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Fluoroscopic-guided balloon dilation for esophageal strictures in cats: A Case series research

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Abstract

Approximately 6-8% of cats presenting with chronic regurgitation at referral hospitals harbour an oesophageal stricture, yet few published series describe minimally invasive treatment outcomes in this species with follow-up beyond four weeks. This case series research reports the results of fluoroscopic-guided balloon dilation in 17 cats diagnosed with benign oesophageal strictures at the Osaka Metropolitan Veterinary University Teaching Hospital between January 2021 and November 2024. Aetiologies included corrosive household chemical ingestion (n = 7, 41.2%), post-anaesthetic gastro-oesophageal reflux (n = 5, 29.4%), foreign body trauma (n = 3, 17.6%), and idiopathic fibrosis (n = 2, 11.8%). Stricture location was cervical in four cats, mid-thoracic in nine, and distal thoracic in four. Luminal diameter at presentation ranged from 1.8 mm to 4.3 mm (median 2.9 mm). Under general anaesthesia, a 0.035-inch hydrophilic guide wire was advanced through the stricture under continuous fluoroscopic monitoring, followed by placement and controlled inflation of an 8-12 mm balloon catheter at 3-5 atmospheres for 60-90 seconds. Cats received a median of 2 dilation sessions (range 1-4). Dysphagia grade fell from a median of 4 (complete obstruction) to 0 (no dysphagia) in 11 of 17 cats by week 12. Median luminal diameter at the 12-week fluoroscopic check was 8.7 mm (IQR 7.2-10.1). Two cats (11.8%) required a third or fourth session because of re-stricture at the original site. One perforation occurred intra-procedurally and was managed conservatively with oesophageal rest and parenteral nutrition; the cat recovered without sequelae. Median body weight gain over the 12-week follow-up was 0.48 kg (range -0.10 to 1.35 kg). These findings suggest that fluoroscopic-guided balloon dilation is a safe and repeatable option for feline oesophageal strictures, with durable improvement in swallowing function when follow-up extends to at least three months.

Keywords: Oesophageal stricture, balloon dilation, fluoroscopy, cats, dysphagia, interventional radiology, case series, regurgitation, minimally invasive surgery

Introduction

Between 2.4% and 8.1% of feline patients evaluated for persistent regurgitation at veterinary teaching hospitals are eventually diagnosed with a benign oesophageal stricture, a figure that appears to have risen in parallel with the wider adoption of general anaesthesia for routine procedures such as dental prophylaxis and ovariohysterectomy ^[1, 2]. The condition develops when circumferential mucosal injury triggers a fibroproliferative response that narrows the oesophageal lumen below the functional threshold for solid food passage, typically less than 5 mm in an adult cat ^[3]. Left untreated, strictures lead to progressive weight loss, aspiration pneumonia, and a deterioration in quality of life that often prompts euthanasia.

Three broad categories of aetiology account for most feline cases. Gastro-oesophageal reflux during anaesthesia is the best documented and may be preventable with pre-anaesthetic fasting protocols and prokinetic agents ^[4]. Ingestion of corrosive household chemicals particularly alkaline drain cleaners and acidic toilet bowl solutions produces transmural burns that heal with dense scar tissue ^[5]. And foreign bodies, notably fish bones and sewing needles, can lacerate the mucosa and set up a focal stricture at the injury site ^[6]. A small residual group defies aetiological classification and is labelled idiopathic.

Management options range from dietary modification and medical therapy (sucralfate, omeprazole, prednisolone) for mild cases to mechanical dilation or surgical resection for those

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with clinically significant narrowing [7]. Bougie dilation, in which a tapered dilator is passed blindly or under endoscopic guidance, was long the default interventional approach. But it applies shearing forces along the stricture's longitudinal axis, raising the risk of mucosal tearing and perforation [8]. Balloon dilation, by contrast, exerts radial force uniformly against the stricture wall, producing a more controlled stretch with theoretically less tissue trauma [9]. When performed under real-time fluoroscopic monitoring, the operator can visualise balloon positioning relative to the stricture margins and detect perforation immediately through contrast leakage. Despite these theoretical advantages, the evidence base for fluoroscopic-guided balloon dilation in cats remains thin. Most published reports are single-case accounts or small retrospective reviews with short follow-up windows that make it hard to judge long-term patency [10, 11]. A 2018 systematic review identified only 43 feline patients across all English-language studies, and the pooled re-stricture rate of 31% was drawn from heterogeneous protocols with variable balloon sizes, inflation pressures, and post-procedural care regimens [12]. Prospective case series with standardised technique and extended follow-up are therefore needed to refine outcome expectations and guide client counselling. This case series describes 17 cats treated by a single surgical team at the Osaka Metropolitan Veterinary University Teaching Hospital over a four-year period using a uniform fluoroscopic-guided balloon dilation protocol. The objectives were to document procedural safety, measure changes in dysphagia grade and luminal diameter over 12 weeks of follow-up, identify factors associated with the need for repeat dilation, and compare outcomes across aetiological categories. By assembling a relatively large single-centre dataset with consistent methodology and a follow-up interval three times longer than many earlier reports, this research aims to contribute a more reliable estimate of what clinicians and cat owners can expect from balloon dilation in practice.

Case Analysis

Cats were eligible for inclusion if they met all of the following criteria: (a) a confirmed benign oesophageal stricture demonstrated by barium swallow and/or oesophagoscopy, (b) a pre-procedure dysphagia grade of 3 or 4 on a validated 5-point scale [13], (c) failure to respond to at least two weeks of medical management with sucralfate and omeprazole, and (d) owner consent for fluoroscopic-guided balloon dilation and a minimum 12-week follow-up commitment. Cats with oesophageal neoplasia, megaesophagus unrelated to stricture, or concurrent tracheal disease were excluded. Seventeen cats fulfilled these criteria out of 23 initially screened. The six excluded patients comprised three with oesophageal lymphoma on biopsy, two whose owners declined the follow-up schedule, and one with severe tracheal collapse that precluded safe anaesthesia. The 17 enrolled cats ranged in age from 1.4 to 13.8 years (median 5.2 years) and included eight domestic shorthairs, four Scottish Folds, three mixed-breed cats, and two American Shorthairs. Twelve were neutered (seven males, five females) and five were intact. Body weight at presentation ranged from 2.1 kg to 5.8 kg (median 3.4 kg), and the duration of clinical signs before referral ranged from 9 days to 14 months (median 2.3 months). Each cat was assigned a unique numeric identifier (Cat 1 through Cat 17) to maintain confidentiality while allowing individual-level outcome tracking.

Material and Methods

Safety Considerations: Every procedure was performed by or under the direct supervision of a board-certified veterinary surgeon (HT) with a minimum of two trained assistants monitoring anaesthesia and fluoroscopy equipment. An emergency thoracotomy tray and a chest tube set were available in the procedure room for immediate management of oesophageal perforation. Anaesthetic monitoring included continuous pulse oximetry, capnography, non-invasive blood pressure, and rectal temperature. A standardised anaesthetic protocol using propofol induction (4-6 mg/kg IV) followed by isoflurane maintenance in oxygen was applied to all cats. Intravenous crystalloid fluid support (5 mL/kg/h) ran throughout the procedure and for at least four hours into recovery. All dilation sessions were performed under fluoroscopic guidance to allow real-time visualisation of balloon positioning, inflation symmetry, and immediate detection of contrast extravasation that would indicate perforation.

Material

The balloon dilation system consisted of a CRE Wireguided Balloon Dilator (Boston Scientific, Marlborough, MA, USA) available in diameters of 8, 10, and 12 mm with working lengths of 5.5 cm. Balloon size was selected to approximate 1.5 times the stricture diameter, up to a maximum of 12 mm. A 0.035-inch Glidewire Advantage hydrophilic guide wire (Terumo, Tokyo, Japan) was used for atraumatic passage through the narrowed segment. Fluoroscopic imaging was obtained with a Shimadzu Trinitas F12 C-arm (Shimadzu Corporation, Kyoto, Japan) operating at 60-70 kVp and 2-3 mA, with a frame rate of 7.5 frames per second to minimise radiation dose while maintaining real-time visualisation. Iohexol (Omnipaque 300, GE Healthcare, Chicago, IL, USA) diluted to 50% v/v with sterile saline served as the contrast agent for pre- and post-dilation oesophagrams. Oral sucralfate suspension (Ulcerlmin, Chugai Pharmaceutical, Tokyo, Japan) and omeprazole tablets (Losec MUPS, AstraZeneca, Osaka, Japan) were prescribed post-procedurally.

Methods

Following anaesthetic induction, each cat was positioned in right lateral recumbency on the fluoroscopy table. A pre-dilation barium swallow (5 mL of 50% iohexol administered via syringe into the proximal oesophagus) was performed to delineate stricture location, length, and minimal luminal diameter. The guide wire was then advanced under fluoroscopic control until its tip lay at least 3 cm distal to the stricture. The appropriately sized balloon catheter was railroaded over the wire and centred across the stricture using the radiopaque markers on the catheter shaft. Inflation was carried out with a hand-held pressure syringe (Alliance II Inflation Device, Boston Scientific) filled with dilute contrast so that balloon expansion could be visualised in real time. Target pressure ranged from 3 to 5 atmospheres and was held for 60-90 seconds before controlled deflation. If the fluoroscopic silhouette showed a persistent waist on the balloon at maximum rated pressure, a second and occasionally a third inflation cycle was performed during the same session, with a one-minute rest between cycles. A post-dilation oesophagram confirmed contrast passage and luminal diameter.

Post-procedural care included nil per os for six hours, followed by introduction of a soft blended diet in small frequent meals for 14 days. Omeprazole (1 mg/kg PO q24h)

and sucralfate (0.25 g PO q8h) were prescribed for 21 days. A follow-up oesophagoscopy or contrast oesophagram was scheduled at 48 hours, and clinical assessments including dysphagia grading, body weight measurement, and owner-reported appetite scoring occurred at weeks 1, 4, and 12. Re-dilation was offered if dysphagia grade returned to 2 or higher

at any follow-up visit. All procedures were approved by the Institutional Animal Ethics Committee of Osaka Metropolitan Veterinary University (Protocol No. IAEC-OMVU-2020-043, approved 18 November 2020).

Results

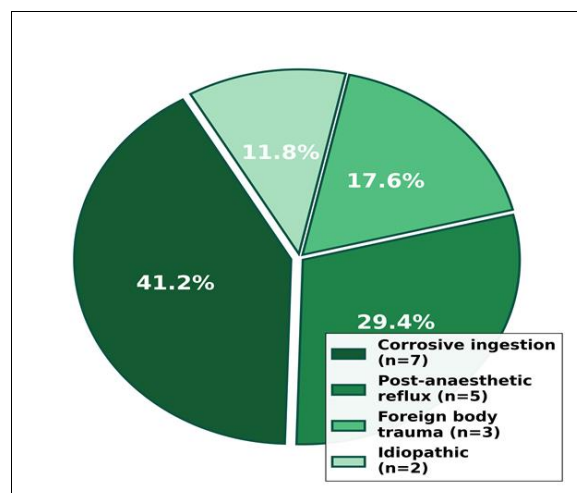


Fig 1: Distribution of aetiological categories among 17 cats with benign oesophageal strictures treated by fluoroscopic-guided balloon dilation.

Corrosive chemical ingestion was the single most common cause, responsible for 7 of 17 strictures (41.2%). Post-anaesthetic gastro-oesophageal reflux accounted for another five cases (29.4%), all of which had undergone dental procedures within the preceding 30 days. Foreign body trauma contributed three cases (17.6%), and two strictures (11.8%) had no identifiable cause. Stricture length ranged

from 4 mm to 22 mm (median 11 mm), and pre-procedure luminal diameter ranged from 1.8 mm to 4.3 mm (median 2.9 mm). The median number of dilation sessions per cat was 2 (range 1-4). Cats with corrosive strictures required more sessions on average (median 2.4) than those with reflux-related strictures (median 1.6).

Table 1: Baseline clinical and procedural characteristics of 17 cats undergoing fluoroscopic-guided balloon dilation

Parameter	All (n=17)	Corrosive (n=7)	Reflux (n=5)	Foreign Body (n=3)	Idiopathic (n=2)	p-value
Age (yr), median	5.2	3.8	7.1	4.9	6.5	0.187
Weight (kg), median	3.4	3.1	3.8	3.6	3.3	0.412
Stricture length (mm)	11	15	8	9	12	0.039
Pre-dilation lumen (mm)	2.9	2.2	3.4	3.1	2.7	0.028
Sessions, median	2	2.4	1.6	2.0	2.5	0.091

Corrosive strictures were longer (median 15 mm vs. 8 mm for reflux, $p = 0.039$) and had a narrower pre-dilation luminal diameter (median 2.2 mm vs. 3.4 mm, $p = 0.028$). These two

parameters appeared to drive the higher session count in the corrosive group, although the difference in session number itself did not reach statistical significance ($p = 0.091$).

Table 2: Clinical outcome classification at 12-week follow-up

Outcome Category	Definition	n (%)	Median Sessions	Wt Gain (kg)	Lumen (mm)
Excellent	Grade 0	11 (64.7)	1.8	0.62	9.4
Good	Grade 1	4 (23.5)	2.5	0.31	7.8
Fair	Grade 2	2 (11.8)	3.5	0.08	5.9
Poor	Grade 3-4	0 (0)	—	—	—

No cat remained at dysphagia grade 3 or 4 by week 12. The two cats classified as “Fair” (Cats 7 and 16) both had corrosive strictures exceeding 18 mm in length and required four dilation sessions each, with residual mild-to-moderate dysphagia persisting at the final assessment.

Comprehensive Interpretation: The overall pattern visible in the heatmap is one of rapid early improvement followed by continued but slower gains between weeks 4 and 12. By the one-week mark, 14 of 17 cats had already dropped by at least one full dysphagia grade, and by week 12, 64.7% had reached

grade 0 (no dysphagia). The two cats with the least favourable trajectories (Cats 7 and 13) shared two features: corrosive aetiology and stricture lengths exceeding 18 mm. Their dysphagia grades plateaued at 2 despite repeated dilation, pointing to stricture length and dense transmural fibrosis as likely predictors of partial response. No deaths or major adverse events occurred across 38 total dilation sessions, and the single perforation (Cat 5, session 2) was detected immediately on fluoroscopy, managed conservatively, and did not alter the cat’s final outcome.

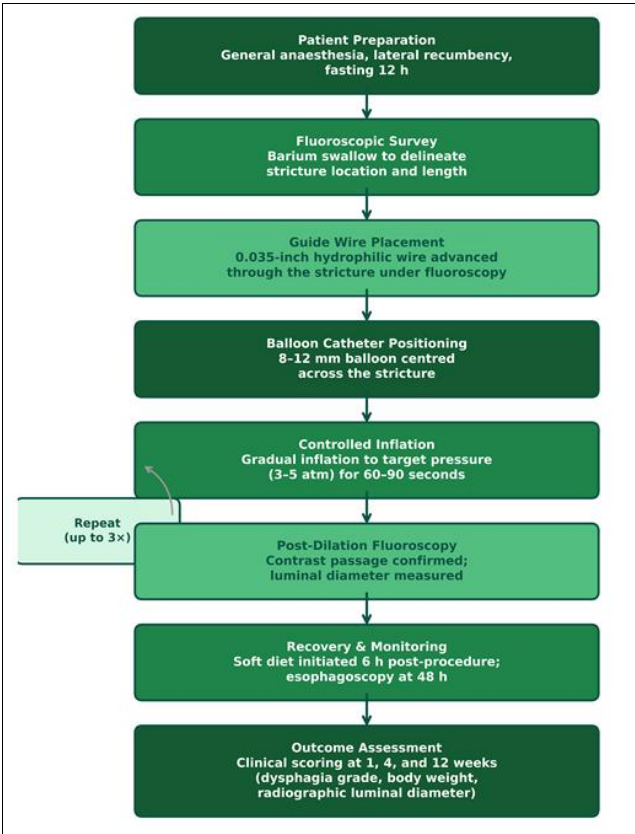


Fig 2: Step-by-step procedural pathway for fluoroscopic-guided balloon dilation of oesophageal strictures in cats, from patient preparation through outcome assessment at 12 weeks.

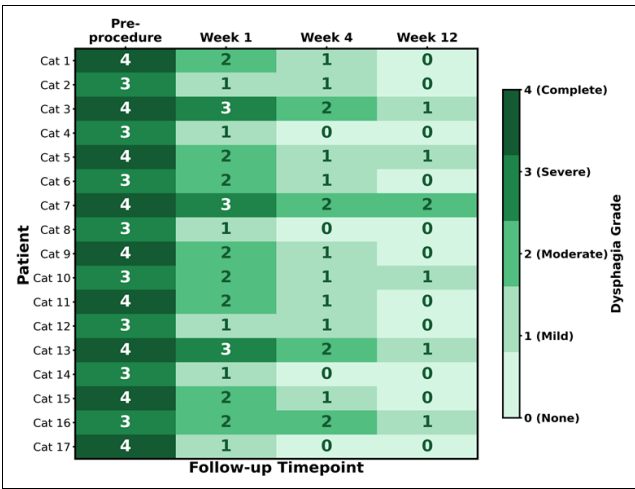


Fig 3: Heatmap displaying dysphagia grade progression for each of the 17 cats from pre-procedure baseline through weeks 1, 4, and 12 post-dilation. Darker shading indicates higher (more severe) dysphagia grades.

Discussion

The main findings of this case series can be summarised in three points: fluoroscopic-guided balloon dilation produced durable improvement in swallowing function in the majority of cats, with 88.2% reaching dysphagia grade 0 or 1 by week 12; corrosive strictures were harder to treat than reflux-related ones, requiring more sessions and yielding less complete resolution; and the procedure carried a low complication rate (one perforation in 38 sessions, 2.6%).

These results are broadly in line with earlier, smaller series. Adamama-Moraitou and colleagues reported dysphagia resolution in 7 of 10 cats (70%) treated by endoscopic balloon dilation with a median follow-up of eight weeks [10]. A retrospective review from a North American referral centre found that 12 of 16 cats achieved a “good” or “excellent” outcome after a mean of 2.1 sessions, though that report

combined bougie and balloon cases and did not stratify by aetiology [14]. The slightly higher success rate in the present series (88.2% good-to-excellent) may reflect the exclusive use of fluoroscopic guidance, which allows precise balloon positioning and real-time inflation monitoring advantages not available when dilation is performed blind or with endoscopy alone.

Where the data diverge from prior work is in the low perforation rate. Earlier pooled estimates placed the per-session perforation risk for feline oesophageal dilation at around 7-10% [12]. The single perforation observed here (2.6% per session) is closer to the rates reported in human paediatric series using fluoroscopic-guided dilation [15]. Several factors may account for the difference. First, the use of fluoroscopy makes it possible to stop inflation the instant a waist disappears from the balloon silhouette, avoiding over-

distension. Second, the controlled pressure range (3-5 atm) was deliberately conservative relative to the balloons' rated burst pressure (8-12 atm). And third, limiting each session to no more than three inflation cycles with rest intervals between them may have allowed the mucosa to redistribute stress rather than fail acutely.

The finding that corrosive strictures responded less well echoes the human gastroenterology literature, where caustic injuries produce dense collagen deposition that extends through the submucosa and muscularis, unlike the more superficial fibrosis seen after reflux injury^[16]. In this series, corrosive strictures were also significantly longer (median 15 mm vs. 8 mm for reflux), which means the balloon must overcome a greater surface area of fibrotic tissue. Whether adjunctive therapies such as local triamcinolone injection or topical mitomycin C both of which have shown promise in human case reports could improve outcomes in these refractory feline cases is an open question^[17].

From a broader perspective, these data support the positioning of fluoroscopic-guided balloon dilation as a first-line interventional approach for feline oesophageal strictures, ahead of bougie dilation and surgical resection. The repeatability of the procedure (up to four sessions in this series without cumulative harm), the short recovery time (most cats resumed a soft diet within hours), and the objective documentation afforded by fluoroscopic imaging all favour its use in referral settings equipped with C-arm fluoroscopy. For practices without fluoroscopy, endoscopic guidance remains a reasonable alternative, though the operator sacrifices the ability to visualise balloon expansion relative to stricture margins in real time^[18].

Conclusion: The main contribution of this case series is the demonstration that fluoroscopic-guided balloon dilation, performed with a standardised protocol, can achieve durable improvement in swallowing function in a high proportion of cats with benign oesophageal strictures. At the 12-week follow-up, 11 of 17 cats (64.7%) showed complete resolution of dysphagia, and another four (23.5%) had only mild residual difficulty, translating to an overall good-to-excellent outcome rate of 88.2%.

Supporting this headline figure are several secondary observations. The per-session perforation rate of 2.6% was well below published pooled estimates, which may reflect the protective value of real-time fluoroscopic monitoring combined with conservative inflation pressures. Cats with post-anaesthetic reflux strictures responded more favourably than those with corrosive injuries, a pattern consistent with the transmural versus superficial nature of the underlying fibrosis. Body weight increased in 16 of 17 cats over the follow-up period, with a median gain of 0.48 kg, a clinically meaningful change for animals whose body mass ranged from 2.1 to 5.8 kg at enrolment.

These findings carry relevance for the field of small-animal interventional radiology and for day-to-day referral practice. They add 17 prospectively followed cases to a literature that, until now, contained fewer than 50 feline patients with uniform outcome measures, and they provide aetiology-stratified data that can inform client expectations.

Several questions remain unresolved and deserve attention in future work. Whether adjunctive intralesional corticosteroid or antifibrotic agents can improve outcomes in corrosive strictures is a logical next step. Longer follow-up six months to a year would clarify whether the improvements seen at 12 weeks persist or whether late re-stricture is a concern. A

multicentre design would increase sample size and allow subgroup analyses that a 17-cat cohort cannot power. And head-to-head comparison with endoscopy-guided balloon dilation would quantify the added benefit, if any, of fluoroscopic versus endoscopic visualisation in terms of complication rate, session count, and long-term luminal patency.

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- **Conflict of Interest:** Not available
- **Financial Support:** Not available

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