

Application of flexible endoscopy for gastrointestinal foreign body removal in a leopard gecko (*Eublepharis macularius*)

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Abstract

A male captive-bred leopard gecko (*Eublepharis macularius*) presented with a history of inadvertent ingestion of a rubber tip from forceps during feeding. The foreign body was impalpable on physical examination, while radiographic evaluation confirmed its presence in the stomach. Considering the procedural risks associated with invasive surgical interventions, endoscopic retrieval under general anesthesia was pursued. An initial attempt using a 2.8 mm superfine flexible endoscope with 0.8 mm forceps was unsuccessful due to insufficient stability, which hindered effective navigation to the foreign body. In contrast, a second attempt using a larger 9.2 mm flexible endoscope with 2.3 mm forceps improved visualization and mechanical control, allowing for successful removal. Despite concerns about the potential adverse effects of introducing a relatively large-diameter instrument into the small-bodied patient, gastric mucosal inspection revealed no abnormalities, and the patient experienced an uneventful recovery. This case report describes the application of two flexible endoscope models for the retrieval of a gastrointestinal foreign body in a leopard gecko, an approach rarely documented in the literature. Given the limitation of a single case, larger case series and comparative studies are warranted to validate the safety, reproducibility, and clinical applicability of flexible endoscopy as a viable option. The establishment of evidence-based guidelines will facilitate safer and more tailored applications, ultimately advancing minimally invasive techniques in reptile medicine.

Keywords: flexible endoscopy, foreign body ingestion, gastrointestinal impaction, leopard gecko, minimally invasive technique

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Introduction

The leopard gecko (*Eublepharis macularius*) is a small lizard species originating from Middle Eastern countries, particularly deserts and rocky grasslands (Bradley and Nieves, 1999). It has become a common exotic pet owing to its ease of husbandry, long lifespan, distinctive spotted appearance, and docile nature, which in turn has contributed to its popularity in the pet trade (De Vosjoli *et al.*, 2017; Valdez, 2021). However, the increasing number of captive leopard geckos has also led to numerous husbandry-related health issues (De Vosjoli *et al.*, 2017). Gastrointestinal (GI) impaction associated with foreign body (FB) ingestion is a major concern, especially under substandard housing conditions (Stahl, 2003; Franco *et al.*, 2024).

Normal GI motility can be severely compromised in such cases, potentially leading to life-threatening complications including necrosis, perforation, and plication (Rossi, 2019; Littman *et al.*, 2022). Open GI surgery has been widely performed (De Voe, 2019), but it may carry significant complications, including leakage of bowel contents, dehiscence, and iatrogenic organ damage (Mehler and Bennett, 2021). This has driven a growing interest in minimally invasive techniques such as endoscopic FB removal (Divers, 2010). In small reptile medicine, rigid endoscopy is generally favored over the flexible endoscope due to its versatility, offering superior image resolution and a more suitable length for small-bodied patients (Divers, 1999). Accordingly, clinical descriptions of flexible endoscopy in small species remain sparse, with only a few cases documented in large-bodied species (Lumeij and Happe, 1985; Pressler *et al.*, 2003; Lebens *et al.*, 2016). Yet, this situation presents a practical clinical dilemma, as many veterinary settings are equipped with flexible endoscopes for dogs and cats but may lack specialized rigid endoscopic equipment for exotic species. This highlights the clinical significance of evaluating the feasibility, challenges, and potential outcomes of using existing flexible endoscopes in small reptiles when it may be the only minimally invasive option available.

This report aims to address this knowledge gap by detailing gastroscopic FB removal in a leopard gecko. To the best of our knowledge, it is the first report to document the use of two flexible endoscopes of different sizes, outlining the technique, encountered challenges, clinical outcomes, and practical implications in a small reptile patient.

Case description

A male captive-bred leopard gecko of unknown age was referred to the Veterinary Medical Teaching Hospital following the inadvertent ingestion of a rubber tip from forceps while being fed crickets. The owner immediately brought the gecko to the hospital and reported no clinical signs other than the FB ingestion.

On presentation, the leopard gecko weighed 50 g, and its body condition score was three out of five based on its tail fat reserves. The gecko was alert and

displayed a normal activity level, with no evidence of systemic abnormalities, including lethargy, dehydration, dysecdysis, dyspnea, regurgitation, tenesmus, pale mucous membranes, weight loss, incoordination, or neurologic signs. Gentle coelomic palpation showed no definite structure suggestive of the ingested object, nor were any overt GI signs identified such as discomfort or distension. Orthogonal radiographs were obtained to evaluate the features of the FB and revealed a 3.2 × 0.4 cm object with a soft tissue-mineral density margin located at the stomach-intestinal level, consistent with the suspected FB (Fig. 1). No further specific abnormalities were detected. Blood analysis for health screening and preanesthetic assessment was recommended but declined by the owner.

Endoscopic removal was chosen as the preferred approach, considering the location of the FB and the high invasiveness of open surgery. Warmed subcutaneous fluids were administered to provide circulatory support. General anesthesia was induced via intramuscular injection of medetomidine (Domitor, Zoetis, Seoul, Korea) at a dose of 0.1 mg/kg and alfaxalone (Alfaxan® Multidose, Careside, Seongnam, Korea) at 15 mg/kg. Additional anesthetic support was provided via isoflurane (Isotroy 100®, Troikaa Pharmaceuticals Ltd., Ahmedabad, India) inhalation during the procedure, aiming to maintain a light-to-surgical plane of anesthesia. About 10 minutes post-induction, the gecko lost its jaw tone and the righting and palpebral reflexes, showed no spontaneous movement, and did not respond to toe pinch (Mans *et al.*, 2019). Throughout the procedure, spontaneous breathing (16-20 breaths/min) was preserved, and heart rate remained stable at 84-90 beats/min, as monitored by a Doppler probe (Fig. 2). Advanced monitoring such as capnography and pulse oximetry was excluded due to the patient's small size and technical limitations. Thermal support was also provided, and the patient was manually handled to minimize displacement caused by endoscope manipulation. No significant adverse events, such as severe bradycardia or prolonged apnea, were observed.

For gastroscopy, two flexible endoscope systems were prepared: a 2.8 mm superfine flexible endoscope (VSF-E11F/HV-11P, Zhuhai Seesheen Medical Technology Co., Zhuhai, China) and a larger 9.2 mm model (GIF-V70/CV-70, Olympus Co., Seoul, Korea). Their detailed specifications are listed in Table 1 and a visual comparison is shown in Figure 3. Initially, the former, slimmer scope was selected considering the body size of the patient. Instrumental insertion was achieved without resistance, followed by partial clearance of intraluminal mucus using suction or cotton-tipped applicators. The rubber tip was visualized within the stomach as observed on the radiographs (Fig. 4A). However, failure to secure the rubber tip via external digital manipulation hampered endoscopic navigation, making retrieval by 0.8 mm endoscopic alligator forceps unfeasible. Additionally, the endoscope's pliability and slenderness exacerbated unintended deflections, complicating the manipulation process.

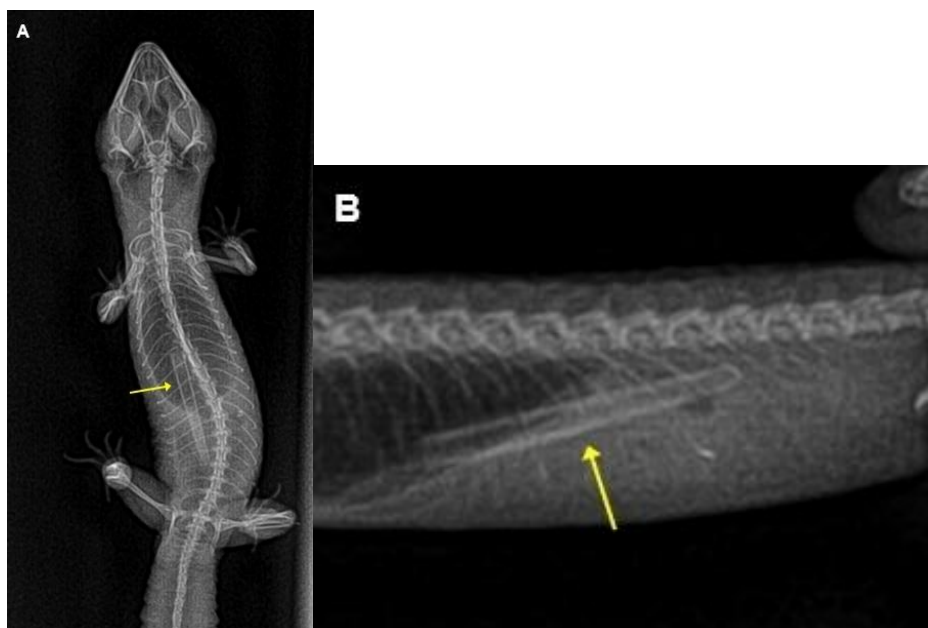


Figure 1 Dorsoventral (A) and lateral (B) radiographic views of a leopard gecko (*Eublepharis macularius*) with a history of foreign body ingestion. The images reveal a 3.2×0.4 cm object (yellow arrows) with a soft tissue-mineral density margin located at the stomach-intestinal level.



Figure 2 Leopard gecko under general anesthesia during the endoscopic procedure. Thermal support and heart rate monitoring via a Doppler probe were provided.

Table 1 Specifications of the flexible endoscopes used for foreign body retrieval in the leopard gecko (*Eublepharis macularius*).

Feature	Superfine Flexible Endoscopy (VSF-E11F)	Larger Flexible Endoscopy (GIF-V70)
Outer Diameter (mm)	2.8	9.2
Working Length (mm)	610	1,030
Working Channel (mm)	1.2	2.8
Bending Angle(°)	Up 210, Down 130	Up 210, Down 90, Right/Left 100
Processor Model	HV-11VP	CV-70
Output Resolution (pixels)	1280 × 800	720 × 480
Endoscopic Forceps Used	0.8 mm alligator forceps	2.3 mm alligator forceps

As an alternative, the endoscope was replaced with a larger model to promote FB extraction. Compared to the former model, slight resistance was sensed during insertion from the esophagus to the stomach, and the angulation range was limited. In contrast, the thicker optical fiber delivered mechanical force more directly, improving tip control and navigation in the digestive tract. Whenever resistance occurred, advancement was paused and resumed after stabilization. Air insufflation was carefully performed to expand the gastric lumen, allowing for adequate visualization. The rubber tip was still located in the stomach, with no additional gastric contents observed on inspection of the gastric mucosa (Fig. 4B). The foreign body was retrieved successfully using 2.3 mm alligator forceps under endoscopic guidance (Fig. 4C). No gross mucosal lesions or hemorrhage were identified following the passage of the larger endoscope. The instrument was withdrawn while simultaneously evacuating the insufflated air, and anesthesia was discontinued. The leopard gecko recovered uneventfully; by 40 min post-procedure, the patient maintained an upright posture and ambulated independently, at which point it was considered fully recovered.

Enrofloxacin (Baytril® 2.5%, Bayer Korea, Seoul, Korea) at 5 mg/kg and meloxicam (Metacam®, Boehringer Ingelheim, Seoul, Korea) at 0.2 mg/kg were prophylactically administered subcutaneously, and oral medication was prescribed. Based on the rapid

intervention, post-operative condition, and gastric mucosal appearance, the patient was discharged on the same day. A five-day fasting period was advised to allow GI recovery, with gradual reintroduction of feeding thereafter. The owner was instructed to monitor the gecko for signs of anorexia, emesis, or other adverse symptoms. Consequently, the gecko showed a favorable recovery without any complications.



Figure 3 Comparison of two flexible endoscopes used for foreign body retrieval in the leopard gecko: a 2.8 mm superfine flexible endoscope (top), and a 9.2 mm flexible endoscope (bottom).



Figure 4 Endoscopic views of the stomach with a gastric foreign body before (A, B) and after (C) retrieval. (A) Initial approach to remove the foreign body with a 2.8 mm superfine flexible endoscope, but it was unsuccessful. (B) Visualization of the foreign body using a 9.2 mm flexible endoscope, with no remarkable findings observed in the mucosa. The asterisk indicates the grasping forceps. (C) The retrieved rubber tip of the feeding forceps after extraction from the stomach.

Discussion

This case describes a stepwise application of flexible endoscopy for foreign-body removal in a leopard gecko. The observed limitations in operative stability and the potential for complications associated with a relatively larger instrument diameter suggest practical considerations for instrument selection in small reptiles. In clinical settings where access to rigid systems is limited, this case provides selection criteria for deciding whether flexible endoscopy can be used as a minimally invasive alternative.

The initial attempt highlighted a critical challenge: insufficient shaft stability. While the design allowed smooth entry and visualization, its flexibility hindered

precise navigation and the mechanical force transmission required for retrieval. This experience provides a practical rationale for stability-enhancing strategies in flexible endoscopy. A previous report described the use of a syringe barrel as an external sheath during gastroscopy in a green iguana (*Iguana iguana*), shielding the endoscope from oral trauma (Lebens *et al.*, 2016). Similarly, a mother-daughter configuration involving a rigid cylindrical sheath may enhance structural support by encasing the endoscope and assisting targeted navigation (Gaab, 2013). Although not applied in this case, the application of such modifications could help overcome the observed stability issues, thereby increasing the viability of flexible endoscopy in small patients.

Table 2 Comparison of modalities for foreign body retrieval in small reptiles.

Criteria	Flexible Endoscopy	Rigid endoscopy	Open GI Surgery
Feasibility	Variable feasibility: reach to the stomach is possible, but retrieval success depends on instrument properties	High feasibility: often primary choice in small reptiles	Feasible when endoscopy fails or unsuitable
Safety	Variable: Risk is highly dependent on scope diameter; larger diameters increase the risk of luminal trauma and perforation	Caution with compromised gastrointestinal integrity	High risk of major complications (e.g., coelomitis, dehiscence); more hazardous in smaller patients due to fragile organs
Practicality	Viable option in equipped settings: may require stability augmentation	Practical option in equipped settings: superior stability and image resolution than comparable flexible endoscope	Invasive option, but enables direct visualization and prompt intraoperative response

In the subsequent attempt at retrieval with the larger model succeeded; however, this should be interpreted as a case-specific result. The previous issue of excessive deflection was mitigated, but it was deemed an incidental effect of the thick insertion tube rather than a benefit of flexible endoscopy. In this case, the passage of the larger scope was well-tolerated without adverse effects, likely due to the preserved GI integrity from timely intervention, the bluntness of the FB, and the high esophageal distensibility of lizards permitting safe device accommodation (Benchaya *et al.*, 2024). Nevertheless, the excessive scope diameter remains a critical risk factor for potential luminal trauma. Prolonged FB retention can compromise GI perfusion via luminal stretching and elevated intraluminal pressure (Divers, 2010; Maxwell *et al.*, 2021). Mechanical stress imposed by oversized devices, inadequate gas insufflation, or fluid irrigation in the setting of compromised integrity poses a considerable risk of iatrogenic perforation (Mans, 2013; Littman *et al.*, 2022). Therefore, this approach should be reserved for carefully selected cases. Although no gross mucosal damage was observed in this case, a short prophylactic course of enrofloxacin was administered in view of potential infection caused by mucosal microtrauma during endoscopic manipulation, and meloxicam was co-administered for analgesia and anti-inflammatory control.

When the size, shape, or location of the FB renders endoscopic extraction unattainable, surgical intervention is commonly adopted (Divers, 2010). It affords direct visualization and enables prompt action for unexpected complications, such as rupture or adhesions (Brown *et al.*, 2019; Ueda *et al.*, 2024). Accordingly, successful surgical retrieval involving gastrotomy or enterotomy has been documented in various *Squamata* species (Büker *et al.*, 2010; Vasaruchapong and Chanhom, 2013; Stein *et al.*, 2014). However, the risk of coelomitis or surgical site dehiscence cannot be excluded (Di Girolamo and Mans, 2016), and the fragility of visceral structures makes invasive procedures more hazardous in smaller patients (Alworth *et al.*, 2011). This reflects a trend towards developing innovative, case-adapted techniques to overcome device limitations and minimize the use of invasive techniques. An inland bearded dragon (*Pogona vitticeps*) exemplified this trend with the successful nonsurgical removal of a

large spherical FB using negative pressure suction under endoscopic guidance (Littman *et al.*, 2022). This underscores the need to adaptively find case-specific solutions within practical constraints, rather than adhering to any single established protocol.

This case highlights practical criteria for selecting a retrieval modality. Rigid endoscopy offers superior stability and is often the primary choice when the FB is accessible (Divers, 2010). Flexible endoscopy may serve as an alternative, but as demonstrated here, maneuverability is restricted without stability augmentation. Particularly with a large-diameter scope, the procedure should only proceed when safety is ensured by factors such as preserved GI integrity and controlled gas insufflation. Conversion to surgery is the appropriate option when endoscopic retrieval is unlikely or the risk of tissue injury is high. A careful assessment of these variables is therefore key to balancing procedural success with patient safety. Table 2 summarizes these criteria.

Several critical limitations of this study should be acknowledged. Foremost, it is a single case with scarce comparable data on the use of flexible endoscopy in small reptiles. The findings cannot be generalized, and this anecdotal success does not guarantee reproducibility. The unverified safety of using a large-diameter endoscope in small reptiles remains a significant hurdle; the favorable outcome in this well-tolerated case cannot ensure safety in patients with pre-existing mucosal compromise. Another limitation is the omission of capnography and pulse oximetry during anesthesia, which can preclude the detection of hypoxemia, hemodynamic instability, or any endoscope size-related effects on physiologic indices. To address these constraints, future accumulation of similar cases and systematic evaluation of reproducibility are necessary. In addition, comparative studies assessing success rates and complication risks across flexible endoscopy, rigid endoscopy, and surgical methods are essential to establish evidence-based clinical guidelines. With such a foundation, customized approaches that consider anatomical features, the characteristics of the FB, and available equipment would be important for advancing minimally invasive techniques in reptile medicine.

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