Open Mouth Jaw Locking in a Cat and a Literature Review

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ABSTRACT

Open mouth jaw locking in dogs and cats is characterized by an inability to close the mouth that usually results from fixed mandibular coronoid process displacement lateral to the ipsilateral zygomatic arch and abnormal contact pressure between these two structures. Other causes of an open mouth persentation include temporomandibular luxation or dysplasia and trigeminal neuropathy. While historic and physical findings can be suggestive of likely causes, imaging, most commonly radiography, is often required to confirm the diagnosis, and computed tomography may be used as an adjunctive or the sole imaging modality. Manual reduction is the first-line treatment method in open mouth jaw locking secondary to coronoid process-zygomatic arch interlocking and temporomandibular dislocation. An understanding of the anatomy and function of the temporomandibular joint is essential in making a diagnosis and in the management of the different conditions. This report describes the clinical presentation, imaging diagnosis and management of a case of feline open mouth jaw locking and temporomandibular joint luxation and subluxation. An intra-oral approach to manual reduction is described in the report.

Keywords: Temporomandibular Joint; Open Mouth Jaw Locking; Luxation; Subluxation.

CASE REPORT

A 7-year-old, male neutered domestic shorthair cat was presented due to an acute onset of the inability to close its mouth. While sitting with the owner, the cat emitted an abnormal sound and fell off the couch. The cat was brought immediately for examination, which showed that the cat was unable to close its mouth. There was no known history of trauma. However, owner had noted a chipped tooth of which the inciting event and time of sustainment were unknown. The cat lived indoor with another cat and was fed a dry commercial diet.

At presentation, the cat was bright, alert and responsive, with a rectal temperature of 39.1˚C, heart rate of 150 beats/minute and respiratory rate of 76 breaths/minute. The upper right canine tooth was fractured; the age of the fracture could not be ascertained. The mouth was wide open. Manipulation failed to permit oral closure and was painful. The cat was then sedated (Dexdomitor, 0.008mg/kg, Orion Corporation Orion Pharma, Espoo, Finland and butorphanol-tartrate, 0.4mg/kg, Zoetis, Parsippany, NJ, IM) for diagnostic imaging.

Initial dorsoventral and right and left lateral oblique views (Figures 1 and 2 & 3, respectively) showed right temporomandibular joint (TMJ) luxation and left TMJ subluxation. The mandibles had shifted towards the left relative to the rest of the skull, along with leftward rostral-lateral angling and clock-wise rotation (when viewed cranio-caudally) of the mandfibulr arcade. Impingement of the left mandibular coronoid process on the ventrolateral aspect of the rostral end of the left zygomatic arch was present. There was no contact between the maxillary and mandibular canine teeth. No evidence of skull fracture was noted.

With a diagnosis, application of buccally-directed, gentle digital pressure to the right hemi-mandible from inside of the mouth immediately corrected the coronoid impingement and temporomandibular luxation and subluxation. Another set of radiographs of the head showed complete temporomandibular reduction, realignment of the maxillary and mandibular arcades and removal of the abnormal contact between the left mandibular coronoid process and the left zygomatic

arch. Sedation was then reversed (Antisedan, 0.08mg/kg, Orion Corporation Orion Pharma, Espoo, Finland, IM). The cat was able to eat commercial canned food soon after, did well overnight, and was discharged a day later with a tape muzzle, E-collar and instructions to feed semiliquid canned food for four weeks. Buprenorphine (Buprenorphine-HCl, 0.02mg/kg, Par Pharmaceuticals, Rochester, MI) was applied between the cheek and gums q8h for 3 days. The owners were instructed to prohibit access to toys to prevent recurrence. Five month post-reduction, the cat was healthy and no re-luxation or oral discomfort or pain had been noted, even when the cat ate or yawned.

Figure 1: Dorsoventral radiograph of the skull and mandibles (with the mouth in a naturally locked position). There is leftward displacement and rostrolateral angling of the mandibular arcade in the dorsal plane. There is also a degree of clockwise rotation of the lower jaw around its long axis as evidenced by the relatively increased angling of the left coronoid process(short open arrow) and apparent widening of the mandibular symphysis (long open arrow). Left coronoid process impingement on and lateralization to the rostral aspect of the left zygomatic arch (solid arrow) are present.

Figures 2 & 3: Right and left lateral oblique radiographs of the skull and mandibles (with the mouth in a naturally locked position). There is luxation of the right temporomandibular joint (dotted arrow) and subluxation of the left temporomandibular joint (solid arrow). A lack of contact between the maxillary and mandibular canine teeth is also evident.

DISCUSSION

The TMJ is a synovial-condylar joint (1). The slightly ventrolateral-dorsomedially oriented, congruent to mildly incongruent joint is located between the mandibular fossa of the zygomatic process of the squamous temporal bone and the condyloid process of the ramus of the mandible (1-4). A tubercle of greater prominence in cats than in dogs is located rostral to the mandibular fossa (2, 3, 5). Hinge-type movements predominate in dogs and cats due to the elongation of the condyloid process in the transverse plane (2, 4, 5, 6). A thin meniscus that forms a 360° attachment to the joint capsule separates the joint into a dorsal (maxillary) and a ventral (mandibular) compartment and acts to minimize friction, to absorb shock and to enable articular congruity (1, 2, 5, 6). In the cat, the conical shape of the condyloid process and the deeply recessed mandibular fossa preclude lateral movements (4). Rostral thickening of the disc prevents anterior dislocation (4). Laterally, the joint is reinforced by a thickened area of joint capsule in the cat (2, 3, 5) and also the lateral ligament in the dog (1, 2, 5). Laxity in the joint capsule and the lateral ligament may play a permissive role in TMJ luxation (1). The retroarticular process, a ventral projection of the squamous temporal bone that forms part of the mandibular fossa, helps preventing caudal condylar movement (1-3, 5). Attachments of the temporal, masseter, styloauricular and medial and lateral pterygoid muscle fibers to the joint capsule in cats may provide additional articular stability (3).

An inability of small animals to close the mouth may result from open-mouth jaw locking (OMJL), the displacement and usually locking of the mandibular coronoid process lateral to the zygomatic arch (2, 5,7). In dogs, conditions associated with OMJL may include TMJ laxity secondary to dysplasia, trauma, contralateral total mandibulectomy, peri-temporomandibular bony proliferation, and possibly masticatory muscle myositis, while in cats these include zygomatic arch flattening, mandibular malunion or thickening, traumatic facial injuries, increased symphyseal movements and brachycephaly (5, 7).

The history is important in the diagnosis of OMJL, as it is usually observed after animals have yawned, groomed or vocalized (5, 7). Animals experiencing OMJL may show facial pawing or rubbing, head shaking, sialorrhea and vocalization (7). Physical findings of a wide open mouth, lowered positioning of the mandible ipsilateral to the side of the lesion, lack of dental contact and, in some cases, palpable coronoid process superficial to the zygomatic arch, help to distinguish OMJL from TMJ dislocation (7, 8). Resolution might be spontaneous or require manual correction, but recurrence is possible (7).

An inability to close the mouth can also result from temporomandibular luxation (11, 12). While caudal luxation might occur with fractures in the retroarticular process, mandibular fossa or mandibular head, rostral mandible movement is more common (5, 13, 14). Trauma-induced TMJ dislocation, a relatively common cause of OMJL in cats, may occur with or without condylar process fractures and maxillofacial fractures, such as those involving the symphysis, hard palate, zygomatic arch, maxilla and mandibles (13). Cats are relatively prone to rostro-dorsal unilateral luxation independent of interruption of the mandibular corpora and symphysis due to the increased angle between the mandibles (5, 9). As opposed to caudal dislocation, unilateral rostro-dorsal luxation presents with the mandibles deviated towards the opposite side of the lesion (2, 15). Lesions in cats are most commonly caused by falling from a height or high rise syndrome but might occur following vehicular impact, human encounters, cat fights and other trauma (13). Recurrent TMJ luxation has been reported in a cat with a brainstem lesion and a cat with trigeminal paralysis (9). Injuries in dogs might be caused by trauma and joint dysplasia (5). In dogs, temporomandibular subluxation, more common in the rostral direction, might involve one or both joints and has etiologies such as dysplasia, degeneration, trauma and surgical mandibular fracture repair (5). Schwartz and colleagues (2002) also proposed the differential post-anesthetic rise in tone in the masticatory hemi-muscles following mandibular surgery as a possible precipitating factor in temporomandibular subluxation and abnormal occlusion (5). Temporomandibular subluxation or luxation, with OMJL and malocclusion, might occur secondary to TMJ dysplasia, a congenital or developmental disorder in cats and dogs that results in joint incongruity (2, 5, 10). Greater degree of rostromedial-caudolateral angling of the condylar process that results in increased rostro-ventral arcing of the lateral portion of the condyloid process in a wide open mouth has been suggested as a possible cause of stretch-induced TMJ capsule and lateral ligament laxity, thereby permitting temporomandibular subluxation and mandibular displacement (5, 7).

Ventrodorsal or dorsoventral, lateral, lateral-oblique and rostrocaudal radiographic views are used to detect coronoid process-zygomatic arch locking and to evaluate associated temporomandibular changes, such as an ipsilateral or contralateral condyloid subluxation or luxation, increased obliquity of the affected coronoid process, misshapen mandibular fossa, condyloid flattening or thickening, under- or over-developed articular protuberances and osteophytosis (2, 5, 7, 9). In four cats reported with OMJL, subluxation was the only radiographic abnormality (5). Computed tomography (CT) scanning may be superior to traditional radiography, due to better evaluation of the bony structures in terms of examinable sizes and details, removal of superimposition and the options of contrast imaging and image reconstruction, especially in cases where the mandible and skull appear normal or findings are ambiguous, radiographically (10). Beam and colleagues (2007) demonstrated the use of CT as an aid in the diagnosis of OMJL and pre-operative planning in a cat (8). At the authors' institution, CT had been used successfully in the diagnosis of an additional case of OMJL and TMJ subluxation in a cat with no known history of trauma (Figures 4 & 5).

On radiographs, the normal intra-articular area occupied by the joint cartilage and meniscus is seen as a narrow radiolucent space with clear margins between the head of the condyloid process and the mandibular fossa, with the articular space being of consistent width in the cat but is curved and narrowed medially in the dog due to the visualization of the retroarticular process and temporal bone (5). The dorsoventral view is superior for diagnosing anterior luxation and subluxation by allowing the visualization of joint space narrowing or widening, although oblique and "nose-up" oblique projections may be used to decrease superimposition (2, 5). Furthermore, open mouth views may allow detection of dynamic temporomandibular subluxation (5). Radiographic confirmation of TMJ subluxation may be challenging, and possible bilateral involvement precludes a rule-out diagnosis based on joint width comparison (5). Detection of radiographic changes, such as flattened mandibular fossa and condyloid process, malformed condyloid process, incompletely or malformed retroarticular process, widened and irregular joint space with osteophyte formation and steep angling of the articular facet of the condylar process, suggest TMJ dysplasia (5, 10). Caution should be exercised in dogs up to six months of age, as incomplete ossification may give the TMJ a dysplastic appearance on radiographs (5). In temporomandibular dysplasia, CT imaging may also reveal sclerosis enclosing hypo-intensive areas in the subchondral bones, which possibly results from osteoarthritic remodeling (10).

Another important differential for an open jaw presentation is trigeminal nerve dysfunction (2, 12, 16). Idiopathic

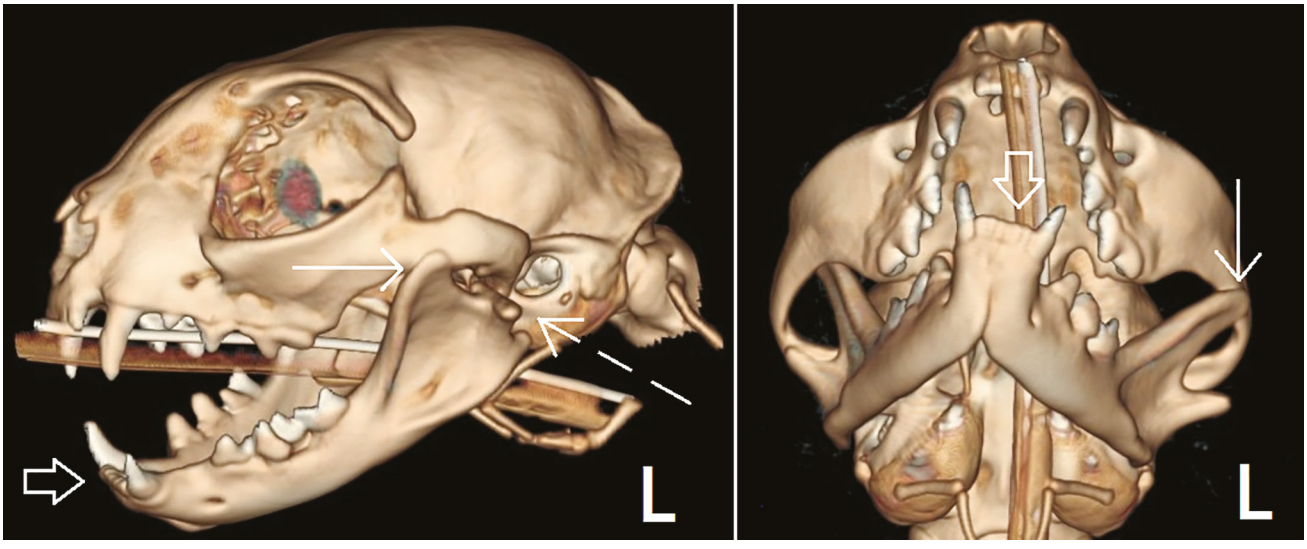

Figure 4 & 5: Three dimensionally reconstructed left lateral and cranioventral-caudodorsal views of the skull and mandibles (with the mouth in a naturally locked position). There are impingement of the laterally displaced and locked left coronoid process on the ipsilateral zygomatic arch (solid arrow), luxation of the left temporomandibular joint (dotted arrow), rightward displacement of the lower jaw, clockwise rotation of the mandibular arcade around its long axis (open arrow) and loss of contact between the maxillary and mandibular teeth.

trigeminal neuropathy (also known as trigeminal neurapraxia or trigeminal neuritis) is a non-purulent, demyelination-associated condition characterized by an acute and usually transient episode of flaccid paralysis that results in a loss of voluntary ability to close the mouth (2, 12, 16). Other reported etiological agents that might affect the trigeminus in dogs include neoplasia (e.g., infiltrative lymphoma) and infection (e.g. neosporosis) (12). To rule out mandibular dysfunction, a complete neurological examination with a focus on Cranial Nerve V function should be done in the conscious animal (2).

The present cat suffered from concurrent OMJL and TMJ subluxation and luxation, the cause(s) of which remains unclear. It cannot be determined whether the subluxation and luxation preceded coronoid displacement or vice versa. Possible causes of this acute episode include idiopathy, chronic subluxation of unknown origin, temporomandibular dysplasia or malformation, neuropathy and unreported trauma. While the fractured upper right canine tooth may be a possible indicator of previous trauma, it might have occurred when the cat fell off the couch. Trigeminal neuropathy is made less likely by the cat's ability to eat normally after manual reduction. TMJ dysplasia seems unlikely, given the age at diagnosis but cannot be ruled out without further imaging.

Simple anterior luxation can be corrected by temporomandibular distraction, enabled by manual mouth closure over a transversely-oriented rod placed between the caudal maxillary and mandibular molars (2, 14). In rostral luxation, reduction is achieved by the forces exerted by the nearby soft tissues and a push on the rostral mandible in the caudal direction, sometimes as a second step to a rostral pull on the affected side to first dislodge the condyle from the articular eminence, and, as opposed to caudal luxation, is usually stable (2, 11, 14). Tape muzzling may be employed to provide additional support (2, 15). Reiter (2004) reported manual repair of OMJL by applying a medially directed pressure to the coronoid process in a wide open mouth, followed by mouth closure (7). In the present case, exertion of digital pressure to the right hemi-mandible from within the oral cavity appeared to be adequate for reducing the temporomandibular joint luxation and sub-luxation and correcting the left coronoid impingement on the ipsilateral zygomatic arch.

In cases of unstable reduction, long term stabilization options may include inter-canine bonding, maxillomandibular external fixation, trans-articular wiring, TMJ capsular imbrication, mandibular condylectomy and partial zygomatic arch or coronoid resection, with or without feeding tube placement (2, 7, 10). Mandibular symphyseal separation and arthrodesis, along with dental extraction, were also used in a cat with malocclusion and unstable OMJL (7).

CONCLUSIONS

The TMJ is complex in structure and function. Temporomandibular dysfunction might result from pathologies in its associated osseous and soft tissue components. Understanding TMJ structure and mechanics facilitates the making of a differential list, diagnostic planning, interpretation of imaging findings and formulation of a management plan in cases of TMJ disorders.

Numerous processes may cause an inability to close the jaws in dogs and cats. The history and physical examination are important in prioritizing the likely etiology. Historical and physical evidence of trauma should lead the clinician to suspect TMJ dislocation and possible concurrent maxillofacial injuries. On the other hand, the absence of prior history of trauma could suggest OMJL. Flaccid paralysis of the masticatory muscles suggests trigeminal neuropathy. Temporomandibular dysplasia should be suspected in young animals with presenting signs consistent with TMJ luxation and OMJL. A diagnosis of OMJL and TMJ luxation or subluxation can be made based on survey radiographic and CT findings, while trigeminal neuropathy requires careful cranial nerve assessment for confirmation. TMJ luxation and OMJL can often be corrected via closed reduction. Unstable reduction necessitates other treatment options, including acrylic bonding of the canine teeth, external fixation and surgical correction.

ACKNOWLEDGEMENTS

Authors thank the following clinicians for their involvement in the diagnosis and management of the cases: Walter Renberg, DVM, MS, DACVS; James Roush, DVM, MS, DACVS; Sasha Thomason, DVM; Mackenzie Hallman, DVM, DACVR; David Upchurch, DVM, DACVS; Omar Gonzalez, DVM; Megan Wilson, DVM; Hugh Gifford, DVM.

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