed tomography becomes necessary (Tundo et al., 2019). Three-dimensionally printed 3-D models contribute to the understanding of the anatomical particularities of the fracture, serve as an anatomical model for surgical planning and intraoperative guidance, contributing to the predictability and success of complex surgical interventions (Godinho et al., 2024).

The objectives pursued in the restoration of a maxillofacial fracture are: pain management, antibiotic therapy (broad-spectrum antibiotics, cephalosporins possibly associated with metronidazole), restoration of oral occlusion, avoidance/reduction of trauma to the vascularization and innervation of the area during the surgical intervention to reduce the fracture, avoidance of trauma to the teeth located in the fracture focus at the time of fracture reduction, extraction of fractured teeth, restoration of masticatory function (Glyde et al., 2003).

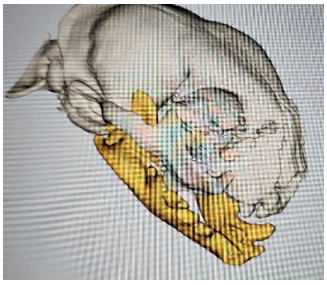

Figure 2. Cat, maxillofacial trauma; straight fracture without displacement of the mandibular ramus (original Uzun)

Figure 3. Intermandibular symphyseal fracture, mental laceration of the skin and subcutis in a cat (original Mocanu)

Figure 4. Dog, radiological image of a mandibular ramus fracture, with displacement (original Ionaşcu)

Complications of mandibular fractures include haemorrhage, nerve damage (Zacher et al., 2013).

The therapeutic approach for fractures of the mandible (Figure 4) or maxilla ranges from conservative, non-invasive management, through "closed" reduction of the fracture, to "open" surgical reduction, with internal fixation. The treatment of fractures is influenced by a number of factors including: the location of the fracture focus, the degree of displacement of the bone fragments, the type of fracture, the stability of the patient and the experience of the surgeon (Fossum, 2019)

The treatment of choice for mandibular or maxillary fractures is represented by surgical treatment - osteosynthesis with: wire or miniplates and titanium screws. The aim of this treatment is to restore the anatomy and function of the mandible and maxilla, by immobilizing, realigning the fractured bones and restoring oral occlusion. To avoid malunion and delayed consolidation, it is necessary that after surgical reduction of the fracture focus there is stability, adequate vascularization and lack of infection. (Freeman et al., 2023)

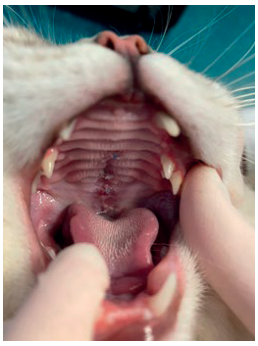

Figure 5. Traumatic cleft palate 14 days after surgery (original Mocanu)

Acute traumatic midline cleft palate defects in cats, commonly associated with feline fall-from-height syndrome, can be successfully repaired using primary appositional closure after debridement, in separate points with absorbable sutures (Figure 5) (Zacher et al., 2013).

The stability of an osteosynthesis is generated by the set of metal implants (wires, screws, plates) that fix the bone fragments, and the delicate manipulation of soft tissues, performing sutures in layers without creating tension preserves the vascularization. Removal of necrotic tissues, intraoperative lavage with sterile saline, postoperative antibiotic therapy, ensuring drainage by installing drain tubes ensures good healing and prevents the development of postoperative infections (Verstaete et al., 2020; Legendre, 2005)

If the patient with a mandibular or maxillary fracture has dental calculus, scaling will be performed first, then the fracture site will be reduced. (Verstaete et al., 2020)

Teeth involved in fractures should not be removed unless they are fractured. This is particularly important in fractures involving the caudal mandibular body because the large premolar and molar teeth occupy a substantial portion of this bone; they are essential contributors to fracture stability.

Unlike long bone fractures where stability is an absolute requirement, in maxillofacial fractures stability can be less rigid in favour of restoring occlusion. In multiple fracture repair, the mandibular fractures are repaired first, the teeth are placed in proper occlusion, and then the maxillofacial fractures are repaired (Stepaniuk, 2014).

Mandibular fractures with minimal displacement and adequate oral occlusion (Fossum 2019) can be treated conservatively, non-surgically, with a muzzle-like bandage made of fabric that allows the mouth to be opened only for drinking water or eating soft food (Fossum, 2019). This type of bandage is kept in place for 6 weeks. A common complication is local dermatitis under the bandage that will heal after the bandage is removed. This type of conservative treatment of mandibular fractures cannot be applied to cats or brachycephalic dog breeds (because there is not enough support from the nasal bones) or when the mandibular fracture is associated with a maxillary fracture, because the pressure exerted on the maxillary fracture causes discomfort (Fossum, 2019).

Postoperatively, the patient's general condition needs to be monitored throughout the convalescence period. In the conditions of a post-traumatic and post-surgical status, nutritional support will be provided by intravenous administration of rehydration solutions, parenteral nutrition solutions, amino acids that will correct any secondary electrolyte deficiencies and will nutritionally support the body. For the management of postoperative inflammation and pain, anti-inflammatory drugs (robexacoxib) and analgesics (tramadol, buprenorphine) will be administered by injection. Postoperative antibiotic therapy by system (injectable) with cephalosporins (possibly associated with metronidazole) for 10-14 days. Per os, the food administered must be soft in the form of a paste. Probiotics can be administered orally (mixed into the food) that favourably influence the digestion processes and increase the body's immunity. If necessary, especially in cats, a feeding tube can be installed (Freeman et al., 2023; Kleftouri et al., 2017).

The animal should be encouraged to eat on its own as soon as possible after surgery; this determines a good evolution and a rapid recovery. The animal owner must be informed about the postoperative complications and follow the recommendations regarding the patient's diet and medication. Thus, it is forbidden for patients with mandibular/maxillary fractures to gnaw bones, toys or to interact intensely or aggressively with other dogs.

Complications of mandibular fractures include haemorrhage, nerve damage, malocclusion, osteomyelitis, malunion, temporomandibular ankylosis, and implant failure (Bubenik, 2005).

Clinical case 1: Male, neutered, long-haired Persian cat was presented for consultation following a facial trauma. The history revealed that the animal had become apathetic, was eating little, and was not grooming itself.

Clinical examination by palpation revealed oedema and tenderness in the left mandibular region. After the initial approach and stabilization of the clinical condition, computed tomography revealed a closed fracture of the mandibular ramus.

Since the patient was brachycephalic, a surgical fixation technique with a 3D printed plate was adopted for open reduction of the fracture and avoidance of complications. The plate was 3D printed according to the patient's anatomical model following the measurements obtained by computed tomography (Figures 6 and 7).

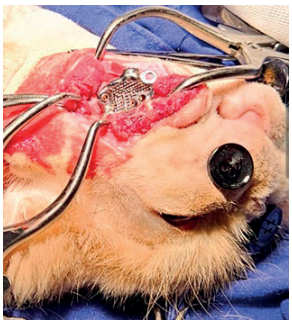

Figure 6. Application of the 3D printed plate in clinical case 1 (original Uzun)

Figure 7. Postoperative radiological examination of clinical case 1 (original Uzun)

Clinical case 2: European cat, 6 months old, fall from the 2nd floor. The patient is stable, alert.
A complete clinical examination was performed, abrasion of the chin region and intermandibular disunion were observed.
The radiological examination confirmed the diagnosis of mandibular symphysis fracture.
The feline patient under general inhalation anaesthesia by endotracheal intubation is placed in the supine position with the head and neck extended.
Tracheostomy for inhalatory anaesthesia is not recommended in cats because it involves risks (Woodbridge et al., 2013d).
The evaluation of dental occlusion after fracture reduction will be performed by detaching the probe tube.
The fracture was examined, necrotic tissues were debrided, lavage was performed with saline, the edges of the intermandibular symphysis were curetted until haemorrhage occurred, and the bone fragments were repositioned in anatomical position.
A small incision is made with a scalpel in the lower mental area that concerns the cutis and subcutaneous connective tissue.
Through the incision, maintaining contact with the mandible, a 14 G syringe needle is inserted and removed at the level of the gingival mucosa in the diastema behind the lower canine. The needle will be slightly curved beforehand in order to be able to follow the curved contour of the mandible.
A 0.3 mm surgical wire will be inserted through the hole at the tip of the needle, then the needle is withdrawn together with the wire, up to the level of the incision, after which we remove the needle. The same procedure is performed on the opposite side.
The wire is inserted by symmetrical traction on both ends of it, so as to apply an equal force. The ends of the wire are shortened and twisted by continuous pulling and rotation. The two ends of the wire are twisted under the mandible, progressively tightening the two mandibular branches, they approach each other, and the intermandibular symphysis is restored; the knot is bent inward.
After stabilizing the fracture focus, the dental occlusion is checked. A perfectly aligned fracture focus is not acceptable if the dental occlusion is not correct (Fossum, 2019).
Extraction of the metal implant is done after 45 days-60 days after surgery.

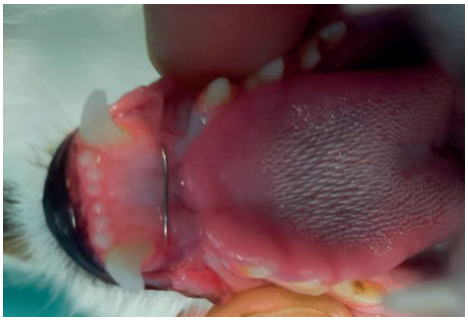

Figure 8. Intermandibular fracture repaired with surgical wire cerclage 60 days after surgery; the gum and adjacent tissues are observed to have grown over the metal implant due to body development as a result of the feline patient's aging: Cat, European breed, 8 months, clinical case 2 (original Mocanu)

Correct occlusion is achieved when, with the oral cavity closed, the mandibular canines are inside the maxillary canines.
Clinical case 3: dog, Mioritic Shepherd breed, male, 2 months old, maxillofacial trauma by bite; rostral fracture of the jaw with displacement, multiple gingival and buccal mucosa lacerations (Figure 9). After stabilization, emergency intervention was performed to avoid haemorrhagic and infectious complications. Skull growth in skeletally immature dogs could be severely restricted and influenced by the use of internal fixation. Because the jaw and other bones of the skull simultaneously undergo growth, elongation, and displacement in the rostrocaudal and lateral directions, rigid fixation with plates that "block" the bone sutures of the skull inhibit the growth of the facial bones (Arzi et al., 2015)

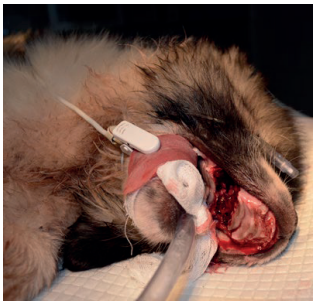

Figure 9. Rostral maxillofacial trauma, open jaw fracture, dog, Mioritic Shepherd, 2 months, clinical case 3 (original Mocanu)

Following these considerations, since it was a paediatric patient, the surgical technique of interfragmentary fixation in separate points (Figure 10) of the bone fragments with surgical wire was applied.

Figure 10. Postoperative radiological image of clinical case 3. The metal implants are visible in the area of the maxillary fracture (original Mocanu)

After decontamination of the area and debridement by abundant lavage with sterile saline, blood clots and necrotic tissues were removed by sharp dissection, haemostasis was performed. The fractured fragments were put back in anatomical position. Holes were made on each side of the fractured maxillary bone into which surgical wire was inserted. Fixation loops were created, the ends of which were intertwined. Oral occlusion was checked. The soft tissues were sutured in layers with absorbable threads in separate points.
Postoperatively, the animal was hospitalized for 10 days, during which treatment with antibiotics, analgesics, anti-inflammatories, and probiotics was applied. From the second day, the animal was able to feed and drink water on its own. Postoperative recovery was favourable, the animal recovered completely (Figure 11).

Figure 11. Appearance of the jaw 4 months after surgery clinical case 3 (original Mocanu)

Due to the normal soft tissue healing process, whereby the fibrous connective tissue that forms during healing contracts as the final scar forms, the patient at the age of 6 months presented with mild mandibular pseudo-prognathism.

CONCLUSIONS

Surgery of maxillofacial trauma in dogs and cats is particularly difficult due to the particularities of the bone structures at this level as well as the complexity of the vascular and nervous structures, but also the existence of peripheral segments of the sense organs (eyes, tongue) that are housed by the viscero-cranium.
The approach to these types of fractures must be multidisciplinary both in terms of establishing the diagnosis through clinical and imaging methods and from a therapeutic point of view. The patient with craniofacial polytrauma must be evaluated by an emergency physician, ophthalmologist, dentist, neurologist, and

maxillofacial surgeon. Imaging examinations (radiography and computed tomography) provide important information that will contribute to understanding the anatomical features of the fracture and will serve to establish the subsequent surgical protocol. The use of the most appropriate surgical techniques established individually for each patient contributes to surgical success and a favourable postoperative outcome.

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