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Effectiveness of caudal segmental mandibulectomy in a cat: clinical and tomographic outcomes

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Abstract

Case summary A 1-year-old spayed female domestic British Shorthair cat was presented for facial trauma; there were multiple mandibular fractures involving the right temporomandibular joint (TMJ) that were managed conservatively. After 2 months, the owner reported a gradual onset of the cat's inability to open its mouth and subsequent inappetence. The maximum mouth opening (MMO) measured 7 mm. CT showed ankylosis of the TMJ, and surgical treatment with caudal segmental mandibulectomy (CSM) was performed. The cat had a rapid postoperative recovery and returned promptly to spontaneous eating, with a nearly normal MMO of 33 mm. A CT scan performed 3 months postoperatively showed a mild rightward deviation of the mandible, and a clearly visible non-ossified ostectomy gap between the body and the ramus of the right mandible. The cat continued to eat spontaneously without dysphagia following surgery and was asymptomatic 1 year postoperatively.

Relevance and novel information To the authors' knowledge, this is the first report describing the tomographic findings after CSM, as compared with the clinical outcome. Postoperative CT is indicated to confirm the success of the procedure and to assess TMJ ankylosis sequalae or complications of the CSM surgical site at an early stage. This report confirmed the effectiveness of CSM in resolving TMJ stiffness due to articular fractures or ankylosis with a good clinical and tomographic outcome.

Keywords: Segmental mandibulectomy; temporomandibular joint; CT; ankylosis

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Introduction

Traumatic injuries to the mandibula and temporomandibular joint (TMJ) can result in bone malunion and TMJ ankylosis.[1–5] This is defined as the partial or complete inability to open the mouth, occurring in the presence of bony or fibrous adhesions of the anatomic joint components.[1–5]

CT has recently been credited with being the gold standard technique for directly assessing the anatomic structures involved and for planning the most effective surgical procedure.[6,7] Surgical correction is necessary, especially when TMJ ankylosis severely impacts quality of life and the ability to feed spontaneously.[3,4,6,8,9] Several techniques have been described, including excision of the diseased tissue; however, an increased rate of complications and a considerable risk of recurrence have been reported.[3,4,6,8,9] Villamizar-Martinez and colleagues have recently suggested segmental mandibulectomy as a less invasive and more effective alternative for managing TMJ ankylosis in cats.[10,11] Although the ability to

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adequately restore the maximum mouth opening (MMO) with few minor complications has been evaluated in some feline patients, to the authors' knowledge, this technique has never been assessed postoperatively using an advanced diagnostic imaging follow-up.[10,11] Combining clinical and tomographic follow-up allows for better recognition of tissue modification at the surgical site and the status of the TMJ ankylosis, as well as the occurrence of long-term complications.[11]

Therefore, the aim of this report was to describe, for the first time, the relationship between the clinical and tomographic features resulting from caudal segmental mandibulectomy (CSM) for the treatment of TMJ ankylosis in a cat, and to demonstrate that the gap obtained by ostectomy could become the new fulcrum for the mouth opening.

Case description

A 1-year-old spayed female domestic British Shorthair cat, weighing 3.8 kg, was presented to the Veterinary Hospital of the University of Bologna with signs of facial trauma of unknown origin.

Physical examination upon admission revealed moderate painful and diffuse swelling of the right mandibular region, associated with malocclusion, right mandibular drifting and a crackling noise of the region on palpation. The intraoral examination was normal.

Right mandibular and temporomandibular multiple fractures were suspected. A skull CT scan was performed, which showed multiple complete fractures of the mid portion of the body, ramus and the condyloid process of the right mandible, associated with fractures of the squamous part of the right temporal bone leading to right-sided TMJ luxation.

The owner requested conservative treatment rather than surgery, since they were aware of the possible sequelae.

At that time, the cat was able to eat spontaneously without dysphagia; the MMO, measured using a digital calliper by placing the inner jaws at the midline of the incisal margins of the maxillary and mandibular incisor teeth, was 54 mm. This opening was apparently normal because it was facilitated by the instability of the mandibular fractures. The cat was discharged, and a wet diet was prescribed for the following weeks, to promote chewing. In addition, strict monitoring of the mandibular swelling and the mouth opening capability was advised, as well as checking for dysphagia or pain while feeding. Analgesia was provided with oral meloxicam 0.1 mg/kg q24h for 7 days.

The cat was re-presented 2 months after discharge owing to the gradual onset of the inability to open its mouth and subsequent inappetence of 10 days. A physical examination revealed sialorrhea, malocclusion and the inability to open its mouth. Stiffness of the right TMJ and a hard mandibular swelling of the TMJ and mandibular body were detected using palpation. The cat was sedated and MMO was measured at 7 mm. Ankylosis of the right TMJ was suspected, and a CT scan of the skull was performed; the mouth opening was slightly forced manually to allow orotracheal intubation. The CT examination showed the formation of an exuberant bony callus, with massive new bone formations along the body, ramus and bony fragments near the right TMJ and along the squamous portion of the right temporal bone. The new bone formations led to apparent incarceration and ankylosis of the right TMJ, still incongruent. There was also bony callus formation around the fracture of the body of the right mandible, which was malconsolidated (Figure 1).

CSM was proposed to the owner, who consented to the procedure. The cat was premedicated with ketamine hydrochloride (5 mg/kg IM) and dexmedetomidine (7 µg/kg IM), inducing general anaesthesia with

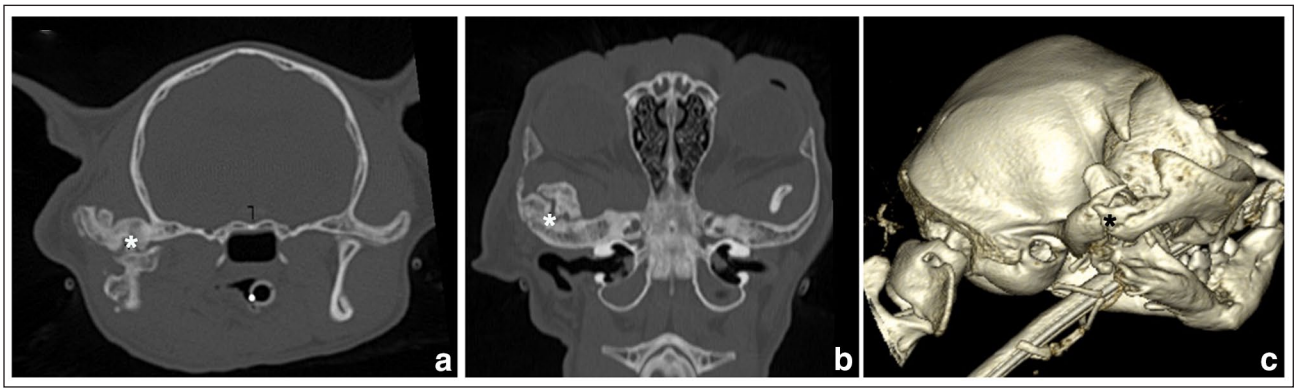

Figure 1 Preoperative survey CT of the temporomandibular joints (TMJs) (2 months after trauma). (a) Transverse, (b) dorsal and (c) 3D volume images are available. Asterisks indicate areas indicative of ankylosis. Note the proliferation of the exuberant bony callus along the body and ramus of the right mandible, and along the squamous portion of the right temporal bone, causing incarceration of the right TMJ. Also note the malconsolidation of the fracture of the right mandible body

propofol intravenously (IV) and maintained with 1.5% isoflurane in oxygen, ensuring analgesia via a right inferior alveolar nerve block with bupivacaine (0.25 mg/kg). The cat was positioned in dorsal recumbency, and the ventral and lateral mandibular regions were bilaterally clipped and aseptically prepared. Cefazoline was administered as an antibiotic prophylaxis at 30 mg/kg IV 30 mins before skin incision. The procedure was performed as described by Villamizar-Martinez et al.[10] A 3 cm long full-thickness skin incision was performed along the ventrocaudal aspect of the right mandibular body. The mandibular body was then exposed between the first molar tooth and the mandibular foramen using a periosteal elevator, isolating and ligating the inferior alveolar neurovascular bundle with monofilament absorbable 3-0 United States Pharmacopeia (USP) suture. The digastricus and the masseter muscles were detached from the mandibular body; a 1.0 cm ostectomy was performed using an oscillating saw, between the furcation of the first molar tooth and the rostral border of the mandibular foramen at the level of the bony callus (Figure 2). Intraoperative mobility of the mandibula was verified; the ventral defect and the intraoral mucosa were then both routinely sutured using monofilament absorbable 3-0 USP suture. An oesophageal tube was applied to ensure postoperative enteral nutrition. The MMO was measured and was 33 mm (Figure 3a). Postoperative analgesia was provided with methadone (0.1 mg/kg IV q24h). No complications were found in the immediate postoperative period; the cat was discharged the day after the procedure, with meloxicam 0.1 mg/kg PO q24h for 5 days, and a canned wet diet was prescribed for the following 2 weeks, to aid spontaneous oral feeding.

The cat was clinically re-evaluated 5, 10 and 15 days postoperatively. It always appeared bright and appetent. The surgical wound healed without complications, the MMO was acceptable and the oesophageal tube was removed 15 days postoperatively. Three months postoperatively, a clinical evaluation was unremarkable, except for the persistence of minimal contralateral mandibular drifting, not associated with chewing difficulties. The MMO, measured under sedation, remained unchanged (33 mm; see Figure 3b), even though the jaw remained malocclude. The patient underwent a control CT scan, which showed the sequalae of the CSM, with a mild rightward deviation of the mandible as compared with the maxilla. A non-ossified gap between the body and the ramus of the right mandible was clearly visible. The ramus of the right mandible was apparently fused with the adjacent temporal bone due to the presence and consolidation of the previously described new bone (Figure 4).

One year after the CSM, the cat was asymptomatic, was eating both wet and dry food normally, and showed neither complications from the surgical procedure nor consequences of TMJ ankylosis.

Discussion

The present study confirmed the effectiveness of CSM in resolving TMJ stiffness from articular fractures or ankylosis. The ostectomy of the mandibular body allowed bypassing the joint and avoiding the potential intraoperative complications related to the complex articular and periarticular anatomy (ie, bleeding, nerve damage, iatrogenic fracture). The operating time of the CSM was short, providing a faster and easier recovery, without postoperative complications (ie, massive facial oedema, bleeding, respiratory distress, intractable pain) ascribed to demolitive procedures, such as gap arthroplasty, condylectomy or extra-articular osteotomy.[3,4,6,8,9,11] A normal MMO in healthy cats is in the range of 41–84 mm, while patients effectively treated with different surgical techniques in previous studies have presented a slightly reduced value of 30–52 mm.[11–13] Although the cat in the present study showed a dramatically reduced MMO, CSM was effective in restoring a functionally acceptable measurement of 33 mm, without any intraoperative or postoperative complications and with a prompt recovery and resumption of spontaneous solid feeding. These results confirmed the usefulness of segmental mandibulectomies, even in chronic conditions when immediate intervention would not be possible. In agreement with other authors, CSM had a good long-term outcome with a reduced rate of recurrence.[10,11]

Segmental mandibulectomies have been poorly described in veterinary literature and are currently considered salvage procedures in both dogs and humans, where they are associated with significant functional deficits, unlike in cats.[3,14]

Preoperative CT scans may be useful in confirming the suspicion of TMJ ankylosis and allow for the ruling out of additional traumatic damage or its sequalae, such as contralateral fractures or soft tissue involvement (ie, muscle contracture or fibrosis), which might impair CSM success.[7] Postoperative CT evaluation of the skull, in combination with a clinical follow-up, may be indicated to confirm the success of the procedure and to assess TMJ ankylosis or the surgical site for potential complications at an early stage. In addition, postoperative CT allows for investigating persistent postoperative malocclusions, which, although described as a possible consequence of CSM, are rarely clinically relevant. A CT scan makes it possible to rule out potential underlying complications, such as mandibular drift of the contralateral TMJ, masticatory muscle atrophy, unjustified variation in MMO or unwanted healing of the ostectomy site with subsequent recurrence of signs or neoarthrosis development.[11]

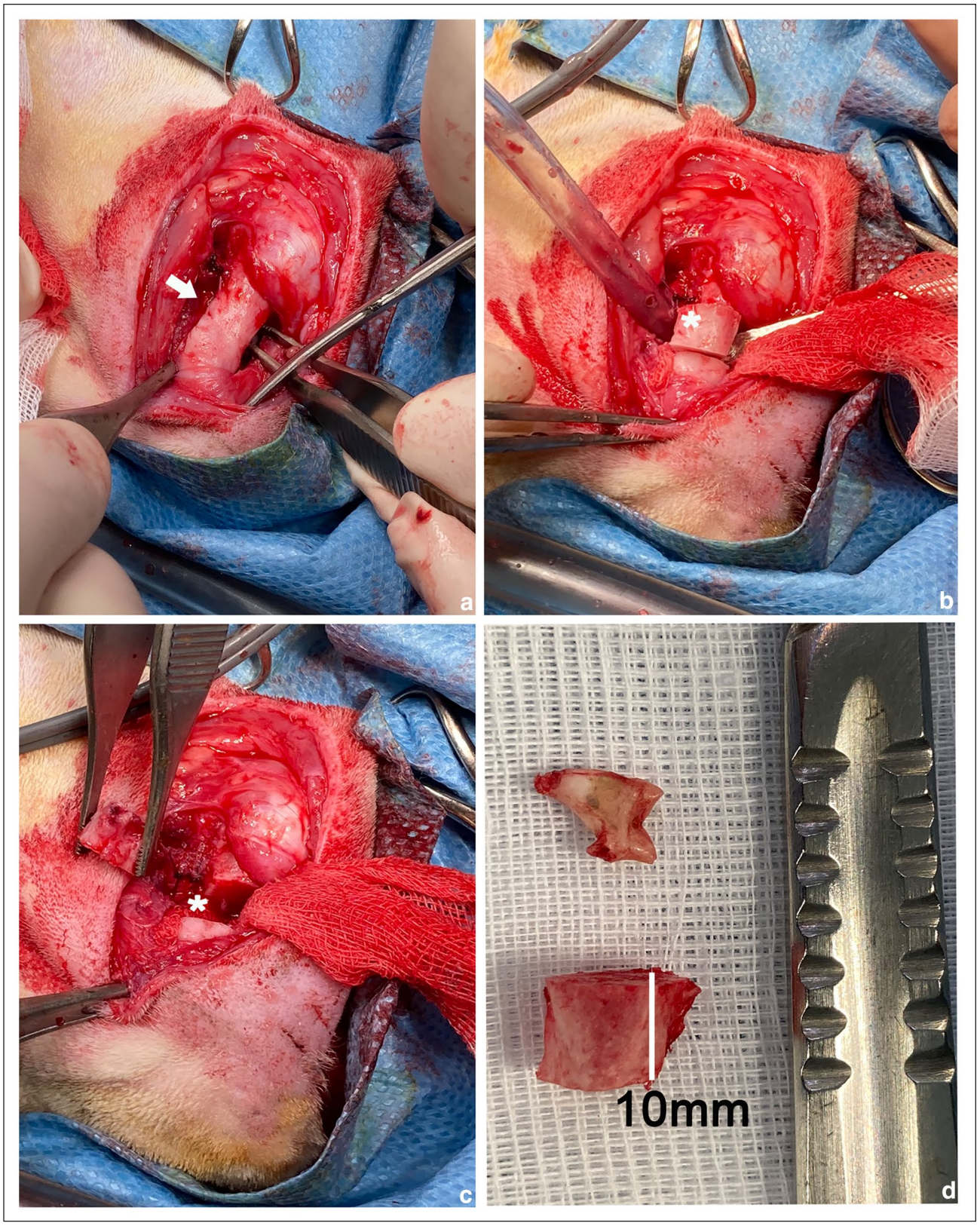

Figure 2 Intraoperative pictures: (a) the mandibular body was exposed at the level of the bony callus (arrow); (b) the ostectomy cutting was completed (asterisk); and (c) the bone segment was removed, highlighting the gap (asterisk). (d) Note the premolar tooth and the bone segment (approximately 10 mm long)

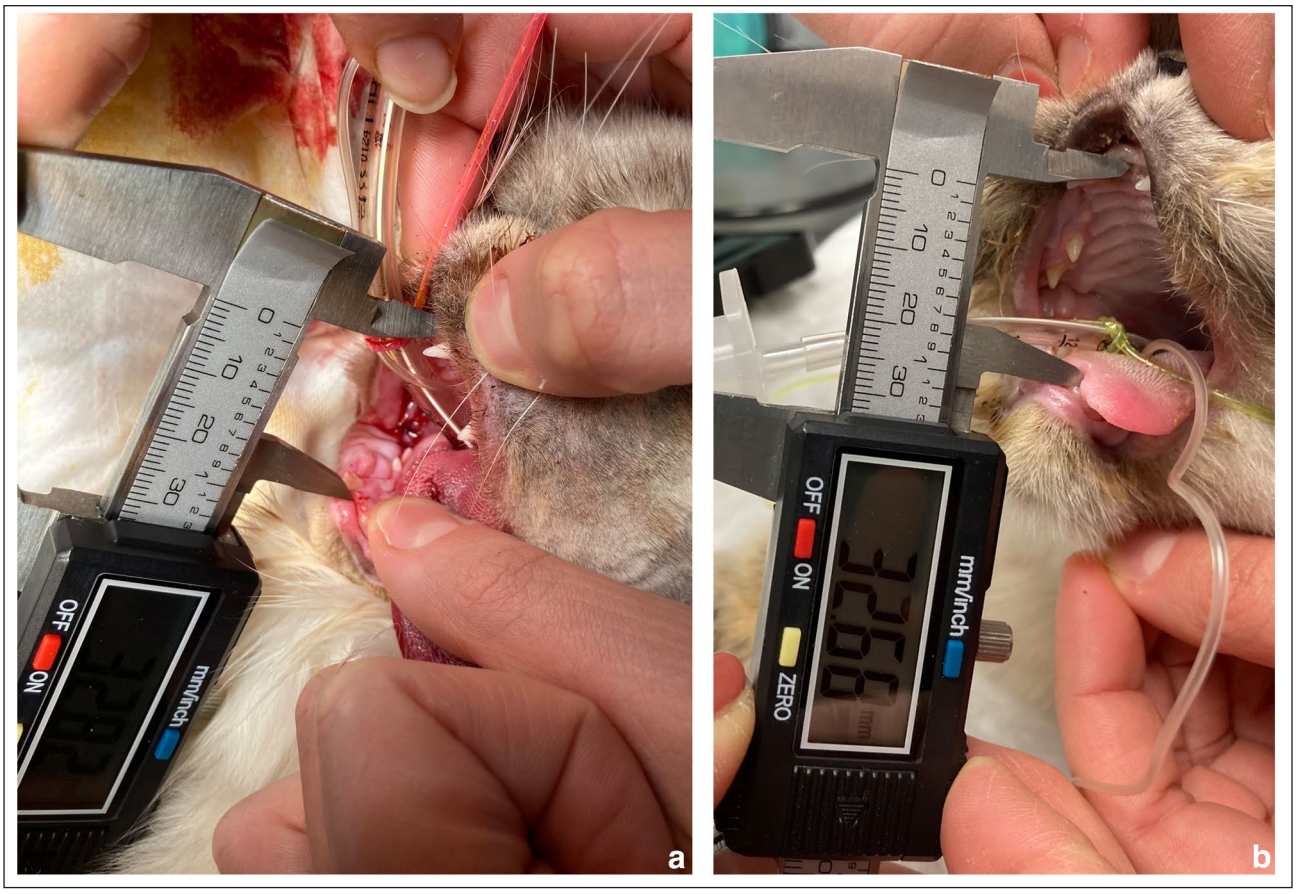

Figure 3 Maximum mouth opening (MMO) postoperative measurements. The MMO was measured using a digital calliper immediately at the end of the surgery (a) and after 3 months (b), and remained unchanged at 33 mm

Figure 4 Postoperative CT of the temporomandibular joints (TMJs) (3 months postsurgery). (a) Transverse, (b) sagittal and (c) 3D volume images are available. Note the progression of the exuberant bony callus along the ramus of the right mandible as well as the clearly visible non-ossified ostectomy gap between the body and the ramus of the right mandible (arrows)

To the authors' knowledge, a postoperative CT scan performed to evaluate the effectiveness of CSM has not been reported previously. In the present study, a postoperative CT scan was performed to investigate the extent of the malocclusion after surgery, the lack of the aforementioned possible complications reported in the literature, and to confirm that the gap obtained with the ostectomy had become the new fulcrum for the mouth opening. In this case, only mild mandibular drift was observed, both clinically and in the CT scans, which did not impair the cat's quality of life or ability to chew. Furthermore, no dental or periodontal diseases were observed, but malocclusion could have predisposed the cat in the long term.[15] The use of postoperative CT in the present study once again confirmed the value of CSM, which should be considered more than an alternative

surgery in the case of diseases causing mouth opening impairment.[11] In addition, both preoperative and postoperative CT scans should be used to inform the owner regarding the surgical prognosis, based on TMJ condition and on the presence of concomitant abnormalities.[7,13]

The authors preferred to perform caudal mandibulectomy rather than middle or rostral ones, owing to the seemingly better clinical outcome reported in the literature, and due to the biomechanical advantage of the caudal fulcrum.[10]

Conclusions

This report described the good clinical and tomographic outcomes of CSM performed to treat the mandibular body, and TMJ fractures and ankylosis in a cat. A skull CT evaluation, associated with a clinical examination, was crucial not only in the preoperative planning, but also during postoperative follow-up. CSM was confirmed to be a valuable surgical technique and should be considered a standard of care for TMJ diseases with mouth opening impairment in cats.

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

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Ethical approval The work described in this manuscript involved the use of non-experimental owned animals. Established internationally recognised high standards ('best practice') of veterinary clinical care for the individual patient were always followed. Ethical approval from a committee was therefore not specifically required for publication in *JFMS Open Reports*. Although not required, where ethical approval was still obtained, it is stated in the manuscript.

Informed consent Written informed consent was obtained from the owner of the animal described in this work for all procedures undertaken. For any animals or people individually identifiable within this publication, verbal informed consent (for their use in the publication was obtained from the people involved.

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