

UC Davis

UC Davis Previously Published Works

Title

Feline skull injuries: treatment goals and recommended approaches

Permalink

<https://escholarship.org/uc/item/96j5n10h>

Journal

Journal of Feline Medicine and Surgery, 22(5)

ISSN

1098-612X

Authors

Arzi, Boaz
Fiani, Nadine
Peralta, Santiago
et al.

Publication Date

2020-05-01

DOI

10.1177/1098612x20917603

Peer reviewed

Feline skull injuries: treatment goals and recommended approaches

Dear Editors, – We read with interest the article by Drs Cristina Rizkallal and Pilar Lafuente entitled ‘Feline skull injuries: treatment goals and recommended approaches’.¹ This article appears to be a narrative review that aims at explaining the existing knowledge on perspectives and management of maxillofacial injuries in cats. One of the valuable aspects of a review paper is that it presents a summary of the scientific literature so that the readers can form an idea about the existing and current knowledge to enhance patient care. Unfortunately, we found this paper to contain (1) terminological inaccuracies; (2) historical treatments that are no longer recommended and widely accepted; (3) a lack of understanding of certain disorders; and (4) minimal information on the current standard of care in feline maxillofacial fracture management. The end result is that the journal’s readership was not exposed to the most updated and scientifically sound information.

✦ **Nomenclature and anatomical descriptions** The authors use the term ‘hemimandible’ on several occasions. According to *Nomina Anatomica Veterinaria* and leading veterinary anatomy books, most animals, including cats, have two mandibles (not hemimandibles), one on each side.^{2,3} On the same note, the mandibular canal contains the inferior alveolar artery, vein and nerve (ie, the neurovascular bundle), not the ‘mandibular alveolar artery’ or the ‘inferior mandibular nerve’. Also, there are no ‘premaxillary bones’, these are the incisor bones. In addition, the articular cartilage of the temporomandibular joint (TMJ) is not made of hyaline cartilage but a fundamentally different fibrocartilaginous tissue, with a fibrocartilaginous disc separating the joint into two non-communicating compartments.^{4,5}

✦ **Mandibular body fractures** The authors discuss two main options: interfragmentary wiring and plate fixation. They do not discuss or provide images of one of the most common methods of repair: interdental wire and composite splint (ie, a minimally invasive approach).^{6,7} With regards to using internal fixation, it is unfortunate that the authors mention the use of general orthopedic and mostly stainless steel plates (eg, dynamic compression plates and locking compression plates). In fact, the mentioned plates are not recommended for use in the oral and maxillofacial region.^{6,8} This is largely due to the fact that, in contrast to stainless steel, titanium miniplate systems are designed for maxillofacial fractures in humans and are an effective means for internal fixation of mandibular and maxillofacial fractures in cats and dogs. Importantly, titanium miniplates have a modulus of elasticity and density similar to bone and enable osteointegration with the underlying bone.⁹ Furthermore, the biomechanics and ideal placement of locking titanium miniplates for repair of mandibular fractures in cats has been thoroughly established, published and practiced.^{8,10} Unfortunately, none of this information is conveyed in this review paper. The use of an external fixator in cats, as mentioned and illustrated in the manuscript, may be a common practice in the authors’ experience but is certainly

not widespread. In fact, external fixation, as demonstrated in Figure 11 of the manuscript, with 12 pins, some crossing from side to side, is highly likely to result in dental and neurovascular damage, pain and interference with tongue function, with little scientific evidence to support its use.

✦ **Maxillary fractures** We contest the statement describing that for large defects in the hard palate an interfragmentary pin with or without a figure-of-eight wire is ‘the treatment of choice’. This is not the case; it is merely the authors’ opinion.

✦ **Temporomandibular joint fractures and disorders** The authors describe a ‘locking-jaw syndrome’, a clinical entity that is actually known as TMJ dysplasia. This is not a syndrome but a clinical disorder that results in ‘locking’ of the coronoid process on the zygomatic arch due to excessive laxity of the TMJ (ie, due to dysplastic changes).^{6,11} In addition, currently, removal of maxillofacial bones, as described for the zygomatic arch, should be performed with precision osteotomy devices, such as instruments used in piezoelectric bone surgery, not with rongeurs.¹² It is also not clear how this non-traumatic skull entity has made its way into this manuscript on skull injuries.

The use of rigid or elastic maxillomandibular fixation, the most common and appropriate fixation for TMJ fractures, is minimally explained and illustrated.^{6,7} Instead, the authors extensively describe the bi-gnathic encircling and retaining device (BEARD) technique, which was reported in 2010 and is not commonly used or published in leading textbooks.¹³

Finally, we acknowledge that there are various approaches to treat maxillofacial fractures in cats and we invite the authors to review the current scientific literature and recently published books that are referenced in this letter. We believe that this literature deserved to be acknowledged by the authors and described to the readership of the journal.

Boaz Arzi DVM, DAVDC, DEVDC, Founding Fellow AVDC Oral and Maxillofacial Surgery Associate Professor, Department of Surgical and Radiological Sciences, University of California, Davis, CA 95616, USA

Nadine Fiani BVSc, DAVDC, Founding Fellow AVDC Oral and Maxillofacial Surgery Assistant Clinical Professor, Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY 14853, USA

Santiago Peralta DVM, DAVDC, Founding Fellow AVDC Oral and Maxillofacial Surgery Assistant Professor, Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY 14853, USA

Frank JM Verstraete DrMedVet, BVSc, MMedVet, DAVDC, DECVS, DEVDC, Founding Fellow AVDC Oral and Maxillofacial Surgery Professor, Department of Surgical and Radiological Sciences, University of California, Davis, CA 95616, USA

Conflict of interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this letter.

Funding

The authors received no financial support for the research, authorship, and/or publication of this letter.

References

- 1 Rizkallal C and Lafuente P. **Feline skull injuries: treatment goals and recommended approaches.** *J Feline Med Surg* 2020; 22: 229–240.
- 2 International Committee on Veterinary Gross Anatomical Nomenclature. *Nomina anatomica veterinaria*. 6th ed. <http://www.wava-amav.org/wava-documents.html> (2017, accessed March 4, 2020).
- 3 Evans HE and de Lahunta A. *Miller's anatomy of the dog*. 4th ed. St Louis, MO: Elsevier Saunders, 2013.
- 4 Zavodovskaya R, Garcia T, Verstraete FJM, et al. **Intra- and extra-articular features of temporomandibular joint ankylosis in the cat (*Felis catus*).** *J Comp Pathol* 2020; 175: 39–48.
- 5 Lin AW, Vapniarsky N, Cissell DD, et al. **The temporomandibular joint of the domestic dog (*Canis lupus familiaris*) in health and disease.** *J Comp Pathol* 2018; 161: 55–67.
- 6 Verstraete FJM, Lommer MJ and Arzi B. *Oral and maxillofacial surgery in dogs and cats*. 2nd ed. St Louis, MO: Elsevier, 2020.
- 7 Reiter AM and Gracis, M. *BSAVA manual of canine and feline dentistry and oral surgery*. Gloucester, UK: British Small Animal Veterinary Association, 2018.
- 8 Greiner CL, Verstraete FJM, Stover SM, et al. **Biomechanical evaluation of two plating configurations for fixation of a simple transverse caudal mandibular fracture model in cats.** *Am J Vet Res* 2017; 78: 702–711.
- 9 Prein J and Kellman RM. **Rigid internal fixation of mandibular fractures – basics of AO technique.** *Otolaryngol Clin North Am* 1987; 20: 441–456.
- 10 Boudrieau RJ and Kudisch M. **Miniplate fixation for repair of mandibular and maxillary fractures in 15 dogs and 3 cats.** *Vet Surg* 1996; 25: 277–291.
- 11 Reiter AM and Lewis JR. **Locked jaw syndrome in dogs and cats: 37 cases.** *J Vet Dent* 2008; 25: 16–22.
- 12 Hennet P. **Piezoelectric bone surgery: a review of the literature and potential applications in veterinary oromaxillofacial surgery.** *Front Vet Sci* 2015; 2: 8. DOI: 10.3389/fvets.2015.00008.
- 13 Nicholson I, Wyatt J, Radke H, et al. **Treatment of caudal mandibular fracture and temporomandibular joint fracture-luxation using a bi-gnathic encircling and retaining device.** *Vet Comp Orthop Traumatol* 2010; 23: 102–108.

The authors respond:

We would like to thank Drs Arzi, Fiani, Peralta and Verstraete for their comments and observations regarding this peer-reviewed manuscript, which focuses on the most common feline skull conditions and the management options available to clinicians. We would like to point out that all the information included in this article is based on published literature and the experience of the authors. More specifically, in response to the comments made by our colleagues:

❖ **Nomenclature and anatomical descriptions** We appreciate the comment that mandible is a more accurate anatomical term than hemimandible. However, the terms hemimandible and halves of the mandible are still widely used in the veterinary literature.^{1–10}

The alveolar artery in the mandibular canal has been termed the inferior or mandibular alveolar artery depending on the anatomy book.¹ The terms mandibular alveolar vein and artery are still used in veterinary anatomy and surgery books.^{2,3,11}

It has been described that a thin fibrocartilaginous disc lies between the hyaline cartilage-covered articular surfaces of the condyloid process of the mandible and the mandibular fossa of the temporal bone.¹²

The term premaxilla appears on several occasions in Miller's anatomy of the dog, as a term historically used to address the incisive bone,¹ and it is also used in peer-reviewed papers reporting maxillofacial injuries and surgery in dogs and cats.^{13,14}

❖ **Mandibular body fractures** Our colleagues mentioned that we do not include one of the most common methods of stabilisation: interdental wire and composite splint. The use of these stabilisation techniques might be common in dogs,¹⁵ especially for clinicians more familiar with dental techniques. However, it has been reported that 'true interdental wiring is not possible in the cat because of the small size and shape of the teeth, which prevent stable anchorage of the wire around the base of the teeth. A modification of interdental wiring, with the wires passing through predrilled holes in between the tooth roots, is sometimes used for bilateral fractures of the rostral mandible or maxilla in cats.² It is likely that clinicians who routinely perform orthopaedic surgeries would elect other techniques, for which they have the experience and necessary equipment. These stabilisation techniques have been extensively reported in the literature.^{2,8,16}

Regarding the use of general orthopaedic implants (stainless steel plates or external skeletal fixation) vs titanium miniplates, the stainless steel implants are widely available to surgeons that routinely perform orthopaedic surgeries. The use of these implants is well described in the surgical literature and these techniques provide adequate stability for mandibular fractures, especially comminuted fractures.^{2–4,8,10,16,17} The different configurations of external skeletal fixator for the stabilisation of mandibular fractures have been previously reported.¹⁰ Placement of pins from side to side in the rostral aspect of the mandible has been reported in dogs and cats without causing interference with tongue function.¹⁰ Although these implants would probably contact the tooth roots, it is unknown if significant clinical problems would manifest in dogs and cats. While human studies show minimal morbidity after this, we do acknowledge that care should be taken to avoid tooth root damage.⁹ We agree about the benefits that titanium miniplates would provide to the stabilisation of mandibular fractures. However, these implants may not be readily available to clinicians not performing maxillofacial surgery exclusively.

❖ **Maxillary fractures** Regarding the questioning of the recommendation that unstable fractures of the hard palate be treated with a pin and cerclage wire,

there is evidence in the literature that 'significantly displaced split palates are best stabilized surgically with a pin or a skewer pin'.² This was actually the most common surgical technique used for hard palate reconstructions in a retrospective study performed in cats with skull fractures.¹⁶

❖ Temporomandibular joint fractures and disorders

Locking-jaw syndrome in cats has been described in the literature, and reported to be over-represented in cats with brachycephalic conformation of the skull.² It has frequently been associated with temporomandibular joint dysplasia, but it has also been linked to traumatically induced conformational changes of the mandible and zygomatic arch^{2,18,19} or even muscular pathology.^{18,19} Although other surgical approaches might be applied, the use of rongeurs for partial removal of the zygomatic arch is reported in the literature as an option for this purpose.²

Additionally, our colleagues mentioned that the bi-gnathic encircling and retaining device (BEARD) technique is extensively explained in our manuscript but is not commonly used in practice. This is a personal opinion as the use of this technique has been reported in retrospective studies of skull fractures in cats.¹⁶ Although it may not be the most frequently applied technique, it definitely has its indications and therefore needs to be explained to the readership.

We recognise that the choice of one management option over another frequently depends on the evidence and equipment available, as well as the clinician's experience. It seems reasonable that veterinarians with wider experience in dental work may choose management techniques that involve the patient's teeth. Conversely, veterinary surgeons with particular experience in orthopaedic procedures and availability of orthopaedic equipment may elect to perform other surgical procedures. We acknowledge there are books focusing on maxillofacial surgery that are available to general practitioners and surgeons if they are interested in widening their knowledge in this field.¹⁵

Pilar Lafuente DVM, PhD, DACVS-SA, DECVS, DACVSMR, CCRT, FHEA, MRCVS
Cristina Rizkallal DVM

References

- 1 Evans HE and de Lahunta A. *Miller's anatomy of the dog*. 4th ed. St Louis, MO: Elsevier Saunders, 2013.
- 2 Montavon PM, Voss K and Langley-Hobbs SJ (eds). *Feline orthopaedic surgery and musculoskeletal disease*. St Louis, MO: Saunders Elsevier, 2009.
- 3 Johnson AL and Dunning D (eds). *Atlas of orthopedic surgical procedures of the dog and cat*. St Louis, MO: Saunders Elsevier, 2005.
- 4 Woodbridge N and Owen, M. **Feline mandibular fractures: a significant surgical challenge**. *J Feline Med Surg* 2013; 15: 211–218.
- 5 Eriksen T, Koch R and Nautrup CP. **Microradiography of the feline marginal periodontium with a microfocal high-resolution x-ray system**. *Scand J Dent Res* 1994; 102: 284–289.
- 6 Goret-Nicaise M, Lengele B and Dhe A. **The function of Meckel's and secondary cartilages in the histomorphogenesis of the cat mandibular symphysis**. *Arch Anat Microsc Morphol Exp* 1984; 73: 291–303.
- 7 Da Silva AM, De Souza WM, Burkhardt de Koivisto M, et al. **Miniplate fixation of the repair of segmental mandibular defects filled with autogenous bone in cats**. *Acta Cir Bras* 2011; 26: 174–180.
- 8 Da Silva AM, De Souza WM, De Athayde Bernabé P, et al. **Miniplate 1.5 fixation for the repair of mandibular osteotomies in cats**. *Acta Cir Bras* 2011; 26: 31–37.
- 9 Tobias KM and Johnston SA (eds). *Veterinary surgery: small animal*. Volume 1. St Louis, MO: Saunders Elsevier, 2012.
- 10 Owen MR, Langley-Hobbs S, Moores, AP, et al. **Mandibular fracture repair in dogs and cats using epoxy resin and acrylic external skeletal fixation**. *Vet Comp Orthop Traumatol* 2004; 17: 189–197.
- 11 Radlinsky MAG. **Surgery of the digestive system**. In: Fossum TW (ed). *Small animal surgery*. 4th ed. St Louis, MO: Elsevier, 2013.
- 12 Little S (ed). **The cat: clinical medicine and management**. St Louis, MO: Saunders Elsevier, 2012.
- 13 Tundo I, Southerden P, Perry A, et al. **Location and distribution of craniomaxillofacial fractures in 45 cats presented for the treatment of head trauma**. *J Feline Med Surg* 2018; 21: 322–328.
- 14 Gallegos J, Schmiedt CW and McAnulty JF. **Cosmetic rostral nasal reconstruction after nasal planum and premaxilla resection: technique and results in two dogs**. *Vet Surg* 2007; 36: 669–674.
- 15 Verstraete FJM and Lommer MJ (eds). *Oral and maxillofacial surgery in dogs and cats*. St Louis, MO: Elsevier Saunders, 2012.
- 16 Knight R and Meeson RL. **Feline head trauma: a CT analysis of skull fractures and their management in 75 cats**. *J Feline Med Surg* 2019; 21: 1120–1126.
- 17 Moores AP. **Maxillomandibular external skeletal fixation in five cats with caudal jaw trauma**. *J Small Anim Pract* 2010; 52: 38–41.
- 18 Nutt AE, Anderson T, Gracis M, et al. **Open-mouth jaw locking in cats: a literature review and use of CT in three cases**. *J Feline Med Surg* 2018; 20: 1180–1191.
- 19 Hsuan L, Biller DS, and Tucker-Mohl K. **Open mouth jaw locking in a cat and a literature review**. *Isr J Vet Med* 2017; 72: 54–59.

DOI: 10.1177/1098612X20917603

© The Author(s) 2020

Article reuse guidelines: sagepub.co.uk/journals-permissions
This letter was handled and processed by the European Editorial Office (ISFM) for publication in *JFMS*